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# Non-thermal Food Engineering Operations

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# Preface

Food process engineering comprises a series of unit operations traditionally applied in the food industry. One major component of these operations relates to the use of heat, directly or indirectly, to provide foods free from pathogenic microorganisms. Thermal processes are able to control microbial populations, but can also affect the biochemical composition of many foods, resulting in losses of quality, both sensory and nutritional. The last three decades have witnessed the advent and adaptation of several operations, processes, and techniques aimed at producing microbiologically safe foods, but with minimum alteration of sensory and nutritive properties. Some of these techniques have eliminated totally the thermal component in food processing, so they are considered to be alterative methods.

Most of the above-mentioned operations not relying on heat to preserve foods have received different denominations. Many terms, such as “emerging technologies,” “novel processes,” “cold pasteurization techniques,” and “non-thermal processing,” have been used to refer to them. Some of these terms are limited or inaccurate. For example, emerging technologies once exploited on a commercial scale may become established, whereas cold pasteurization or sterilization may be interpreted as being conducted at temperatures well below room temperature. The two common features that properly describe all these technologies are their application under room (or ambient) conditions and their elimination of the heat component to preserve or convert foods. Thus, the most generic terms encompassing the technologies under discussion are “ambient-temperature processes” and “non-thermal food processes.” Since there is also the matter of convention within disciplines, a suitable term to describe alternative technologies in food processing is necessary. Food scientists seem to agree on the ambiguity of the terms “ambient temperature” and “room temperature,” and so they prefer to simply define non-thermal food processing as those technological alternatives aimed at preserving the quality of treated foods with the absence of heat treatments.

In terms of education, some programs of study in chemical engineering, agricultural engineering, biosystems engineering, food science and technology, and so on, include food process engineering as a subject. This theme or topic is offered at both the undergraduate and the graduate level, and sometimes a distinction is made between preserving operations and transformation operations, or between traditional thermal processing and alternative non-thermal processing. The Graduate Program in Food Science and Technology of the Autonomous University of Chihuahua has combined these criteria for some time, offering courses on conventional food processing technologies, alternative food processing technologies, and conversion operations. This book has been written as a textbook for a course covering alternative food processing technologies and conversion operations, i.e., the most important non-thermal food processing operations in the food industry, as currently taught at the Autonomous University of Chihuahua. It is divided into three parts: an introductory part which covers handling of food materials along with preliminary operations such as cleaning and sorting, a second part dealing with processing or conversion operations, and a third part devoted to the study of preservation operations, where the most relevant recent alternatives such as ultrahigh hydrostatic pressure and high-voltage pulsed electric fields are included.

The idea of writing the book originated from experiences accumulated over the years in researching and teaching both food conversion operations and alternative food processing technologies. The author reckoned on the need for a compilation of information on the subject of non-thermal technologies, whether used as a preserving method or not, in a single volume. The book is intended to be used as a textbook for different food-processing-related courses, or as a book to be consulted by practicing engineers dealing with these subjects in the food industry. The project took several years of intensive work to collect, analyze, and refine information on the subject from varied and valuable sources. One of these sources was the feedback from students of the above-mentioned course on alternative food processing technologies and conversion operations. Many contributions from students were helpful in organizing the work. Particularly relevant for preparing the third part of the book were analytical reviews on the corresponding themes provided by Maria Antonieta Anaya-Castro, Arcely Córdova-Muñoz, and Edmundo Juárez-Enríquez.

Sincere and fondest appreciation is given to my wife Sylvia and my daughters Samantha and Christina, who suffered the inevitable reduction of time shared with them owing to the extra investment in time needed to write this book.

Chihuahua, Mexico

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# Contents

## Part I Introductory Aspects

<b>1</b>	<b>Classification of Food Processing and Preservation Operations</b> .....	3
1.1	Introduction .....	3
1.2	The Disciplines of Food Engineering and Food Science.....	5
1.3	Chemical Engineering Principles Involved in Food Processing .....	7
1.4	Categorizing Food Processing and Preservation .....	8
	References.....	10
<b>2</b>	<b>Common Preliminary Operations: Cleaning, Sorting, Grading</b> .....	11
2.1	Main Characteristics of Raw Materials in the Food Industry .....	11
2.2	Cleaning of Raw Materials .....	13
2.3	Dehulling and Peeling .....	18
2.4	Sorting and Grading.....	20
	References.....	25
<b>3</b>	<b>Handling of Materials in the Food Industry</b> .....	27
3.1	Handling of Liquids.....	27
3.1.1	Classification of Fluids.....	27
3.1.2	Density of Liquids .....	30
3.1.3	Viscosity: Definitions and Measurement .....	33
3.2	Handling of Solids .....	41
3.2.1	Introductory Aspects .....	41
3.2.2	Solids in Pieces .....	42
3.2.3	Particulate Solids.....	47
	References.....	67

## Part II Processing Operations

<b>4</b>	<b>Size Reduction</b> .....	71
4.1	Principles of Size Reduction .....	71
4.1.1	Introductory Aspects .....	71
4.1.2	Forces Used in Size Reduction .....	72
4.1.3	Properties of Comminuted Products .....	72
4.2	Energy Requirements: Comminution Laws .....	74
4.2.1	Rittinger's Law .....	74
4.2.2	Kick's Law .....	75
4.2.3	Bond's Law and Work Index .....	75
4.3	Size Reduction Equipment .....	75
4.3.1	Classification .....	75
4.3.2	Features .....	76
4.3.3	Operation .....	81
4.4	Criteria for Selection of Comminution Processes .....	85
4.4.1	General Considerations .....	85
4.4.2	Hardness and Abrasiveness .....	86
4.4.3	Mechanical Structure .....	86
4.4.4	Moisture .....	86
4.4.5	Temperature Sensitivity .....	87
4.5	Applications .....	87
	References .....	87
<b>5</b>	<b>Size Enlargement</b> .....	89
5.1	Introduction: Size Enlargement Processes .....	89
5.2	Aggregation Fundamentals: Strength of Agglomerates .....	89
5.3	Agglomeration Methods .....	93
5.3.1	Tumble/Growth Agglomeration .....	93
5.3.2	Pressure Agglomeration .....	95
5.4	Selection Criteria for Agglomeration Methods .....	97
5.4.1	Feed Characteristics .....	97
5.4.2	Product Properties .....	101
5.4.3	Alternative Methods .....	101
5.5	Design Aspects of Agglomeration Processes .....	102
5.6	Applications of Agglomeration .....	104
	References .....	104
<b>6</b>	<b>Mixing and Emulsification</b> .....	105
6.1	Introduction: Mixing of Fluids and Mixing of Solids .....	105
6.2	Mixing of Liquids and Pastes .....	106
6.2.1	Power Requirements: Dimensional Analysis .....	106
6.2.2	Mixing of Liquids .....	108
6.2.3	Mixing of Pastes and Plastic Solids .....	111
6.2.4	Applications .....	114

6.3	Mixing of Dry Solids .....	115
6.3.1	Mixing Mechanisms: Segregation .....	115
6.3.2	Statistical Approach to Mixing of Solids.....	117
6.3.3	Powder Mixers .....	120
6.3.4	Selection and Design Criteria.....	122
6.3.5	Applications.....	125
6.4	Emulsification .....	125
6.4.1	Introduction and Theory .....	125
6.4.2	Emulsification by Mixing.....	127
6.4.3	Homogenization.....	128
6.4.4	Applications.....	129
	References.....	130
<b>7</b>	<b>Separation Techniques for Solids and Suspensions .....</b>	<b>131</b>
7.1	Classification of Separation Techniques.....	131
7.2	Solid–Solid Separations.....	132
7.2.1	Screening.....	133
7.2.2	Other Solid–Solid Separation Techniques.....	141
7.3	Properties of Fluids and Solids Relevant for Separation Techniques .....	143
7.3.1	Interactions of Particles and Fluids.....	144
7.3.2	Rheology of Suspensions .....	147
7.3.3	Efficiency of Separation Processes .....	148
7.4	Solid–Gas Separations .....	152
7.4.1	Introduction .....	152
7.4.2	Cyclone Separation .....	152
7.4.3	Gas Filtration.....	159
7.4.4	Other Solid–Gas Separation Techniques .....	162
7.5	Solid–Liquid Separations .....	163
7.5.1	Introduction: Solid–Liquid Separations Used in Food Processes .....	163
7.5.2	Sedimentation .....	163
7.5.3	Centrifugation.....	172
7.5.4	Hydrocyclone Separation .....	181
7.5.5	Filtration.....	185
	References.....	196
<b>8</b>	<b>Membrane Separations.....</b>	<b>199</b>
8.1	Introduction .....	199
8.2	Basic Concepts of Membrane Filtration.....	199
8.2.1	Features of Membranes .....	205
8.2.2	Nomenclature and Manufacture of Membranes.....	205
8.3	Membrane Modules and Membrane Separation Equipment .....	207
8.4	Specific Separation Processes and Applications.....	210
8.4.1	Microfiltration.....	210

- 8.4.2 Ultrafiltration..... 211
- 8.4.3 Reverse Osmosis..... 212
- References..... 213

**Part III Preservation Operations**

- 9 Electromagnetic Radiation: Ultraviolet Energy Treatment..... 217**
  - 9.1 Introduction: The Electromagnetic Spectrum ..... 217
  - 9.2 Mechanisms of Microbial Inactivation ..... 219
  - 9.3 Advantages and Limitations of UV Processing ..... 221
  - 9.4 Applications..... 223
    - 9.4.1 Decontamination of Air..... 223
    - 9.4.2 Surface Treatment..... 223
    - 9.4.3 Water Purification..... 225
    - 9.4.4 Fruit and Vegetable Juices..... 225
  - References..... 228
- 10 Ionizing Radiation: Irradiation ..... 231**
  - 10.1 Theoretical Aspects..... 231
  - 10.2 Processing Considerations..... 234
    - 10.2.1 Radiation Sources..... 234
    - 10.2.2 Dosimetry of Irradiation..... 235
    - 10.2.3 Irradiation Plant..... 236
    - 10.2.4 Safety Issues ..... 238
  - 10.3 Effects of Radiation ..... 239
    - 10.3.1 Chemical Effects of Ionizing Radiation..... 239
    - 10.3.2 Effects on Foods ..... 240
    - 10.3.3 Effects on Microorganisms ..... 241
    - 10.3.4 Effects on Enzymes..... 243
  - 10.4 Applications ..... 244
    - 10.4.1 Processed Foods ..... 244
    - 10.4.2 Shelf Life Extension..... 246
    - 10.4.3 Disinfestation ..... 248
  - References..... 248
- 11 Ultrasound in Food Preservation..... 251**
  - 11.1 Introduction..... 251
  - 11.2 Principles: Acoustic Cavitation and Sonochemistry ..... 253
  - 11.3 Ultrasound Treatment as a Preservation Technology ..... 255
    - 11.3.1 Inactivation of Microorganisms ..... 255
    - 11.3.2 Effects on Spores ..... 256
  - 11.4 Ultrasonic Equipment..... 257
  - 11.5 Applications ..... 260
  - References..... 261
- 12 Pulsed Light Technology..... 263**
  - 12.1 Introduction..... 263
  - 12.2 Process and Equipment..... 266

12.3	Microbial Inactivation .....	268
12.4	Other Effects.....	271
12.5	Applications .....	271
	References.....	272
<b>13</b>	<b>High-Voltage Pulsed Electric Fields .....</b>	<b>275</b>
13.1	Introduction .....	275
13.2	Theoretical Background .....	275
13.2.1	Principle .....	275
13.2.2	Mechanisms of Microbial Inactivation.....	276
13.2.3	Scope of the Technology .....	278
13.3	Kinetics of Microbial Inactivation .....	278
13.4	Effects on Enzymes.....	281
13.5	Effects on Nutritive and Sensory Attributes .....	281
13.5.1	Milk and Dairy Products .....	281
13.5.2	Fruit and Vegetable Juices and Beverages .....	283
13.5.3	Solid Food Materials .....	286
13.6	Combination with Other Preservation Techniques.....	289
13.7	Equipment: Design and Development.....	291
13.8	Applications .....	293
	References.....	295
<b>14</b>	<b>Ultrahigh Hydrostatic Pressure .....</b>	<b>301</b>
14.1	Introduction .....	301
14.2	Theoretical Aspects.....	302
14.3	Kinetics of Inactivation.....	305
14.4	Effects on Microorganisms.....	306
14.4.1	Vegetative Cells .....	307
14.4.2	Spores.....	307
14.4.3	Synergistic Effects.....	309
14.5	Effects on Enzymes.....	310
14.5.1	Polyphenoloxidase .....	310
14.5.2	Pectin Methylesterase.....	311
14.5.3	Peroxidase .....	312
14.5.4	Lipases and Proteases.....	312
14.6	Effects on Nutritive and Quality Attributes.....	313
14.7	Equipment .....	314
14.8	Applications and Prospects for the Future .....	319
	References.....	320
<b>15</b>	<b>Protective and Preserving Food Packaging .....</b>	<b>325</b>
15.1	Concepts and Definitions .....	325
15.2	Packaging Materials .....	327
15.3	Methods of Packaging: Modified and Controlled Atmosphere Packaging .....	329
15.4	Shelf Life and Quality of Packaged Foods.....	332
	References.....	334



<b>16 Other Methods</b> .....	337
16.1 Non-conventional Chemical Reagents .....	337
16.2 Biocontrol Cultures .....	339
16.3 Some Other Alternatives and Future Trends .....	341
References.....	343
<b>Appendix</b> .....	345
<b>Index</b> .....	351