

HANDBOOK OF FOOD BIOENGINEERING
VOLUME 11

DIET, MICROBIOME AND HEALTH



Edited by
Alina Maria Holban
Alexandru Mihai Grumezescu



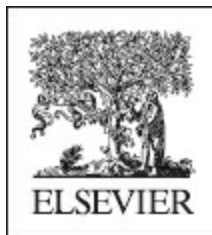
Diet, Microbiome and Health

Handbook of Food Bioengineering, Volume 11

Edited by

Alina Maria Holban

Alexandru Mihai Grumezescu



ACADEMIC PRESS

An imprint of Elsevier

Table of Contents

Cover

Title page

Copyright

List of Contributors

Foreword

Series Preface

Preface for Volume 11: Diet, Microbiome and Health

Section 1: State of the Art and Applications

Chapter 1: Gut Microbes: The Miniscule Laborers in the Human Body

Abstract

1. Introduction

2. Major Players of the Gut Microbiome

3. Functions of the Gut Flora
4. Infant Gut Flora
5. Evolution of Gut Microbial Flora
6. Diet in Shaping Composition of Gut Flora
7. Gut Microbiota and Diseases
8. Gut Flora and Brain Functions
9. Effect of Antibiotics on the Gut Microbiome
10. Fortifying Gut Flora
11. Conclusions

Chapter 2: Role of Probiotics Toward the Improvement of Gut Health With Special Reference to Colorectal Cancer

Abstract

1. Probiotics
2. Probiotics as Health Promoters
3. Probiotics and Colorectal Cancer
4. Conclusions

Section 2: Probiotics and Prebiotics

Chapter 3: Therapeutic Aspects of Probiotics and Prebiotics

Abstract

1. Introduction
2. The Concept of Probiotics
3. Therapeutic Effects of Probiotics
4. Prebiotics and Synbiotics

5. Therapeutic Effects of Prebiotics
6. Synbiotics
7. Therapeutic Effects of Synbiotics
8. Conclusions

Chapter 4: Lactic Acid Bacteria Beverage Contribution for Preventive Medicine and Nationwide Health Problems in Japan

Abstract

1. Introduction
2. Tolerance to Gastric Acid and Bile, and Viability in the Intestinal Tract
3. Modification of Gastrointestinal Function: Improvement of Diarrhea and Constipation
4. Metabolism: Changing Urinary Excretion of Nitrogen
5. Immunomodulation
6. Prevention of Cancer
7. Effect on Inflammatory Bowel Disease
8. Protection Against Infection
9. Global Burden Diseases in Japan
10. Concluding Remarks

Chapter 5: Gut Microbiota Alterations in People With Obesity and Effect of Probiotics Treatment

Abstract

1. Obesity: A Multifactorial Disease
2. Human Microbiome
3. Conclusions

Chapter 6: Safety of Probiotics

Abstract

1. Introduction
2. Regulatory Systems
3. Most Frequent and Important Adverse Events of Probiotics
4. Safety Assessment Studies
5. Proposed Evaluation of the Safety of Probiotics by FAO/WHO
6. Conclusions

Section 3: Nutritional Aspects

Chapter 7: Flavonoids in Foods and Their Role in Healthy Nutrition

Abstract

1. Introduction
2. Chemistry and Classification of Flavonoids
3. Antioxidant Activity of Flavonoids
4. Bioavailability of Flavonoids
5. Physiological Role and Pharmacological Activities of Flavonoids
6. Flavonoid Content and Antioxidant Activity of Selected Bulgarian Plant Foods
7. Conclusions

Chapter 8: The Role of Milk Oligosaccharides in Host–Microbial Interactions and Their Defensive Function in the Gut

Abstract

1. Introduction
2. Effect of Oligosaccharides on Pathogen Colonization
3. Effects of Oligosaccharides on Commensal Colonization

4. Immunomodulation by Oligosaccharides
5. Mucin Expression, Defensive Function, and Indirect Effects of Oligosaccharides
6. Developing Areas
7. Conclusions and Future Perspectives

Chapter 9: Nutritional Yeast Biomass: Characterization and Application

Abstract

1. Introduction
2. *Saccharomyces cerevisiae* Preparations
3. *Saccharomyces boulardii* as a Probiotic Yeast
4. *Yarrowia lipolytica* as a Source of Bioactive Compounds
5. Nutritional Benefits of Other Yeast Strains
6. Conclusions

Section 4: Health, Disease, and Therapy

Chapter 10: Effect of Diet on Gut Microbiota as an Etiological Factor in Autism Spectrum Disorder

Abstract

1. Introduction
2. Factors Affecting Infant Gut Microbiota
3. Gut Microbiota of Autistic Patients
4. Dietary Factors Affecting the Gut Microbiota
5. Manipulation of Imbalanced Gut Microbiota
6. Role of Probiotics, Prebiotics, and Symbiotics

7. Conclusions

Chapter 11: Dietary Fibers: A Way to a Healthy Microbiome

Abstract

1. Introduction
2. Gut Microbiota
3. Dietary Fiber and Gut Microbiota
4. Types of Dietary Fiber
5. Interplay Between Gut Microbiota and Host Metabolism
6. Role of Dietary Fiber in Disease Prevention
7. Conclusions

Chapter 12: Effects of the Gut Microbiota on Autism Spectrum Disorder

Abstract

1. Introduction
2. Gut Microbiota
3. Gut–Brain Axis and the Microbiota
4. The Microbiota–Gut–Brain Axis and Autism Spectrum Disorder
5. Treatments to Modify the Gut Microbiota in Order to Recover the Symptoms in Autism Spectrum Disorder
6. Summary

Chapter 13: Diet, Microbiome, and Neuropsychiatric Disorders

Abstract

1. Introduction
2. Mechanisms in Which the Microbiome Effects the Brain and Central Nervous System

3. Major Depression Disorder (MDD)
4. Schizophrenia
5. Bipolar Disorder
6. Anxiety Disorders
7. Obsessive-Compulsive Disorder (OCD)
8. Autism Spectrum Disorders (ASD)
9. Conclusions
10. Conflict of Interest

Section 5: Function and Safety

Chapter 14: Gastrointestinal Exposome for Food Functionality and Safety

Abstract

1. Gross Structure of Food-Associated Gastrointestinal Network
2. Mutual Interaction Between Food Components and Gut Microbiota
3. Crosstalk Between Food Contaminants and the Gut Microbiota: Potent Implications in Environmental IBD Etiology
4. Crosstalk Between Foodborne Toxins and Gut Pathogens: Cases in Mycotoxicoses
5. Food and Drug Metabolism in the Gastrointestinal Tract
6. Neuroendocrine Regulation in the Gastrointestinal Exposome
7. Impact of Foodborne Pathogens and Microbial Toxins on Gastrointestinal Immunity
8. Integrated Management of Food-Linked Gastrointestinal Exposome Networks

Acknowledgments

Chapter 15: Risk From Viral Pathogens in Seafood

Abstract

1. Introduction
 2. Risks From Pathogenic Microbes in Seafood
 3. Risks From Pathogenic Viruses in Seafood
 4. Historical Perspectives
 5. Seafood as Vehicles for Viruses
 6. Outbreaks and Prevalence
 7. Viral Pathogens in Seafood
 8. Risk Factors
 9. Detection and Diagnosis
 10. Risk Management
 11. Conclusions
- Acknowledgments

Index

Copyright

Academic Press is an imprint of Elsevier
125 London Wall, London EC2Y 5AS, United Kingdom
525 B Street, Suite 1800, San Diego, CA 92101-4495, United States
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom

Copyright © 2018 Elsevier Inc. All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

Library of Congress Cataloging-in-Publication Data

A catalog record for this book is available from the Library of Congress

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

ISBN: 978-0-12-811440-7

For information on all Academic Press publications visit our website at <https://www.elsevier.com/books-and-journals>



Publisher: Andre Gerhard Wolff

Acquisition Editor: Nina Bandeira

Editorial Project Manager: Jaclyn Truesdell

Production Project Manager: Punithavathy Govindaradjane

Designer: Matthew Limbert

Typeset by Thomson Digital

List of Contributors

Navneet Agnihotri, Panjab University, Chandigarh, India

Asif Ahmad, Pir Mehr Ali Shah Arid Agriculture University,
Rawalpindi, Punjab, Pakistan

Fasiha Ahsan, National Institute of Food Science & Technology,
University of Agriculture, Faisalabad, Pakistan

Hussain Al Dera

King Saud bin Abdulaziz University for Health Sciences
King Abdullah International Medical Research Center, Riyadh, Saudi
Arabia

Rawan Aldahash, King Saud bin Abdulaziz University for Health
Sciences, Riyadh, Saudi Arabia

Priyanka Bhadwal, Panjab University, Chandigarh, India

Chetna Bhandari, Panjab University, Chandigarh, India

Maira R. Segura Campos, Autonomous University of Yucatan,
Mérida, Yucatán, México

Petko Denev, Institute of Organic Chemistry with Center of
Phytochemistry, Plovdiv, Bulgaria

Afaf El-Ansary

King Saud University
Autism Research and Treatment Center, Riyadh, Saudi Arabia

Masatoshi Hara, The Japan Dietetic Association, Tokyo, Japan

Rita M. Hickey, Teagasc Food Research Centre, Fermoy, Ireland

Jane A. Irwin, University College Dublin, Dublin, Ireland

Monika E. Jach, The John Paul II Catholic University of Lublin,
Lublin, Poland

Daniel C. Javitt, Columbia University Medical Center, New York,
NY, United States

Gabriel A. Javitt, Technion University, Haifa, Israel

Akira Kanda, HANA Nutrition College, Tokyo, Japan

Sumaira Khalid

Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi
Government College University, Faisalabad, Punjab, Pakistan

Samanta S. Khora, VIT University, Vellore, Tamil Nadu, India

Danuta Kołozyn-Krajewska, Warsaw University of Life Sciences,
Warsaw, Poland

Sandeep Kumar, Panjab University, Chandigarh, India

Edwin E. Martínez Leo, Autonomous University of Yucatan,
Mérida, Yucatán, México

Sana Mahmood, National Institute of Food Science & Technology,
University of Agriculture, Faisalabad, Pakistan

Yuseok Moon

Department of Biomedical Sciences, Pusan National University,
Yongsan

Immunoregulatory Therapeutics Group in Brain Busan 21 Project,
Busan, South Korea

Sinead T. Morrin

Teagasc Food Research Centre, Fermoy
University College Dublin, Dublin, Ireland

Nalan H. Noğay, Erciyes University, Kayseri, Turkey

Armando M. Martín Ortega, Autonomous University of Yucatan,
Mérida, Yucatán, México

Fanny Ribarova, Medical College J. Filaretova, Medical University–
Sofia, Sofia, Bulgaria

Suma Sarojini, Department of Life Sciences, Christ University,
Bangalore, Karnataka, India

Anna Serefko, Medical University of Lublin, Lublin, Poland

Mian K. Sharif, National Institute of Food Science & Technology,
University of Agriculture, Faisalabad, Pakistan

Bhoomika Sharma, Panjab University, Chandigarh, India

Prerna Sharma, Panjab University, Chandigarh, India

Barbara Sionek, Warsaw University of Life Sciences, Warsaw,
Poland

Silvia Tsanova-Savova, Medical College J. Filaretova, Medical
University–Sofia, Sofia, Bulgaria

Dorota Zielińska, Warsaw University of Life Sciences, Warsaw,
Poland

Foreword

In the last 50 years an increasing number of modified and alternative foods have been developed using various tools of science, engineering, and biotechnology. The result is that today most of the available commercial food is somehow modified and improved, and made to look better, taste different, and be commercially attractive. These food products have entered in the domestic first and then the international markets, currently representing a great industry in most countries. Sometimes these products are considered as life-supporting alternatives, neither good nor bad, and sometimes they are just seen as luxury foods. In the context of a permanently growing population, changing climate, and strong anthropological influence, food resources became limited in large parts of the Earth. Obtaining a better and more resistant crop quickly and with improved nutritional value would represent the Holy Grail for the food industry. However, such a crop could pose negative effects on the environment and consumer health, as most of the current approaches involve the use of powerful and broad-spectrum pesticides, genetic engineered plants and animals, or bioelements with unknown and difficult-to-predict effects. Numerous questions have emerged with the introduction of engineered foods, many of them pertaining to their safe use for human consumption and ecosystems, long-term expectations, benefits, challenges associated with their use, and most important, their economic impact.

The progress made in the food industry by the development of applicative engineering and biotechnologies is impressive and many of the advances are oriented to solve the world food crisis in a constantly increasing population: from genetic engineering to improved preservatives and advanced materials for innovative food

quality control and packaging. In the present era, innovative technologies and state-of-the-art research progress has allowed the development of a new and rapidly changing food industry, able to bottom-up all known and accepted facts in the traditional food management. The huge amount of available information, many times is difficult to validate, and the variety of approaches, which could seem overwhelming and lead to misunderstandings, is yet a valuable resource of manipulation for the population as a whole.

The series entitled *Handbook of Food Bioengineering* brings together a comprehensive collection of volumes to reveal the most current progress and perspectives in the field of food engineering. The editors have selected the most interesting and intriguing topics, and have dissected them in 20 thematic volumes, allowing readers to find the description of basic processes and also the up-to-date innovations in the field. Although the series is mainly dedicated to the engineering, research, and biotechnological sectors, a wide audience could benefit from this impressive and updated information on the food industry. This is because of the overall style of the book, outstanding authors of the chapters, numerous illustrations, images, and well-structured chapters, which are easy to understand. Nonetheless, the most novel approaches and technologies could be of a great relevance for researchers and engineers working in the field of bioengineering.

Current approaches, regulations, safety issues, and the perspective of innovative applications are highlighted and thoroughly dissected in this series. This work comes as a useful tool to understand where we are and where we are heading to in the food industry, while being amazed by the great variety of approaches and innovations, which constantly changes the idea of the “food of the future.”

Anton Fikai, PhD (Eng)

*Department Science and Engineering of Oxide Materials and Nanomaterials,
Faculty of Applied Chemistry and Materials Science, Politehnica University
of Bucharest,
Bucharest, Romania*

Series Preface

The food sector represents one of the most important industries in terms of extent, investment, and diversity. In a permanently changing society, dietary needs and preferences are widely variable. Along with offering a great technological support for innovative and appreciated products, the current food industry should also cover the basic needs of an ever-increasing population. In this context, engineering, research, and technology have been combined to offer sustainable solutions in the food industry for a healthy and satisfied population.

Massive progress is constantly being made in this dynamic field, but most of the recent information remains poorly revealed to the large population. This series emerged out of our need, and that of many others, to bring together the most relevant and innovative available approaches in the intriguing field of food bioengineering. In this work we present relevant aspects in a pertinent and easy-to-understand sequence, beginning with the basic aspects of food production and concluding with the most novel technologies and approaches for processing, preservation, and packaging. Hot topics, such as genetically modified foods, food additives, and foodborne diseases, are thoroughly dissected in dedicated volumes, which reveal the newest trends, current products, and applicable regulations.

While health and well-being are key drivers of the food industry, market forces strive for innovation throughout the complete food chain, including raw material/ingredient sourcing, food processing, quality control of finished products, and packaging. Scientists and industry stakeholders have already identified potential uses of new and highly investigated concepts, such as nanotechnology, in virtually every segment of the food industry, from agriculture (i.e., pesticide production and processing, fertilizer or vaccine delivery, animal and