

Woodhead Publishing in Food Science and Technology

Managing frozen foods

Edited by Christopher J Kennedy



WOODHEAD PUBLISHING LIMITED

Contents

Preface	ix
List of contributors	xi
List of acronyms	xv
1 Introduction	1
<i>C. J. Kennedy, University of Leeds</i>	
2 Maintaining safety in the cold chain	5
<i>L. Bøgh-Sørensen, Danish Veterinary and Food Administration, Søborg</i>	
2.1 Introduction	5
2.2 Response of micro-organisms to freezing	5
2.3 The main risks in the supply chain for frozen foods	12
2.4 Techniques for microbiological analysis	16
2.5 Sampling	17
2.6 Effects of temperature abuse: viability and recovery	20
2.7 Thawing techniques	21
2.8 New developments in research	24
2.9 Summary: effective monitoring and product quality	25
2.10 References	26
3 Fruit and vegetables: the quality of raw material in relation to freezing	27
<i>A. Maestrelli, IVTPA, Milan</i>	
3.1 Introduction	27
3.2 Factors affecting F&V cultivar selection suitable for freezing	30

3.3	Technological factors	33
3.4	Sensory factors	37
3.5	Agronomic and technological aspects of potatoes for freezing	39
3.6	Nutritional factors	40
3.7	How to measure subjective and objective F&V quality characteristics	43
3.8	Future perspective of F&V cultivar selection for frozen products	49
3.9	Summary	51
3.10	Acknowledgements	53
3.11	References	53
4	The pre-treatment of fruits and vegetables	57
	<i>D. Torreggiani (IVTPA, Milan), T. Lucas (CEMAGREF), A.-L. Raoult-Wack (CIRAD)</i>	
4.1	Introduction	57
4.2	Blanching	59
4.3	Partial dehydration and formulation techniques	60
4.4	Future trends	75
4.5	Summary	75
4.6	References	77
5	The pre-treatment of meat and poultry	81
	<i>S.J. James, FRPERC, Bristol</i>	
5.1	Introduction	81
5.2	Influence of the live animal	83
5.3	Pre- and post-slaughter handling	86
5.4	New trends	89
5.5	Summary	90
5.6	References	91
6	The selection and pre-treatment of fish	95
	<i>N. Hedges (Unilever Research, Sharnbrook) and Jette Nielsen (The Danish Institute for Fisheries Research, Bygning)</i>	
6.1	Introduction to the freezing of fish	95
6.2	What are the elements of the frozen fish product supply chain?	96
6.3	The freezing of fish	97
6.4	Changes occurring on frozen storage	100
6.5	Pre-freezing factors that influence the quality of frozen fish products	103
6.6	The effect of freezing rate	106
6.7	The effect of temperature cycling	106
6.8	Summary	106

6.9	References	107
6.10	Further reading	110
7	Factors affecting the stability of frozen foods	111
	<i>N.E. Zaritzky, CIDCA, La Plata</i>	
7.1	Physical changes during freezing and frozen storage	111
7.2	The chemistry of frozen foods	122
7.3	The impact of freezing on food quality	126
7.4	New trends in research	130
7.5	Summary: maximising quality in the freezing processes	132
7.6	References	133
8	Freezing processed foods	137
	<i>C. J. Kennedy, University of Leeds</i>	
8.1	Introduction	137
8.2	Ready meals	137
8.3	Bakery products	143
8.4	Ice cream	149
8.5	Bibliography	157
9	Freezer technology	159
	<i>J.P. Miller (Air Products plc, Basingstoke) and C. Butcher (CopyWrite, Coventry)</i>	
9.1	Introduction	159
9.2	Refrigeration systems	160
9.3	Freezers	172
9.4	Choosing a freezer	189
9.5	Further reading	193
10	Selecting packaging for frozen food products	195
	<i>M. George, Campden and Chorleywood Food Research Association, Chipping Campden</i>	
10.1	Introduction	195
10.2	Essential requirements for frozen food packaging	196
10.3	Legislative responsibilities	200
10.4	Types of packaging material	202
10.5	Assessing the suitability of packaging materials for different products	204
10.6	Packaging machinery	206
10.7	Future developments in frozen food packaging	207
10.8	Summary: how packaging can maximise product quality	210
10.9	References	210
10.10	Further reading	211

11 Storing frozen food: cold store equipment and maintenance ..	213
<i>R. Fuller, Consultant</i>	
11.1 Storage, shelf-life and product quality	213
11.2 Cold store design	214
11.3 Detail design features	221
11.4 Monitoring and recording product conditions	225
11.5 Good operating practice	226
11.6 New developments	230
11.7 Summary	231
11.8 References	231
11.9 Further reading	232
12 Retail display equipment	233
<i>G. Cortella (University of Udine) and</i>	
<i>F. Polonara (University of Ancona)</i>	
12.1 Introduction	233
12.2 Design of display cabinets	234
12.3 Variations for different product types	245
12.4 Installation	245
12.5 Operation, monitoring, maintenance and breakdown	248
12.6 New developments	251
12.7 Legislative issues	254
12.8 Summary	257
12.9 Acknowledgements	259
12.10 References	259
13 Future trends in frozen foods	263
<i>C. J. Kennedy, University of Leeds</i>	
13.1 Introduction	263
13.2 Consumers will want more frozen foods – markets	264
13.3 Frozen foods will be more nutritious	265
13.4 Ice crystals will be smaller: controlling ice nucleation	266
13.5 And they will stay smaller: controlling ice crystal growth ...	269
13.6 The frozen food chain will be controlled more effectively ..	273
13.7 We will have wider choice and better display when we go shopping	275
13.8 If we go shopping at all	276
13.9 Summary	276
13.10 Bibliography	277
Index	279