Novel Food Processing Technologies
2. Principles of Enzymology for the Food Sciences, *John R. Whitaker*
4. Principles of Food Science
   Part I: Food Chemistry, *edited by Owen R. Fennema*
   Part II: Physical Methods of Food Preservation, *Marcus Karel, Owen R. Fennema, and Daryl B. Lund*
5. Food Emulsions, *edited by Stig E. Friborg*
6. Nutritional and Safety Aspects of Food Processing, *edited by Steven R. Tannenbaum*
7. Flavor Research: Recent Advances, *edited by R. Teranishi, Robert A. Flath, and Hiroshi Sugisawa*
8. Computer-Aided Techniques in Food Technology, *edited by Israel Saguy*
9. Handbook of Tropical Foods, *edited by Harvey T. Chan*
10. Antimicrobials in Foods, *edited by Alfred Larry Branen and P. Michael Davidson*
11. Food Constituents and Food Residues: Their Chromatographic Determination, *edited by James F. Lawrence*
18. Citrus Fruits and Their Products: Analysis and Technology, *S. V. Ting and Russell L. Rouseff*
20. Umami: A Basic Taste, *edited by Yojiro Kawamura and Morley R. Kare*
21. Food Biotechnology, *edited by Dietrich Knorr*
22. Food Texture: Instrumental and Sensory Measurement, *edited by Howard R. Moskowitz*
23. Seafoods and Fish Oils in Human Health and Disease, *John E. Kinsella*
24. Postharvest Physiology of Vegetables, *edited by J. Weichmann*
26. Food Toxicology, Parts A and B, *Jose M. Concon*
27. Modern Carbohydrate Chemistry, *Roger W. Binkley*
29. Protein Quality and the Effects of Processing, *edited by R. Dixon Phillips and John W. Finley*
30. Adulteration of Fruit Juice Beverages, *edited by Steven Nagy, John A. Attaway, and Martha E. Rhodes*
31. Foodborne Bacterial Pathogens, *edited by Michael P. Doyle*
32. Legumes: Chemistry, Technology, and Human Nutrition, *edited by Ruth H. Matthews*
<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Editors/Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>Industrialization of Indigenous Fermented Foods</td>
<td>edited by Keith H. Steinkraus</td>
</tr>
<tr>
<td>34</td>
<td>International Food Regulation Handbook: Policy • Science • Law</td>
<td>edited by Roger D. Middlekauff and Philippe Shubik</td>
</tr>
<tr>
<td>35</td>
<td>Food Additives</td>
<td>edited by A. Larry Branen, P. Michael Davidson, and Seppo Salminen</td>
</tr>
<tr>
<td>36</td>
<td>Safety of Irradiated Foods</td>
<td>J. F. Diehl</td>
</tr>
<tr>
<td>37</td>
<td>Omega3 Fatty Acids in Health and Disease</td>
<td>edited by Robert S. Lees and Marcus Karel</td>
</tr>
<tr>
<td>39</td>
<td>Seafood: Effects of Technology on Nutrition</td>
<td>George M. Pigott and Barbee W. Tucker</td>
</tr>
<tr>
<td>41</td>
<td>Handbook of Cereal Science and Technology</td>
<td>Klaus J. Lorenz and Karel Kulp</td>
</tr>
<tr>
<td>42</td>
<td>Food Processing Operations and Scale-Up</td>
<td>Kenneth J. Valentas, Leon Levine, and J. Peter Clark</td>
</tr>
<tr>
<td>43</td>
<td>Fish Quality Control by Computer Vision</td>
<td>edited by L. F. Pau and R. Olafsson</td>
</tr>
<tr>
<td>44</td>
<td>Volatile Compounds in Foods and Beverages</td>
<td>edited by Henk Maarse</td>
</tr>
<tr>
<td>46</td>
<td>Listeria, Listeriosis, and Food Safety</td>
<td>Elliot T. Ryser and Elmer H. Marth</td>
</tr>
<tr>
<td>47</td>
<td>AcesulfameK</td>
<td>edited by D. G. Mayer and F. H. Kemper</td>
</tr>
<tr>
<td>49</td>
<td>Food Extrusion Science and Technology</td>
<td>edited by Jozef L. Kokini, ChiTang Ho, and Mukund V. Karwe</td>
</tr>
<tr>
<td>50</td>
<td>Surimi Technology</td>
<td>edited by Tyre C. Lanier and Chong M. Lee</td>
</tr>
<tr>
<td>51</td>
<td>Handbook of Food Engineering</td>
<td>edited by Dennis R. Heldman and Daryl B. Lund</td>
</tr>
<tr>
<td>52</td>
<td>Food Analysis by HPLC</td>
<td>edited by Leo M. L. Nollet</td>
</tr>
<tr>
<td>53</td>
<td>Fatty Acids in Foods and Their Health Implications</td>
<td>edited by Ching Kuang Chow</td>
</tr>
<tr>
<td>54</td>
<td>Clostridium botulinum: Ecology and Control in Foods</td>
<td>edited by Andreas H. W. Hauschild and Karen L. Dodds</td>
</tr>
<tr>
<td>55</td>
<td>Cereals in Breadmaking: A Molecular Colloidal Approach</td>
<td>Ann-Charlotte Eliasson and Kåre Larsson</td>
</tr>
<tr>
<td>56</td>
<td>LowCalorie Foods Handbook</td>
<td>edited by Aaron M. Altschul</td>
</tr>
<tr>
<td>58</td>
<td>Lactic Acid Bacteria</td>
<td>edited by Seppo Salminen and Atte von Wright</td>
</tr>
<tr>
<td>59</td>
<td>Rice Science and Technology</td>
<td>edited by Wayne E. Marshall and James I. Wadsworth</td>
</tr>
<tr>
<td>60</td>
<td>Food Biosensor Analysis</td>
<td>edited by Gabriele Wagner and George G. Guilbault</td>
</tr>
<tr>
<td>62</td>
<td>Carbohydrate Polyesters as Fat Substitutes</td>
<td>edited by Casimir C. Akoh and Barry G. Swanson</td>
</tr>
<tr>
<td>64</td>
<td>Handbook of Brewing</td>
<td>edited by William A. Hardwick</td>
</tr>
</tbody>
</table>
67. Food Polysaccharides and Their Applications, edited by Alistair M. Stephen
70. Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing, edited by D. K. Salunkhe and S. S. Kadam
72. Freezing Effects on Food Quality, edited by Lester E. Jeremiah
74. Carbohydrates in Food, edited by AnnCharlotte Eliasson
75. Baked Goods Freshness: Technology, Evaluation, and Inhibition of Staling, edited by Ronald E. Hebeda and Henry F. Zobel
77. Handbook of Food Analysis: Volumes 1 and 2, edited by Leo M. L. Nollet
78. Computerized Control Systems in the Food Industry, edited by Gauri S. Mittal
79. Techniques for Analyzing Food Aroma, edited by Ray Marsili
80. Food Proteins and Their Applications, edited by Srinivasan Damodaran and Alain Paraf
82. Nonthermal Preservation of Foods, Gustavo V. Barbosa-Cánovas, Usha R. Pothakamury, Enrique Palou, and Barry G. Swanson
83. Milk and Dairy Product Technology, Edgar Spreer
84. Applied Dairy Microbiology, edited by Elmer H. Marth and James L. Steele
87. Polysaccharide Association Structures in Food, edited by Reginald H. Walter
88. Food Lipids: Chemistry, Nutrition, and Biotechnology, edited by Casimir C. Akoh and David B. Min
89. Spice Science and Technology, Kenji Hirasa and Mitsuo Takemasa
91. Coloring of Food, Drugs, and Cosmetics, Gisbert Otterstätter
93. Complex Carbohydrates in Foods, edited by Susan Sungsoo Cho, Leon Prosky, and Mark Dreher
94. Handbook of Food Preservation, edited by M. Shafiur Rahman
95. International Food Safety Handbook: Science, International Regulation, and Control, edited by Kees van der Heijden, Maged Younes, Lawrence Fishbein, and Sanford Miller
98. Safe Handling of Foods, edited by Jeffrey M. Farber and Ewen C. D. Todd

Copyright © 2005 by Marcel Dekker.
101. Surimi and Surimi Seafood, edited by Jae W. Park
102. Drug Residues in Foods: Pharmacology, Food Safety, and Analysis, Nickos A. Botsoglou and Dimitrios J. Fletouris
103. Seafood and Freshwater Toxins: Pharmacology, Physiology, and Detection, edited by Luis M. Botana
104. Handbook of Nutrition and Diet, Babasaheb B. Desai
106. Green Tea: Health Benefits and Applications, Yukihiro Hara
107. Food Processing Operations Modeling: Design and Analysis, edited by Joseph Irudayaraj
108. Wine Microbiology: Science and Technology, Claudio Delfini and Joseph V. Formica
111. Transport Properties of Foods, George D. Saravacos and Zacharias B. Maroulis
113. Handbook of Dietary Fiber, edited by Susan Sungsoo Cho and Mark L. Dreher
114. Control of Foodborne Microorganisms, edited by Vijay K. Juneja and John N. Sofos
115. Flavor, Fragrance, and Odor Analysis, edited by Ray Marsili
118. Food Protein Analysis: Quantitative Effects on Processing, R. K. Owusu-Apenten
119. Handbook of Food Toxicology, S. S. Deshpande
121. Physical Chemistry of Foods, Pieter Walstra
122. Handbook of Food Enzymology, edited by John R. Whitaker, Alphons G. J. Voragen, and Dominic W. S. Wong
125. International Handbook of Foodborne Pathogens, edited by Marianne D. Miliotis and Jeffrey W. Bier
126. Food Process Design, Zacharias B. Maroulis and George D. Saravacos
127. Handbook of Dough Fermentations, edited by Karel Kulp and Klaus Lorenz
128. Extraction Optimization in Food Engineering, edited by Constantina Tzia and George Liadakis

Copyright © 2005 by Marcel Dekker.
131. Handbook of Flavor Characterization: Sensory Analysis, Chemistry, and Physiology, edited by Kathryn Deibler and Jeannine Delwiche
134. Handbook of Food and Beverage Fermentation Technology, edited by Y. H. Hui, Lisbeth Meunier-Goddik, Ase Solveig Hansen, Jytte Josephsen, Wai-Kit Nip, Peggy S. Stanfield, and Fidel Toldrá
135. Genetic Variation in Taste Sensitivity, edited by John Prescott and Beverly J. Tepper
137. Vitamin E: Food Chemistry, Composition, and Analysis, Ronald Eitenmiller and Junsoo Lee
140. Fat Crystal Networks, Alejandro G. Marangoni
141. Novel Food Processing Technologies, edited by Gustavo V. Barbosa-Cánovas, María S. Tapia, and M. Pilar Cano

Additional Volumes in Preparation

Handbook of Dough Fermentations, edited by Karel Kulp and Klaus Lorenz

Extraction Optimization in Food Engineering, edited by Constantina Tzia and George Liadakis

Physical Principles of Food Preservation: Second Edition, Revised and Expanded, Marcus Karel and Daryl B. Lund


Food Process Design, Zacharias B. Maroulis and George D. Saravacos

Copyright © 2005 by Marcel Dekker.
To our families
Food processing has become more sophisticated and diverse in response to the growing demand for quality foods. Consumers today expect food products that provide, among other things, convenience, variety, adequate shelf life and caloric content, reasonable cost, and environmental soundness. Strategies to meet such demands include modification to existing food processing techniques and the adoption of novel processing technologies.

Innovation is a key factor in the sustained growth of the food industry, although the journey from concept to implementation is not trivial, and often quite painful. One reason the path can be so bumpy is that hurdles in the road to implementation are neither properly addressed nor fully understood. The chances for success, however, can be improved significantly through basic research covering a broad spectrum of disciplines prior to the commercialization of new products and technologies. At the same time, it is worth mentioning that consumers all around the world are learning more about the food products they eat, regulatory agencies are becoming more stringent and the food industry more liable. Therefore, in order to meet the demand for better quality food products, every effort should be made to understand the basic principles behind food processing, as well as to recognize new opportunities and to consider combined strategies. Today the world of food technology has a handful of options to explore that could make the food industry more diverse, competitive, and efficient. The aim of this book is to investigate some of the options available, namely the alternative technologies and strategies, and to address the new challenges facing the food industry by providing specific examples on how these alternatives could be applied to specific food products.

This book is the most comprehensive and ambitious undertaking we are aware of on the subject of emerging technologies, in that it covers most of the relevant novel technologies applicable in food processing. All chapters are written by key scientists with diverse backgrounds in either industry or academia, and all provide an update on emerging technologies as well as vision for the future. In addition, the most comprehensive support is offered. To aid in the understanding of novel technologies, a section on microbial prediction is included, a topic that parallels the technologies discussed throughout the book. Microbial prediction is included because we believe that new technologies have forced the issue of revisiting traditional (and sometimes obsolete) methods to describe microbial inactivation kinetics and the calculation of lethality.
At present, new food processing technologies are capturing the attention of many key scientists in academia and government, as well as food industries endeavoring to stay one step ahead in terms of technology. Consumers prefer high-quality foods with longer shelf life and, clearly, some of the new technologies can meet these demands. For these reasons, the number of books, conferences, workshops, and discussion groups centered on topics relevant to new technologies for quality foods is growing at an exponential rate. It is also worth mentioning, as an indicator of strong interest in the subject, that the U.S. Institute of Food Technologists (IFT) has a new division dealing with emerging technologies, and that there is also a new international journal, *Innovative Food Science and Emerging Technologies*, exclusively dedicated to covering novel technologies.

This book is the result of a two-step process. First, the EMERTEC Conference was held in Madrid, Spain, which was organized and sponsored by the Ibero-American Program for Science and Technology (CYTED) through one of its subprograms - “Treatment and Conservation of Foods,” Project XI: “Development of Emerging Technologies of Interest to Ibero-America.” The Project Leader was María S. Tapia and the EMERTEC Chair of the Organizing Committee was M. Pilar Cano-Dolado. Before and during the conference, in light of the quality of the presentations and the interest and enthusiasm generated from the audience, the editors and associated editors discussed putting a book together; one that would be based on the most relevant EMERTEC invited presentations and subsequently combined with other chapters identified as key to the book’s theme. It has been quite apparent from the beginning that this book grew into a well-integrated unit organized in five sections. Consequently, it reads more as a single authored book with fully integrated chapters than as one compiled by editors, having benefited directly from the discussions by true experts in their fields. The five sections mentioned are: Ultra High Pressure, Pulsed Electric Fields, Other Methods of Nonthermal Processing of Foods, Alternative Thermal Treatments, and Impact of Predictive Microbiology in the Food Industry. We strongly believe this book will be embraced by the food science and food technology communities as a valuable—perhaps the most valuable—reference used for consultation on matters of novel food science and technology.

*Gustavo V. Barbosa-Cánovas  
María S. Tapia  
M. Pilar Cano-Dolado*
# Contents

**Preface**  

**Contributors**

1. Present Status and the Future of PEF Technology  
   *G.V. Barbosa-Cánovas and David Sepúlveda*

2. Microbial Inactivation by Pulsed Electric Fields  
   *Rafael Pagán, Santiago Condón, and Javier Raso*

3. Inactivation Kinetics of Microorganisms by Pulsed Electric Fields  
   *M. Rodrigo, A. Martínez, and D. Rodrigo*

4. Does High-Intensity Pulsed Electric Fields Induce Changes in Enzymatic Activity, Protein Conformation, and Vitamin and Flavor Stability?  
   *Olga Martín-Belloso, Silvia Bendicho, Pedro Elez-Martínez, and Gustavo V. Barbosa-Cánovas*

5. Pulsed Electric Field-Assisted Extraction of Juice from Food Plants  
   *Eugene Vorobiev, Abdel Baset Jemai, Hazem Bouzrara, Nikolai Lebovka, and Maksym Bazhal*

6. Application of PEF on Orange Juice Products  
   *D. Rodrigo, F. Sampedro, A. Martínez, M. Rodrigo, and G.V. Barbosa-Cánovas*

7. PEF—A Food Industry’s View  
   *Huub Lelieveld*
## Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>Fundamentals and Applications of High Pressure Processing to Foods</td>
<td>157</td>
</tr>
<tr>
<td></td>
<td><em>J. Welti-Chanes, A. López-Malo, E. Palou, D. Bermúdez, J.A. Guerrero-Beltrán, and G.V. Barbosa-Cánovas</em></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Thermodynamic Aspects of High Hydrostatic Pressure Food Processing</td>
<td>183</td>
</tr>
<tr>
<td></td>
<td><em>Gustavo V. Barbosa-Cánovas and José J. Rodríguez</em></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>High-Pressure-Assisted Heating as a Method for Sterilizing Foods</td>
<td>207</td>
</tr>
<tr>
<td></td>
<td><em>Volker Heinz and Dietrich Knorr</em></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Freezing and Thawing of Foods Under Pressure</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td><em>P.D. Sanz</em></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Starch and Other Polysaccharides Under High Pressure</td>
<td>261</td>
</tr>
<tr>
<td></td>
<td><em>Fernando Fernández-Martín, Gipsy Tabilo-Munízaga, and Gustavo V. Barbosa-Cánovas</em></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Advances in Use of High Pressure to Processing and Preservation of Plant Foods</td>
<td>283</td>
</tr>
<tr>
<td></td>
<td><em>M. Pilar Cano and Begoña de Ancos</em></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>High-Pressure Applications on Myosystems</td>
<td>311</td>
</tr>
<tr>
<td></td>
<td><em>Pilar Montero and M. Carmen Gómez-Guillén</em></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>High-Pressure Processing of Milk and Dairy and Egg Products</td>
<td>343</td>
</tr>
<tr>
<td>16.</td>
<td>Commercial High-Pressure Equipment</td>
<td>361</td>
</tr>
<tr>
<td></td>
<td><em>Jan Hjelmqvist</em></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Food Irradiation—An Emerging Technology</td>
<td>375</td>
</tr>
<tr>
<td></td>
<td><em>James H. Moy</em></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Ultraviolet Light and Food Preservation</td>
<td>405</td>
</tr>
<tr>
<td></td>
<td><em>Aurelio López-Malo and Enrique Palou</em></td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Microbial Inactivation by Ultrasound</td>
<td>423</td>
</tr>
<tr>
<td></td>
<td><em>Santiago Condón, Javier Raso, and Rafael Pagan</em></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Use of Magnetic Fields as a Nonthermal Technology</td>
<td>443</td>
</tr>
<tr>
<td></td>
<td><em>Gustavo V. Barbosa-Cánovas, Barry G. Swanson, M. Fernanda San Martín G., and Federico Harte</em></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Nonthermal Technologies in Combination with Other Preservation Factors</td>
<td>453</td>
</tr>
<tr>
<td></td>
<td><em>Javier Raso, Rafael Pagan, and Santiago Condón</em></td>
<td></td>
</tr>
</tbody>
</table>
22. *Sous Vide*/Freezing Technology for Ready Meals
   *F.S. Tansey and T.R. Gormley*
   477

23. Advances in Ohmic Heating and Moderate Electric Field (MEF) Processing
   *Sudhir K. Sastry*
   491

24. Radio-Frequency Heating in Food Processing
   *Juming Tang, Yifen Wang, and T.V. Chow Ting Chan*
   501

25. Current State of Microwave Applications to Food Processing
   *Pedro Fito, Amparo Chiralt, and M. Eugenia Martín*
   525

26. Supercritical Fluid Extraction: An Alternative to Isolating Natural Food Preservatives
   *Guillermo Reglero, F. Javier Señoráns, and Elena Ibáñez*
   539

27. Modeling Systems and Impact on Food Microbiology
   *Gail Betts and Linda Everis*
   555

28. Predictive Microbiology and Role in Food Safety Systems
   *Antonio Martínez, Miguel Rodrigo, Dolores Rodrigo, Pilar Ruiz, Amaury Martínez, and Ma. José Ocio*
   579

29. Experimental Protocols for Modeling the Response of Microbial Populations Exposed to Emerging Technologies: Some Points of Concern
   *Stella M. Alzamora, Sandra Guerrero, Pascual E. Viollaz, and Jorge Welti-Chanes*
   591

30. Application of Artificial Intelligence to Predictive Microbiology
   *Rosa María García-Gimeno, César Hervás-Martínez, and Gonzalo Zurera-Cosano*
   609

31. Growth/No-Growth Interface Modeling and Emerging Technologies
   *Enrique Palou and Aurelio López-Malo*
   629

32. Calculating Microbial Inactivation During Heat Treatments Without D and Z Values
   *Micha Peleg*
   653

33. Safety and Quality in the Food Industry
   *María S. Tapia, Ivelio Arispe, and Amaury Martínez*
   669
Contributors

Stella M. Alzamora  Universidad de Buenos Aires, Buenos Aires, Argentina

Begoña de Ancos  Instituto Del Frio, Consejo Superior de Investigaciones Cientificas (CSIC), Madrid, Spain

Ivelio Arispe  Universidad Central de Venezuela Caracas, Venezuela

Gustavo V. Barbosa-Cánovas  Department of Biological Systems Engineering, Washington State University, Pullman, Washington, U.S.A.

Abdel Baset Jemai  Université de Technologie de Compiègne, Compiègne, France

Maksym Bazhal  Université de Technologie de Compiègne, Compiègne, France, McGill University, Montreal, Quebec, Canada

Sílvia Bendicho  Universitat de Lleida, Lleida, Spain

D. Bermúdez  Universidad de las Américas-Puebla, Santa Catarina Mártil, Cholula, Puebla, Mexico

Gail Betts  Campden and Chorleywood Food Research Association, Gloucestershire, UK

Hazem Bouzrara  Université de Technologie de Compiègne, Compiègne, France

M. Pilar Cano  Instituto Del Frio, Consejo Superior de Investigaciones Cientificas (CSIC), Madrid, Spain

M. Capellas  Universitat Autònoma de Barcelona, Bellaterra, Spain

Amparo Chiralt  Universidad Politécnica de Valencia, Valencia, Spain

T.V. Chow Ting Chan  Washington State University, Pullman, Washington, U.S.A.
Santiago Condón  University of Zaragoza, Saragossa, Spain

Pedro Elez-Martínez  Universitat de Lleida, Lleida, Spain

Linda Everis  Campden and Chorleywood Food Research Association, Gloucestershire, UK

Fernando Fernández-Martín  Instituto del Frío (CSIC), Ciudad Universitaria, Madrid, Spain

Pedro Fito  Universidad Politécnica de Valencia, Valencia, Spain

Rosa María García-Gimeno  University of Córdoba, Córdoba, Spain

R. Gervilla  Universitat Autònoma de Barcelona, Bellaterra, Spain

M. Carmen Gómez-Guillén  Ciudad Universitaria, Madrid, Spain


B. Guamis  Universitat Autònoma de Barcelona, Bellaterra, Spain

Sandra Guerrero  Universidad de Buenos Aires, Buenos Aires, Argentina

J.A. Guerrero-Beltrán  Washington State University, Pullman, Washington, U.S.A.

Federico Harte  University of Uruguay, Montevideo, Uruguay

Volker Heinz  Technical University Berlin, Berlin, Germany

César Hervás-Martínez  University of Córdoba, Córdoba, Spain

Jan Hjelmqwist  Avure Technology AB (formerly Flow Pressure Systems), Västerås, Sweden

Elena Ibáñez  CSIC, Madrid, Spain

Dietrich Knorr  Technical University Berlin, Berlin, Germany

Nikolai Lebovka  Université de Technologie de Compiègne, Compiègne, France, and Institute of Biocolloidal Chemistry, NASU, Kyiv, Ukraine

Huub Lelieveld  Unilever Research & Development, Vlaardingen, The Netherlands

Aurelio López-Malo  Universidad de las Américas-Puebla, Santa Catarina Mártir, Cholula, Puebla, Mexico

M. Eugenia Martín  Universidad Politécnica de Valencia, Valencia, Spain

Olga Martín-Belloso  Universitat de Lleida, Lleida, Spain
Barry G. Swanson  Washington State University, Pullman, Washington, U.S.A.

Gipsy Tabilo-Munizaga  Washington State University, Pullman, WA, U.S.A.

Juming Tang  Washington State University, Pullman, Washington, U.S.A.

F.S. Tansey  Teagasc, The National Food Centre, Ashtown, Dublin 15, Ireland

María S. Tapia  Universidad Central de Venezuela Caracas, Venezuela

A.J. Trujillo  Universitat Autònoma de Barcelona, Bellaterra, Spain

Pascual E. Viollaz  Universidad de Buenos Aires, Buenos Aires, Argentina

Eugene Vorobiev  Université de Technologie de Compiègne, Compiègne, France

Yifen Wang  Washington State University, Pullman, Washington, U.S.A.

Jorge Welti-Chanes  Universidad de las Américas-Puebla, Santa Catarina Mártir, Cholula, Puebla, Mexico

J. Yuste  Universitat Autònoma de Barcelona, Bellaterra, Spain

Gonzalo Zurera-Cosano  University of Córdoba, Córdoba, Spain