

Contents

<i>Contributor contact details</i>	xi
<i>Woodhead Publishing Series in Food Science, Technology and Nutrition</i>	xv
<i>Preface</i>	xxi

Part I Key requirements for milk quality and safety

1 Milk biochemistry	3
<i>A. L. Kelly, University College Cork, Ireland and L. Bach Larsen, University of Aarhus, Denmark</i>	
1.1 Introduction	3
1.2 Milk composition and constituents	4
1.3 Indigenous enzymes in milk	10
1.4 The secretion of milk	13
1.5 Factors affecting milk composition and processing properties	15
1.6 Conclusions	21
1.7 References	21
2 The microbiological safety of raw milk	27
<i>M. W. Griffiths, University of Guelph, Canada</i>	
2.1 Microbial contamination of milk	28
2.2 Pathogens and milk	36
2.3 Limitations of raw milk testing as an indicator of safety	39

2.4	Outbreaks of illness associated with the consumption of raw milk	40
2.5	Routes of transmission of foodborne pathogens	45
2.6	Antimicrobial properties of milk	49
2.7	References	53
3	Key requirements for milk quality and safety: a processor's perspective	64
<i>K. Burgess, Dairy Crest, UK</i>		
3.1	Introduction	64
3.2	Key elements of the processor's perspective	65
3.3	Basic requirements: essentials of the contract to supply milk	66
3.4	Beyond the basic milk contract: additional requirements	72
3.5	A vehicle for future quality and safety improvement: farm assurance programmes	78
3.6	Future trends	80
3.7	Sources of further information and advice	82
3.8	References	83
Part II Contaminants in milk		
4	Identifying pathogens in milk	87
<i>B. Stessl and I. Hein, University of Veterinary Medicine Vienna, Austria</i>		
4.1	Overview of milkborne pathogens	87
4.2	Regulatory aspects in Europe, the US and elsewhere	91
4.3	Current techniques for the detection of milkborne pathogens and their limitations	94
4.4	New techniques for the detection of milkborne pathogens	95
4.5	Sources of further information and advice	101
4.6	References	104
5	Pesticides, veterinary residues and other contaminants in milk	113
<i>S. K. Nag, Indian Grassland and Fodder Research Institute, India</i>		
5.1	Introduction	113
5.2	Pesticide residues and other chemical contaminants in milk and their potential impact on health	114
5.3	Heavy metal pollution in milk	129
5.4	Radionuclides	131
5.5	Veterinary drug residues	132
5.6	Mycotoxins	134
5.7	Nitrates and nitrites	136
5.8	Detergents and disinfectants	137
5.9	References	138

6 Contaminants in milk: routes of contamination, analytical techniques and methods of control	146
<i>S. K. Nag, Indian Grassland and Fodder Research Institute, India</i>	
6.1 Introduction	146
6.2 Sources of contamination	147
6.3 Analytical techniques	150
6.4 Regulatory aspects	158
6.5 Management of contaminants	159
6.6 Conclusions	173
6.7 Sources of further information and advice	174
6.8 References	175
7 Good hygienic practice in milk production and processing	179
<i>M. C. te Giffel and M. H. J. Wells-Bennik, NIZO food research, The Netherlands</i>	
7.1 Introduction	179
7.2 The principal hazards	180
7.3 Good hygienic practice	184
7.4 Future trends	189
7.5 Sources of further information and advice	191
7.6 Bibliography	191
Part III Safety and quality issues in raw milk production	
8 Exploiting genetic variation in milk-fat composition of milk from dairy cows	197
<i>J. A. M. van Arendonk, H. J. F. van Valenberg and H. Bovenhuis, Wageningen University and Research Centre, The Netherlands</i>	
8.1 Introduction	197
8.2 The Dutch Milk Genomics Initiative	199
8.3 Mean milk-fat composition in winter and summer	200
8.4 Genetic variation between cows	202
8.5 Molecular genetics	210
8.6 Exploiting variation in fatty acid composition	215
8.7 Conclusions	217
8.8 References	217
9 Cows' diet and milk composition	223
<i>O. M. Harstad, Norwegian University of Life Sciences, Norway and H. Steinshamn, Norwegian Institute for Agricultural and Environmental Research, Norway</i>	
9.1 Introduction: cow's diet and milk composition	223
9.2 Diet and nutritional quality of milk	224
9.3 Milk fat content and composition	225
9.4 Milk protein content and composition	236

9.5 Content of vitamins	237
9.6 Content of minerals	239
9.7 Conclusions and practical implications	239
9.8 References	241
10 Mastitis and raw milk quality, safety and yield	246
<i>J. Hamann, University of Veterinary Medicine Hannover Foundation, Germany</i>	
10.1 Introduction	246
10.2 Effects of mastitis on raw milk quality, safety and yield	247
10.3 Causes of mastitis	256
10.4 Mastitis control	258
10.5 Future trends	259
10.6 Sources of further information and advice	259
10.7 References	260
11 Quality assurance schemes on the dairy farm	264
<i>O. Cerf, Alfort Veterinary School, France, J.-M. Gautier and P. Parguel, Livestock Institute, France</i>	
11.1 Introduction	264
11.2 Standards of the International Organization for Standardization	265
11.3 Standards of the Codex Alimentarius Commission	266
11.4 Guides of the Food and Agriculture Organization	269
11.5 Guides of the International Dairy Federation	269
11.6 National and specific guides	270
11.7 Conclusions	271
11.8 References	272
Part IV Safety and quality issues in milk processing	
12 Improving pasteurised and extended shelf-life milk	277
<i>M. Lewis, University of Reading, UK</i>	
12.1 Introduction	277
12.2 History of pasteurisation of milk	280
12.3 Major changes over the last fifty years	282
12.4 Pasteurisation equipment	283
12.5 Determinants of keeping quality	287
12.6 Other changes during pasteurisation	294
12.7 Further issues during pasteurisation	295
12.8 Pasteurisation of some other milk-based products	296
12.9 Legislation and control	296
12.10 Extended shelf-life milk	297
12.11 Conclusions	298
12.12 References	298

13 Improving UHT processing and UHT milk products	302
<i>H. Deeth, University of Queensland, Australia</i>	
13.1 Introduction	302
13.2 UHT processing: definition and principles	304
13.3 Microbiological aspects	307
13.4 UHT processing: methods and characteristics	310
13.5 Changes in milk during UHT processing	315
13.6 Changes in UHT milk during storage	319
13.7 Sources of further information and advice	323
13.8 References	324
14 Modelling heat processing of dairy products	330
<i>N. Hotrum, M. Fox, H. van Lierloo, E. Smit and P. de Jong, NIZO food research, The Netherlands and M. Schutyser, Wageningen University and Research Centre, The Netherlands</i>	
14.1 Introduction to optimisation of heat processing of milk	330
14.2 Modelling: focus on process, product and costs	334
14.3 Deterministic modelling approaches	335
14.4 Case study: application of deterministic modelling to milk sterilisation	338
14.5 Stochastic modelling approaches	340
14.6 Case study: application of stochastic modelling to milk pasteurisation	341
14.7 Future trends	345
14.8 Sources of further information and advice	346
14.9 References	347
15 Removal of bacteria, spores and somatic cells from milk by centrifugation and microfiltration techniques	349
<i>G. Gésan-Guiou, INRA-Agrocampus Ouest, France</i>	
15.1 Introduction	349
15.2 Centrifugation	350
15.3 Microfiltration (MF)	356
15.4 Conclusions	369
15.5 Sources of further information and advice	370
15.6 References	371
16 High pressure processing of milk	373
<i>T. Huppertz, NIZO food research, The Netherlands</i>	
16.1 Introduction	373
16.2 High pressure processing: principles and technologies	374
16.3 Effects of high pressure on the constituents of milk	377
16.4 Effects of high pressure on micro-organisms in milk	385
16.5 Shelf-life of high pressure-treated milk	390
16.6 Processing characteristics of high pressure-treated milk	390
16.7 Future trends	391
16.8 References	392

17 Pasteurization of milk with pulsed electric fields	400
<i>G. Barbosa-Cánovas and D. Bermúdez-Aguirre, Washington State University, USA</i>	
17.1 Introduction: key issues	400
17.2 Principles of the technology	401
17.3 Pulsed electric fields processing equipment	403
17.4 Microbial inactivation	407
17.5 Modeling microbial inactivation	411
17.6 Enzyme inactivation	412
17.7 Overall quality of milk	413
17.8 Shelf-life extension of milk	413
17.9 Drawbacks and limitations	414
17.10 Conclusions	416
17.11 References	416
18 Other novel milk preservation technologies: ultrasound, irradiation, microwave, radio frequency, ohmic heating, ultraviolet light and bacteriocins	420
<i>G. Barbosa-Cánovas and D. Bermúdez-Aguirre, Washington State University, USA</i>	
18.1 Introduction	421
18.2 Novel technologies for improving quality and their effectiveness	421
18.3 Ultrasound	424
18.4 Irradiation	429
18.5 Microwave	433
18.6 Ohmic heating	437
18.7 Ultraviolet light	441
18.8 Other available technologies	444
18.9 Conclusions	445
18.10 References	445
19 Hazard Analysis Critical Control Point and other food safety systems in milk processing	451
<i>S. C. Murphy, Cornell University, USA</i>	
19.1 Introduction	451
19.2 Background to the Hazard Analysis Critical Control Point (HACCP) concept	452
19.3 Hazard Analysis Critical Control Point (HACCP) in milk processing	456
19.4 Other food safety systems	476
19.5 Sources of further information and advice	478
19.6 References	479
Index	482