

Contents

<i>Contributor contact details</i>	xiii
1 Introduction	1
<i>G. Smit, NIZO Food Research, The Netherlands</i>	
Part I Dairy product safety and quality	3
2 The major constituents of milk	5
<i>P. F. Fox, University College Cork, Ireland</i>	
2.1 Introduction	5
2.2 Lactose	7
2.3 Lipids	12
2.4 Proteins	18
2.5 Minor proteins	26
2.6 Salts	36
2.7 References	38
3 Influences on raw milk quality	42
<i>M. Boland, Fonterra Research Centre, New Zealand</i>	
3.1 Introduction	42
3.2 Breed, genetics and milk quality	45
3.3 Cow diet and milk quality	52
3.4 Other aspects of animal husbandry and milk quality	55
3.5 Future trends	59
3.6 Sources of further information and advice	61
3.7 Acknowledgements	62
3.8 References	62

4 Good hygienic practice in milk processing	68
<i>M. C. te Giffel, NIZO Food Research, The Netherlands</i>	
4.1 Introduction	68
4.2 The principal hazards	69
4.3 Good hygienic practice	72
4.4 Future trends	77
4.5 Sources of further information and advice	79
4.6 Bibliography	79
5 Improvements in the pasteurisation and sterilisation of milk	81
<i>M. J. Lewis, The University of Reading, UK</i>	
5.1 Introduction	81
5.2 Kinetic parameters in heat inactivation	82
5.3 Thermisation and tyndallisation	83
5.4 Pasteurisation	85
5.5 Factors affecting the effectiveness of pasteurisation	86
5.6 Extended shelf-life milks	92
5.7 Sterilisation	92
5.8 Ultra-high temperature (UHT) sterilisation	95
5.9 Aseptic packaging and storage	100
5.10 References	100
6 Modelling the effectiveness of pasteurisation	104
<i>R. C. McKellar, Agriculture and Agri-Food Canada</i>	
6.1 Introduction: the role of predictive modelling	104
6.2 The development of thermal models	105
6.3 Key steps in model development	110
6.4 Models for key enzymes and pathogens	115
6.5 Modelling and risk assessment	117
6.6 Risk assessment and pasteurisation	121
6.7 Future trends	124
6.8 Sources of further information and advice	125
6.9 References	126
7 Flavour generation in dairy products	130
<i>A. E. M. Boelrijk, C. de Jong and G. Smit, NIZO Food Research, The Netherlands</i>	
7.1 Introduction	130
7.2 Raw and heat-treated milk	134
7.3 Yoghurt and buttermilk	142
7.4 Conclusion and future trends	147
7.5 Acknowledgements	148
7.6 References	148

8 Controlling the texture of fermented dairy products: the case of yoghurt	155
<i>D. Jaros and H. Rohm, Dresden University of Technology, Germany</i>	
8.1 Introduction	155
8.2 The manufacture of yoghurt	155
8.3 Factors affecting yoghurt texture	160
8.4 Measuring the rheological and textural properties of yoghurt	166
8.5 Future trends	174
8.6 Sources of further information and advice	176
8.7 References	176
9 Factors affecting the shelf-life of milk and milk products	185
<i>D. D. Muir and J. M. Banks, Hannah Research Institute, UK</i>	
9.1 Introduction	185
9.2 Chemical composition and principal reactions of milk	186
9.3 Bacteria in milk and related enzyme activity	190
9.4 Raw milk enzymes	193
9.5 Control of the quality of short shelf-life products	194
9.6 Yoghurt and fermented milk	197
9.7 Factors affecting the stability of long shelf-life products	198
9.8 Control of the stability of long-life milk products	200
9.9 Summary	206
9.10 Acknowledgement	206
9.11 Bibliography	206
10 Testing the authenticity of milk and milk products	208
<i>F. Ulberth, University of Agricultural Sciences, Austria</i>	
10.1 Introduction	208
10.2 Detecting and quantifying foreign fats	210
10.3 Detecting milk of different species	214
10.4 Detection of non-milk proteins, watering of milk and alteration of casein/whey protein ratio	218
10.5 Measuring heat load	220
10.6 Identifying geographical origin	221
10.7 Conclusions	222
10.8 References	223
11 Functional dairy products	229
<i>M. Saxelin, R. Korppela and A. Mäyrä-Mäkinen, Valio Ltd, Finland</i>	
11.1 Introduction	229
11.2 Composition of milk	229
11.3 Fermented milk products	231
11.4 What do we mean by functional dairy products?	233
11.5 Examples of functional dairy products: gastrointestinal health and general well-being	234

11.6 Examples of functional dairy products: cardiovascular health	238
11.7 Examples of functional dairy products: osteoporosis and other conditions	241
11.8 Future trends	242
11.9 Sources of further information and advice	243
11.10 References	244
12 Developing and approving health claims for functional dairy products	246
<i>J. Snel and R. van der Meer, NIZO Food Research, The Netherlands</i>	
12.1 Introduction	246
12.2 The body's defence mechanisms	247
12.3 <i>In vitro</i> studies	249
12.4 Animal studies	251
12.5 Human studies	252
12.6 Making health claims	254
12.7 Future trends	255
12.8 Sources of further information and advice	256
12.9 References	257
Part II New technologies to improve quality	261
13 On-line measurement of product quality in dairy processing ..	263
<i>G. Ellen and A. J. Tudos, NIZO Food Research, The Netherlands</i>	
13.1 Introduction	263
13.2 On-line measurement of physical parameters	265
13.3 Measuring product composition	269
13.4 On-line microbiological testing	279
13.5 Monitoring fouling and cleaning-in-place	280
13.6 Future trends	283
13.7 Sources of further information and advice	287
13.8 References	288
14 Rapid on-line analysis to ensure the safety of milk	292
<i>A. Amine, Université Hassan II-Mahammedia, Morocco and L. Micheli, D. Moscone and G. Palleschi, Università di Roma 'Tor Vergata', Italy</i>	
14.1 Introduction	292
14.2 Monitoring contamination during milking: faecal contamination and mycotoxins	294
14.3 Measuring the effectiveness of heat treatment	299
14.4 Future trends	306
14.5 References	306

15 High-pressure processing to improve dairy product quality	310
<i>W. Messens, Agricultural Research Centre Ghent, Belgium and J. Van Camp and K. Dewettinck, Ghent University, Belgium</i>	
15.1 Introduction: high-pressure principles and technologies	310
15.2 The effects of high pressure on nutritional and other qualities in milk	311
15.3 The effects of high pressure on bacteria and enzymes	314
15.4 The effects of high pressure on milk proteins	316
15.5 The effects on other properties of milk	317
15.6 The effects on cheese and yoghurt-making properties of milk	319
15.7 High-pressure treatment of cheese	321
15.8 Future trends	325
15.9 Sources of further information and advice	325
15.10 References	326
16 Optimising product quality and process control for powdered dairy products	333
<i>R. E. M. Verdurnen and P. de Jong, NIZO Food Research, The Netherlands</i>	
16.1 Introduction: evaporation and drying processes	333
16.2 Quality criteria for dairy-based powders	340
16.3 Modelling quality	347
16.4 Process and product control	353
16.5 Ensuring process safety	359
16.6 Sources of further information and advice	362
16.7 References	363
17 Separation technologies to produce dairy ingredients	366
<i>G. Bargeman, Akzo Nobel Chemicals bv, The Netherlands</i>	
17.1 Introduction	366
17.2 Separation technologies	368
17.3 Isolation of ingredients	374
17.4 Developments in separation technology	385
17.5 Sources of further information and advice	387
17.6 References	387
18 The use of dissolved carbon dioxide to extend the shelf-life of dairy products	391
<i>C. R. Loss and J. H. Hotchkiss, Cornell University, USA</i>	
18.1 Introduction: factors limiting the shelf-life of dairy products	391
18.2 The effects of CO ₂ on bacterial growth	391
18.3 The effects of CO ₂ on raw milk quality	396
18.4 The effects of CO ₂ on dairy product quality	399

18.5	Bactericidal and sporicidal effects of dissolved CO ₂ during thermal processing	406
18.6	Conclusions	410
18.7	References	410
Part III	Cheese manufacture	417
19	Acceleration of cheese ripening	419
	<i>V. K. Upadhyay and P. L. H. McSweeney, University College Cork, Ireland</i>	
19.1	Introduction	419
19.2	Accelerating cheese ripening: elevated temperature	421
19.3	Addition of exogenous enzymes or attenuated starters	422
19.4	Use of adjunct cultures	431
19.5	Genetic modification of starter bacteria	433
19.6	High-pressure technology	434
19.7	Enzyme-modified cheeses as flavourings	437
19.8	Future trends	440
19.9	Acknowledgement	441
19.10	Sources of further information and advice	441
19.11	References	441
20	Non-starter lactic acid bacteria (NSLAB) and cheese quality ..	448
	<i>T. P. Beresford, Dairy Products Research Centre, Ireland</i>	
20.1	Introduction	448
20.2	Bacteria comprising the NSLAB complex	450
20.3	NSLAB in different cheese varieties	452
20.4	The source of NSLAB in cheese	454
20.5	The growth of NSLAB in cheese	455
20.6	The influence of NSLAB on cheese quality	457
20.7	Selection of NSLAB adjuncts for quality improvement of cheese	461
20.8	Conclusions	463
20.9	References	463
21	The production of smear cheeses	470
	<i>W. Bockelmann, BafM, Germany</i>	
21.1	Introduction: smear-ripened cheese varieties	470
21.2	Production and ripening	472
21.3	Developing ripening cultures	477
21.4	Conclusions and future trends	488
21.5	Sources of further information and advice	489
21.6	References	489

22 Flavour formation in cheese	492
<i>W. J. M. Engels, J. E. T. van Hylckama Vlieg and G. Smit, NIZO Food Research, The Netherlands</i>	
22.1 Introduction	492
22.2 Amino acid conversion	493
22.3 Amino acid catabolism	496
22.4 Methionine catabolism	499
22.5 Branched-chain and aromatic amino acid conversion	501
22.6 Conversion of other amino acids	503
22.7 Natural biodiversity and tailor-made starter cultures	504
22.8 Future trends	505
22.9 References	507
Part IV Appendix	513
23 Improving the nutritional quality of milk	515
<i>D. I. Givens and K. J. Shingfield, The University of Reading, UK</i>	
23.1 Introduction	515
23.2 Factors affecting milk protein content	516
23.3 Factors affecting milk fat content	518
23.4 Future trends	526
23.5 References	527
Index	532