

# Contents

<i>Contributor contact details.....</i>	xv
<i>Woodhead Publishing Series in Food Science, Technology and Nutrition.....</i>	xxi
<i>Introduction .....</i>	xxix
<b>Part I Understanding and measuring chemical deterioration of food and beverages .....</b>	1
<b>1 Oxidative rancidity in foods and food quality.....</b>	3
<i>J. Velasco, C. Dobarganes and G. Márquez-Ruiz, Consejo Superior de Investigaciones Científicas (CSIC), Spain</i>	
1.1 Introduction: oxidative rancidity and food quality.....	3
1.2 Mechanisms of lipid oxidation .....	5
1.3 Factors affecting the rate of lipid oxidation .....	11
1.4 Measuring oxidation in a food or food ingredient .....	16
1.5 Measuring oxidative stability in a food or food ingredient .....	23
1.6 Prevention of oxidative rancidity.....	25
1.7 Future trends .....	27
1.8 Sources of further information.....	28
1.9 References.....	28
<b>2 Protein oxidation in foods and food quality .....</b>	33
<i>M. N. Lund, University of Copenhagen, Denmark, and C.P. Baron, Technical University of Denmark, Denmark</i>	
2.1 Introduction .....	33
2.2 Definition and mechanisms of protein oxidation .....	35

2.3	From amino acid oxidation to protein oxidation.....	40
2.4	Measuring protein oxidation in foods.....	45
2.5	Protein oxidation in food .....	50
2.6	Predicting, monitoring and controlling.....	58
2.7	Future trends .....	61
2.8	References.....	61
<b>3</b>	<b>The Maillard reaction and food quality deterioration .....</b>	<b>70</b>
	<i>C. Perez-Lucas and V. A. Yaylayan, McGill University, Canada</i>	
3.1	Introduction to the Maillard reaction and food quality deterioration .....	70
3.2	Mechanisms involved in the Maillard reaction.....	71
3.3	Factors affecting the Maillard reaction .....	72
3.4	Maillard reaction and food flavor deterioration.....	76
3.5	Maillard reaction, food nutritional losses and browning .....	78
3.6	Maillard-generated toxicants.....	81
3.7	Measuring and monitoring the Maillard reaction in foods to detect quality deterioration.....	85
3.8	Conclusion.....	87
3.9	References.....	88
<b>4</b>	<b>Flavor deterioration during food storage.....</b>	<b>95</b>
	<i>G. Reineccius, University of Minnesota, USA</i>	
4.1	Introduction .....	95
4.2	Loss of desirable aroma components from model systems during storage.....	96
4.3	Loss of desirable aroma components from food systems during storage.....	101
4.4	Measuring, predicting and monitoring flavor deterioration in foods .....	105
4.5	Methodologies .....	105
4.6	Case studies.....	106
4.7	Minimising flavor deterioration .....	108
4.8	Future trends .....	109
4.9	References.....	110
<b>5</b>	<b>Light-induced quality changes in foods and beverages.....</b>	<b>113</b>
	<i>M. L. Andersen and L. H. Skibsted, University of Copenhagen, Denmark</i>	
5.1	Introduction .....	113
5.2	Photochemical reactions in food and beverages.....	115
5.3	Meat and meat products .....	123
5.4	Frozen fish .....	126

5.5	Dairy products .....	129
5.6	Vegetable oils.....	131
5.7	Beer .....	131
5.8	Alcoholic beverages .....	134
5.9	Future trends .....	135
5.10	References.....	135
<b>Part II</b>	<b>Understanding and measuring physical deterioration of foods and beverages .....</b>	<b>141</b>
<b>6</b>	<b>Moisture loss, gain and migration in foods and its impact on food quality .....</b>	<b>143</b>
	<i>G. Roudaut and F. Debeaufort, Université de Bourgogne, France</i>	
6.1	Introduction .....	143
6.2	Basic concepts of the mechanisms of moisture transfers in food products .....	144
6.3	Sorption isotherm characterisation of foods .....	154
6.4	Water relationships in foods .....	161
6.5	Conditions for moisture migration and foods affected by moisture transfer.....	165
6.6	Measurement of water migration.....	169
6.7	Modelling moisture transport phenomena in food products .....	170
6.8	References.....	180
<b>7</b>	<b>Crystallization in foods and food quality deterioration .....</b>	<b>186</b>
	<i>R. K. Bund and R. W. Hartel, University of Wisconsin (Madison), USA</i>	
7.1	Introduction .....	186
7.2	Crystallization in foods.....	187
7.3	Measurement of crystalline microstructure in foods.....	199
7.4	Quality deterioration in food products associated with crystallization .....	203
7.5	Future trends .....	213
7.6	References.....	213
<b>8</b>	<b>Structural and mechanical properties of fats and their implications for food quality .....</b>	<b>216</b>
	<i>M. F. Peyronel, N. C. Acevedo and A. G. Marangoni, University of Guelph, Canada</i>	
8.1	Introduction .....	216
8.2	Fat crystal network structure components.....	220
8.3	Structural basis for elasticity and yield stress of fats .....	234

8.4	Processing conditions for fats.....	250
8.5	Future trends .....	254
8.6	References.....	254
<b>9</b>	<b>Emulsion breakdown in foods and beverages.....</b>	<b>260</b>
	<i>S. Ghosh and D. Rousseau, Ryerson University, Canada</i>	
9.1	Introduction: emulsion breakdown and quality deterioration .....	260
9.2	Mechanisms of emulsion breakdown .....	261
9.3	Controlling emulsion breakdown.....	272
9.4	Factors influencing emulsion breakdown.....	277
9.5	Measuring, predicting and monitoring emulsion breakdown.....	283
9.6	Future trends .....	287
9.7	Sources of further information and advice.....	288
9.8	References.....	288
<b>10</b>	<b>Gelatinization and retrogradation of starch in foods and its implications for food quality.....</b>	<b>296</b>
	<i>A-C. Eliasson, Lund University, Sweden</i>	
10.1	Introduction .....	296
10.2	Concepts of gelatinization and retrogradation .....	297
10.3	Measuring, predicting and monitoring starch gelatinization and retrogradation in foods .....	305
10.4	Controlling starch gelatinization and retrogradation to improve shelf life.....	310
10.5	References.....	315
<b>11</b>	<b>Syneresis in food gels and its implications for food quality.....</b>	<b>324</b>
	<i>S. Mizrahi, Technion-Israel Institute of Technology, Israel</i>	
11.1	Introduction .....	324
11.2	Monitoring syneresis.....	325
11.3	Mechanism of syneresis.....	325
11.4	Characteristics of syneresis phenomena in foods .....	339
11.5	Future trends .....	346
11.6	References.....	346
<b>12</b>	<b>Understanding, detecting and preventing taints in food.....</b>	<b>349</b>
	<i>D. Kilcast, Consultant, formerly of Leatherhead Food Research, UK</i>	
12.1	Introduction .....	349
12.2	Chemistry of taint .....	352
12.3	Sources of taints .....	354
12.4	Detection and analysis of taints .....	358
12.5	Diagnostic taint testing.....	368

12.6	Ethical aspects .....	373
12.7	Case studies.....	373
12.8	Future trends .....	375
12.9	Sources of further information and advice.....	376
12.10	References.....	376
<b>Part III Deterioration in specific food and beverage products.....</b>		<b>379</b>
<b>13</b>	<b>Chemical and physical deterioration of bakery products.....</b>	<b>381</b>
<i>S. P. Cauvain and L. S. Young, BakeTran, UK</i>		
13.1	Introduction .....	381
13.2	Rancidity .....	385
13.3	Staling of bakery products: changes that contribute to loss of freshness .....	386
13.4	Storage instability in baked products .....	391
13.5	Manipulating the shelf life of bakery products.....	401
13.6	Case studies.....	407
13.7	Future trends .....	410
13.8	Sources of further information and advice.....	411
13.9	References.....	411
<b>14</b>	<b>Chemical and physical deterioration of bulk oils and shortenings, spreads and frying oils .....</b>	<b>413</b>
<i>F. D. Gunstone, formerly of the University of St Andrews, St Andrews, UK, and S. Martini, Utah State University, USA</i>		
14.1	Introduction .....	413
14.2	Chemical deterioration and physical instability.....	414
14.3	Analytical procedures for detecting, predicting, and monitoring undesirable changes.....	428
14.4	Preventing oxidative deterioration with antioxidants.....	431
14.5	Future trends .....	435
14.6	Sources of further information and advice.....	436
14.7	References.....	436
<b>15</b>	<b>Chemical processes responsible for quality deterioration in fish .....</b>	<b>439</b>
<i>C. Jacobsen, H. H. Nielsen, B. Jørgensen and J. Nielsen, Technical University of Denmark, Denmark</i>		
15.1	Introduction .....	439
15.2	Composition of fish.....	442
15.3	The <i>rigor mortis</i> process.....	443
15.4	Protein degradation catalysed by enzymes.....	445
15.5	Degradation of lipids by enzymes.....	448
15.6	Enzymatic degradation of trimethylamine-N-oxide (TMAO) .....	449

15.7	Oxidative damage of seafood .....	452
15.8	Conclusions and future trends.....	460
15.9	Sources of further information and advice.....	460
15.10	References.....	460
<b>16</b>	<b>Chemical and physical deterioration of wine .....</b>	<b>466</b>
	<i>A. L. Waterhouse, University of California (Davis), USA, and R. J. Elias, The Pennsylvania State University, USA</i>	
16.1	Introduction .....	466
16.2	Mechanisms of wine deterioration.....	469
16.3	Methods for monitoring wine deterioration.....	472
16.4	Use of oxidation during processing and post-bottling .....	477
16.5	Case studies.....	478
16.6	Future trends .....	480
16.7	Acknowledgements.....	480
16.8	References.....	480
<b>17</b>	<b>Postharvest chemical and physical deterioration of fruit and vegetables .....</b>	<b>483</b>
	<i>A. K. Thompson, formerly Cranfield University, UK</i>	
17.1	Introduction .....	483
17.2	Processes involved in qualitative and quantitative deterioration of fruit and vegetables.....	488
17.3	Factors affecting the rate of postharvest chemical and physical deterioration of fruit and vegetables.....	491
17.4	Detecting, predicting and monitoring chemical deterioration and physical instability of fruit and vegetables .....	503
17.5	Preventing chemical deterioration and physical instability of fruit and vegetables.....	504
17.6	Future trends .....	507
17.7	Sources of further information and advice.....	508
17.8	References.....	508
<b>18</b>	<b>Enzymatic deterioration of plant foods .....</b>	<b>519</b>
	<i>N. A. M. Eskin and M. Aliani, University of Manitoba, Canada</i>	
18.1	Introduction .....	519
18.2	Peroxidases.....	520
18.3	Lipoxygenase .....	523
18.4	Polyphenol oxidase .....	525
18.5	Pectin methylesterases and polygalacturonases.....	526
18.6	Alternative methods of inactivation.....	528
18.7	References.....	531

<b>19 Stability of vitamins during food processing and storage.....</b>	539
<i>P. Berry Ottaway, Berry Ottaway &amp; Associates Ltd, UK</i>	
19.1 Introduction .....	539
19.2 Vitamins.....	540
19.3 Factors affecting vitamin stability .....	541
19.4 Classification of vitamins.....	542
19.5 Vitamin–vitamin interactions.....	553
19.6 Effect of irradiation on vitamin stability in foods.....	553
19.7 Vitamin loss during processing.....	554
19.8 Food product shelf life and its determination.....	556
19.9 Protection of vitamins in foods .....	558
19.10 References.....	559
<b>20 Chemical and physical deterioration of frozen foods .....</b>	561
<i>N. E. Zaritzky, CIDCA CONICET and Universidad Nacional de La Plata, Argentina</i>	
20.1 Introduction .....	561
20.2 Basic principles of food freezing.....	562
20.3 The freezing process: ice formation.....	566
20.4 Freezing graphs.....	568
20.5 Definitions of freezing rate .....	570
20.6 Mathematical modeling of freezing time .....	571
20.7 Intracellular and extracellular ice crystals in frozen tissues.....	574
20.8 Physical changes in frozen foods.....	578
20.9 Chemical changes produced by freezing and frozen storage .....	585
20.10 Microbial stability of frozen foods.....	589
20.11 Effect of freezing and frozen storage on food quality: case studies.....	589
20.12 Shelf life of frozen foods .....	594
20.13 Packaging of frozen food .....	596
20.14 Glass transition temperature and stability of frozen food .....	598
20.15 Cryostabilization of food systems: a case study .....	600
20.16 Future trends .....	602
20.17 References.....	602
<b>21 Chemical deterioration and physical instability in ready-to-eat meals and catered foods.....</b>	608
<i>P. G. Creed, formerly of Bournemouth University, UK</i>	
21.1 Introduction .....	608
21.2 Chemical deterioration and physical instability of ready-to-eat meals and catered foods .....	610

21.3	Detecting, predicting and monitoring chemical deterioration and physical instability of ready-to-eat meals and catered foods .....	619
21.4	Preventing chemical deterioration and physical instability of ready-to-eat meals and catered foods .....	622
21.5	Role of chemical deterioration and physical instability in the determination of shelf life of ready-to-eat meals and catered foods: a case study .....	642
21.6	Future trends .....	646
21.7	Sources of further information and advice.....	647
21.8	References.....	648
<b>22</b>	<b>Chemical deterioration and physical instability of food powders.....</b>	<b>663</b>
	<i>P. Intipunya, Chiang Mai University, Thailand, and B. R. Bhandari, The University of Queensland, Australia</i>	
22.1	Introduction .....	663
22.2	Food powders.....	664
22.3	Basic and functional properties of powders.....	665
22.4	Powder formation techniques and manipulation of powder properties .....	669
22.5	Glass transition related phenomena and quality changes in food powders .....	674
22.6	Deterioration of powder properties .....	683
22.7	Prevention of physical instability and chemical deterioration .....	693
22.8	Future trends .....	695
22.9	References.....	695
<b>23</b>	<b>The effect of non-meat ingredients on quality parameters in meat and poultry .....</b>	<b>701</b>
	<i>M. N. O'Grady and J. P. Kerry, University College Cork, Ireland</i>	
23.1	Introduction .....	701
23.2	Factors affecting meat and poultry quality.....	702
23.3	Prevention of quality deterioration in meat and poultry .....	706
23.4	Conclusions .....	718
23.5	References.....	719
<b>24</b>	<b>Chemical deterioration and physical instability of dairy products .....</b>	<b>726</b>
	<i>G. Mortensen, University of Aarhus, Denmark, U. Andersen, Arla Foods, Denmark, J. H. Nielsen, University of Aarhus, Denmark, and H. J. Andersen, Arla Foods and University of Aarhus, Denmark</i>	
24.1	Introduction .....	726

24.2	Milk as raw material .....	727
24.3	General aspects of deterioration of dairy products .....	727
24.4	Oxidation in dairy products.....	729
24.5	Maillard reaction in dairy products .....	739
24.6	Proteolysis in dairy products .....	741
24.7	Lipolysis in dairy products.....	744
24.8	Syneresis in dairy products .....	745
24.9	Structure changes in dairy products .....	749
24.10	Future trends .....	751
24.11	Sources of further information and advice.....	752
24.12	References.....	753
	<i>Index</i> .....	763