

Contents

<i>Contributors</i>	ix
<i>Preface</i>	xi
Chapter 1 The development of yeast strains as tools for adjusting the flavor of fermented beverages to market specifications	1
<i>Jan H. Swiegers, Sofie M.G. Saerens and Isak S. Pretorius</i>	
Introduction	1
Wine	1
Beer	2
Saké	3
Wine, beer and saké yeasts	3
Wine yeasts	4
Beer yeasts	5
Saké yeasts	5
Acids	6
Non-volatile acids	6
Volatile acids	9
Alcohols	10
Ethanol	10
Glycerol	12
Higher alcohols	14
Esters	17
Carbonyl compounds	23
Acetaldehyde	23
Diacetyl	25
Volatile phenols	26
Sulfur compounds	29
Sulfides	29
Mercaptans	32
Thiols	33
Monoterpenoids	35
Conclusion	38
References	38
Chapter 2 Biotechnology of flavor production in dairy products	56
<i>Bart C. Weimer, Sweta Rajan and Balasubramanian Ganesan</i>	
Introduction	56
Biochemistry of dairy fermentations	57
Biotechnology and flavor	60
Flavor production from bacteria	70

Comparative genomics of flavor production	71
Expression and metabolite analysis	75
Non-culturable lactococci	77
Summary	77
References	78
Chapter 3 Biotechnological production of vanillin	83
<i>Daphna Havkin-Frenkel and Faith C. Belanger</i>	
Introduction	83
Biosynthesis of vanillin	85
Natural occurrence of vanillin	85
Site of vanillin production in vanilla beans	85
Vanillin biosynthetic pathway in <i>V. planifolia</i>	86
Production of vanillin by biotechnology	88
Introduction	88
Use of microorganisms	88
Use of plant tissue culture	94
Use of enzymes	95
Use of physical and mild chemistry	95
Synthetic vanillin	96
Vanillin from vanilla beans	96
Regulations	97
Conclusions and future outlook	98
References	98
Chapter 4 Plant cell culture as a source of valuable chemicals	104
<i>Chee-Kok Chin</i>	
Introduction	104
Establishment of callus culture	105
Initiation and maintenance of cell culture	107
Production of valuable chemicals by cultured plant cells	108
Concluding remarks	113
References	113
Chapter 5 Tomato aroma: Biochemistry and biotechnology	118
<i>Rachel Davidovich-Rikanati, Yaniv Azulay, Yaron Sitrit, Yaakov Tadmor and Efraim Lewinsohn</i>	
The major aroma impact volatiles in tomato and their biosynthetic pathways	118
Biosynthesis of tomato volatiles	119
Degradation of fatty acids	119
Volatiles derived from amino acids	120
Terpenes	121
Carotenoid pigmentation affects the flavor and volatile composition of tomato fruit	122

Genetic engineering of tomato aroma	124
Conclusion	126
References	127
Chapter 6 Flavor development in rice	130
<i>Louis M. T. Bradbury, Robert J. Henry and Daniel L. E. Waters</i>	
Introduction	130
Old flavors of rice	130
Rice texture	131
Fragrant rice	132
The chemistry of rice fragrance	135
The genetics of rice fragrance	136
BAD enzymes and 2AP synthesis	138
The future	141
References	142
Chapter 7 Breeding and biotechnology for flavor development in apple (<i>Malus × domestica</i> Borkh.)	147
<i>Susan K. Brown</i>	
Quality	147
Apple volatiles	148
Ester compounds and ester biosynthesis	148
Measurement techniques	149
Varietal and developmental differences	149
Effect of storage	151
Effect of processing	151
Effect of 1-methylcyclopropene treatment	152
Hypoxia	152
Gene isolation	152
Genetic studies, linkage maps and marker-assisted selection	153
ESTs	154
Transgenic approaches	154
Ethylene production and softening (ACS-ACO)	155
Consumer perceptions and sensory testing	155
References	156
Chapter 8 Aroma as a factor in the breeding process of fresh herbs – the case of basil	161
<i>Nativ Dudai and Faith C. Belanger</i>	
The importance of selecting for aroma in breeding of aromatic plants	161
The importance of genetic factors regarding the essential oil composition in aromatic plants	161
Sweet basil and the <i>Ocimum</i> genus	162
Uses of sweet basil	163

The chemistry of the aroma factors of plants: The essential oil	164
Essential oil profiles of common commercial basil varieties	164
Comparison of chemical analysis methods	169
Variation of the volatile compound composition within the plant	170
Variation of aroma compounds within cultivars and the potential for selection	171
Biosynthetic pathways of basil aroma components	174
Inheritance of aroma compounds in basil	176
Interspecific hybridization among <i>Ocimum</i> species	177
Applications of biotechnology-based approaches to modification of basil aroma	178
References	179
Chapter 9 Increasing the methional content in potato through biotechnology	185
<i>Rong Di</i>	
Flavor compound methional in foods	185
Formation of methional	185
Synthesis of Met in plants	186
Biotechnology to enhance Met and methional	188
References	190
Chapter 10 Regulatory aspects of flavor development – traditional versus bioengineered	194
<i>Sabine Teske and James C. Griffiths</i>	
Bioengineered food products	194
Conventional flavors	195
The use of microbes as vectors of food ingredients and flavors	196
Bioengineered flavors	197
Safety standards of food products, ingredients, and flavors	198
Determination of ‘reasonable certainty of no harm’ safety standard	199
The 1992 Policy – Substantial equivalence of bioengineered food ingredients	202
Plant-derived bioengineered foods – A special case	203
Labeling of bioengineered food products	204
Allergenicity of bioengineered foods	205
Notes	207
References	207
<i>Index</i>	211
<i>Colour plates are found facing p. 84</i>	