

Contents

1	Introduction	1
1.1	How to Use Case Studies	1
Part I Processes Based Largely on Physical Operations		
2	Dry Mixing	5
2.1	Continuous Mixing	10
2.2	Addition of Liquids	10
2.3	Specific Mixers	11
2.4	Examples	12
2.5	Some Lessons	15
3	Snacks and Baking	17
3.1	Snacks	17
3.1.1	Technical Platforms for Snacks	18
3.1.2	Equipment Innovations	18
3.1.3	New Frying Technology	19
3.1.4	Coating and Seasoning	20
3.2	Baking	23
3.2.1	Bread	23
3.2.2	Cake	28
3.2.3	Cookies and Crackers	29
3.3	Examples	30
3.4	Lessons	32
4	Breakfast Cereals	33
4.1	Processes	33
4.2	Coating and Inclusions	35
4.3	Examples	36
4.4	Lessons	37
5	Pet Foods	39
5.1	Complete and Balanced Nutrition	39
5.2	Ingredients and How They Are Handled	41
5.3	Some Unit Operations	43

5.4	Examples	46
5.5	Lessons	48
6	Fruit and Vegetable Juice Processing	49
6.1	Citrus Fruit Juice	49
6.1.1	Processing Steps	49
6.1.2	By-products	51
6.2	<i>Other Juices</i>	52
6.3	Bulk Aseptic Storage	53
6.4	Examples	53
6.5	Lessons	57
7	Membrane Processing	59
7.1	Some Applications	59
7.2	Process Arrangements	61
7.3	Examples	65
7.4	Lessons	66
8	Freeze Drying	67
8.1	Freeze Drying Basics	67
8.2	Equipment Innovations	68
8.3	Other Freeze-Dried Materials	69
8.4	Examples	70
8.5	Lessons	72
 Part II Processes Based on Biochemical Reactions and Thermal Treatment		
9	Continuous Thermal Processing	77
9.1	Aseptic Processing	77
9.1.1	New Developments in Aseptic Processing	77
9.1.2	Aseptic Processing Basics	78
9.1.3	Regulation of Aseptic Processes	79
9.1.4	Aseptically Processed Foods	80
9.1.5	Typical Process Equipment	80
9.1.6	Foodservice Opportunities	80
9.1.7	Bulk Aseptic Storage	81
9.2	Other Applications of the Flow Sheet	81
9.2.1	Cooking	81
9.2.2	Pasteurization	82
9.3	Kinetics of Thermal Processing	84
9.3.1	The Effect of Temperature	85
9.4	Examples	85
9.5	Lessons	89

10	Retort Pouch Foods	91
10.1	History	91
10.2	Commercialization of Retort Pouch Foods	94
10.3	Issues and Lessons	96
10.4	What Happened?	100
10.5	Exercises	101
10.6	Lessons	101
11	Ice Cream	103
11.1	Ice Cream Manufacture	103
11.2	A Digression into Heat Transfer	106
11.2.1	Cooling Refrigerated Foods	106
11.2.2	Fermentation of Yogurt in Cups	107
11.2.3	Leavening of Refrigerated Biscuit Dough in Tubes	107
11.2.4	Freezing of Food Service Muffins	107
11.3	Sanitation and Cleaning	108
11.4	Examples	109
11.5	Lessons	110
12	Sausages and Other Meat Products	113
12.1	Basics of Meat Processing	113
12.1.1	The Sequence of Disassembly	115
12.2	Meat Preservation	116
12.2.1	Forming	117
12.2.2	Cooking	118
12.2.3	Fermentation and Drying	119
12.2.4	Slicing and Packaging	120
12.3	Sanitary Design of Meat Processing Plants	120
12.3.1	Final FDTF Principles and Expanded Definitions	120
12.4	Examples	122
12.5	Lessons	128
13	Non-thermal Processing	129
13.1	Evaluating Non-thermal Processes	129
13.1.1	Validating a Process	130
13.1.2	Determining Kinetics	131
13.1.3	Finding the Data	132
13.2	High Hydrostatic Pressure	132
13.2.1	Equipment	133
13.2.2	Mechanism	133
13.2.3	Other Applications	134
13.2.4	What's Next for HPP?	135
13.2.5	Effects of HPP	135
13.2.6	Dairy Applications of HPP	136
13.3	Irradiation	137
13.4	Pulsed Electric Fields	140

13.4.1	How PEF Works	141
13.4.2	Process Variables	141
13.4.3	Available PEF Units	142
13.4.4	PEF Being Applied Commercially	143
13.4.5	Effects of MEF (a Version of PEF)	143
13.5	Other Non-thermal Processes	143
13.6	Developments in Thermal Processing	144
13.7	Examples and Exercises	145
13.8	Lessons	145
 Part III A Few Broader Topics		
14	Economic Evaluation	149
14.1	Measures of Worth	149
14.2	Estimating Capital Investment at This Stage	151
14.3	Estimating Costs and Benefits	154
14.4	Discussion Topics or Assignments	161
15	Design of a New Facility	163
15.1	Site Selection	163
15.1.1	Example of Site Selection	169
15.2	Size	169
15.2.1	Capability	169
15.3	Overall Layout	172
15.4	Sanitary Design	175
15.5	Security	180
15.6	Support Facilities	182
15.7	Welfare Facilities	186
15.8	Discussion Questions or Assignments	189
16	How to Tour a Food Plant	191
16.1	Material Handling	191
16.2	Other Sanitary Design Features	192
16.3	Characterizing the Plant	192
16.4	Some Examples for Discussion	193
16.5	Lessons	195
17	Build New, Expand, or Upgrade?	197
17.1	Do We Need a New Facility?	197
17.2	Project Phases	198
17.3	Equipment Design, Selection, and Scale-Up	200
17.4	Examples	200
17.5	Lessons	201
18	Developing Processes	203
18.1	Sequence of Process Development	203
18.2	Examples	205

Contents	xi
18.3 Lessons	208
18.4 Closing Note	208
Appendix	
Glossary of Some Terms Used	209
Bibliography	211
Index	215