

CONTENTS

	Page
1. Aseptic processing and packaging of food particulates	1
1.1 Introduction and basic principles	1
1.1.1 Advantages over in-container sterilized foods	1
1.1.2 Advantages over pasteurized chilled foods	2
1.1.3 Advantages over 'cleanfill'	2
1.1.4 Advantages over frozen products	3
1.1.5 Advantages over dried products	3
1.2 Developments in aseptic processing and filling	3
1.3 Aseptic processing—methodology	4
1.3.1 Sterilization of products	4
1.3.2 Sterilization of packaging materials and packages	9
1.4 Maintaining sterility in aseptic machines	10
1.4.1 Sterilization of aseptic installations	11
1.5 Filling	12
1.5.1 Filling principles for liquids	12
1.5.2 Filling principles for particulate mixtures	13
1.6 Closing packs	14
1.6.1 Heat-sealing	14
1.6.2 Types of packs	15
1.7 Typical machines for aseptic packaging of particulate foods	16
1.7.1 Form/fill/seal machine for pouches	16
1.7.2 Thermoform/fill/seal machine for cups and trays	17
1.7.3 Filling and closing line for bottles and jars	18
1.7.4 Form/fill/seal machine for cartons from sleeves	19
1.7.5 Form/fill/seal machine for cartons from the reel	20
1.8 Conclusion	21
References	21
2. The market for aseptic products, processing and packaging systems	23
2.1 Introduction	23
2.2 The west European market	27
2.3 The US market	30
2.3.1 Alfa Laval	30
2.3.2 APV Crepaco	31
2.3.3 ASTEC	32
2.3.4 Cherry Burrell	33
2.3.5 DASI (TCI-Superior)	34
2.3.6 FranRica	34
2.3.7 Terlet	35
2.4 Packaging systems	35
2.5 Future requirements and trends	37
References	38
3. Packaging materials—their properties and criteria for selection	39
3.1 Introduction	39
3.2 Pack selection	40
3.3 Pack criteria	40
3.3.1 Product containment	41
3.3.2 Physical protection	41
3.3.3 Food safety	41
3.3.4 Shelf-life	41
3.3.5 Communication of information	41
3.3.6 Sales appeal	42
3.3.7 Cost-effectiveness	42
3.4 Packaging materials compared	42

3.4.1 Metal containers	43
3.4.2 Rigid plastics containers	47
3.4.3 High-barrier plastics containers	55
3.4.4 The special needs of plastics aseptic packaging	57
3.4.5 Glass containers	59
3.4.6 Flexible packaging materials	61
3.5 Heat-sealing	64
3.5.1 Testing for leaking packs	66
3.6 Shelf-life	66
3.7 Aseptic packs	67
3.8 The cost of packaging	68
3.8.1 Cost-effective packaging	68
3.9 Food packaging legislation	69
3.9.1 EC legislation	69
3.10 Packaging and the environment	70
3.10.1 Litter	70
3.10.2 Disposal of waste	71
3.10.3 Use of natural resources	71
3.10.4 Recycling	72
4. Ohmic heating	74
4.1 Introduction	74
4.1.1 Consumer products	74
4.1.2 Aseptic processing	74
4.1.3 Ohmic heating	74
4.2 Principles of aseptic processing	75
4.2.1 Thermal sterilisation—the options	75
4.2.2 Principles of thermal sterilisation	75
4.3 Processing options	76
4.3.1 Indirect plate heat exchangers	76
4.3.2 Indirect tubular heat exchangers	76
4.3.3 Direct steam injection and steam infusion	76
4.3.4 Scraped surface heat exchangers	77
4.4 Ohmic heating	77
4.4.1 Principles of ohmic heating	77
4.4.2 Advantages of ohmic heating	78
4.5 Design of the ohmic heater	78
4.5.1 Mechanical design	78
4.5.2 Temperature control	78
4.6 Aseptic processing using the ohmic heater	79
4.6.1 Processing system	79
4.6.2 Plant sterilisation	80
4.6.3 Product processing	80
4.6.4 Alternative cooling	81
4.6.5 Cleaning	81
4.6.6 Throughputs	82
4.7 Product quality	82
4.7.1 Microbial process validation	82
4.7.2 Cooking value	84
4.8 Products	87
4.9 Commercial installations	87
4.9.1 Research systems	87
4.10 Conclusions	89
Acknowledgements	89
References	89
5. The ERCA neutral aseptic system	90
5.1 Introduction	90
5.1.1 Sterility without chemicals	90
5.2 Basic construction of the ERCA machine	92

5.2.1	Preparation of materials	92
5.2.2	Machine operation	93
5.3	Extension of basic machine to NAS [®] specification	97
5.4	NAS [®] materials	97
5.4.1	Plastic base web	98
5.4.2	Lidding film	99
5.4.3	Verification of sterility of NAS [®] co-extruded materials	99
5.5	NAS [®] machines	100
5.5.1	General description	100
5.5.2	Plastic film introduction	100
5.5.3	Lidding film introduction	103
5.5.4	Sterile tunnel	104
5.5.5	Forming	105
5.5.6	Filler	106
5.6	Product preparation	108
5.6.1	Production of superheated water	109
5.6.2	Blending	109
5.6.3	UHT process	109
5.6.4	Cooling	110
5.6.5	Cleaning (CIP)	110
5.6.6	Process control	110
5.7	Future developments	110
6.	Microwave processing and package integration	112
6.1	The technology revolution	112
6.2	Consumer influence	113
6.3	Packaging needs	114
6.4	Packaging materials for microwaveable foods	115
6.4.1	Microwave-passive materials	115
6.4.2	Microwave-active and microwave-reflective materials	118
6.4.3	Package geometry for even heating	120
6.5	Microwave heating principles	124
6.5.1	The significance of the wave	125
6.5.2	Microwave interactions with materials	125
6.5.3	Microwave heating factors	126
6.6	Extending product shelf-life	131
6.6.1	HTST processing	131
6.6.2	Microbial and sensory decay	134
6.6.3	Pasteurization versus sterilization	135
6.6.4	Temperature measurement	137
6.6.5	Microwave sterilization	138
6.7	Types of microwave processing systems	140
6.7.1	The frequency debate	140
6.7.2	Penetration depths	142
6.7.3	Operating efficiencies	143
6.7.4	Relative operating costs for industrial microwave processing	143
6.7.5	Batch versus continuous equipment	143
6.7.6	Continuous microwave pressure vessels	143
6.7.7	Thermal stabilisation	145
	Acknowledgements	146
	References	146
7.	The Dole process	148
7.1	Introduction	148
7.2	Technology overview	148
7.3	The Dole system	148
7.3.1	Can-sterilizing unit	149
7.3.2	The filling section	149
7.3.3	Instrumentation and controls	150
7.3.4	System operations	151

7.3.5 Superheated steam	153
8. Microbiological aspects of aseptic processing and packaging	155
8.1 Introduction	155
8.2 Foodborne microorganisms	156
8.2.1 Food poisoning	157
8.3 Raw materials	159
8.4 Processing	160
8.5 Aseptic packaging	162
8.5.1 Hydrogen peroxide and peracids	162
8.5.2 Ultraviolet irradiation	163
8.5.3 Ionising irradiation	164
8.5.4 Thermal treatment	164
8.5.5 Integrity of packs	165
8.6 Validation of aseptic processing and packaging	165
8.6.1 Plant commissioning	166
8.6.2 Sterility testing	167
8.7 Quality control	169
8.7.1 End-product analysis	169
8.7.2 The role of microbiological analysis	171
8.8 Quality management	175
8.8.1 Hazard analysis: critical control point systems	176
8.9 Further thoughts	178
References	179
9. Aseptic packaging of liquid foods	181
9.1 Introduction	181
9.2 Requirements for an aseptic packaging machine	181
9.3 Performance and features of an aseptic packaging machine	183
9.3.1 Sterilization of packaging materials	183
9.3.2 Filling and sealing	185
9.3.3 Aseptic positive-pressure chamber	186
Index	189