

CONTENTS

Figures	xxv
Tables	xxix
About the Editor	xxxiii
Contributors	xxxv
Foreword	il
<i>R. A. Mashelkar</i>	
Preface	li
 PART I: ENVIRONMENTAL BIOTECHNOLOGY	
Advances in Biological Wastewater Treatment	3
<i>Veeriah Jegatheesan</i>	
<i>C. Visvanathan</i>	
<i>R. Ben Aim</i>	
Introduction	3
Conventional Biological Wastewater Treatment	5
Advanced Wastewater Treatment	7
Nutrients in Wastewater	8
Conclusions	11
Anaerobic Animal-Waste Environments: <i>Salmonella</i>	
Species Ecology	13
<i>Steven C. Ricke</i>	
Introduction	13
<i>Salmonella</i> Physiology in the Anaerobic Waste Environment	13
<i>Salmonella</i> Pathogenicity in the Waste Environment	15
Conclusions	17
Biobeneficiation	19
<i>Valentina Umrانيا</i>	
<i>A. D. Agate</i>	
Introduction	19
Possible Mechanisms	19

The Practice	21
Conclusions	22
Biodegradation of Polycyclic Aromatic Hydrocarbons	23
<i>Rodolfo Canet-Castello</i>	
<i>Joseph M. Lopez-Real</i>	
<i>Angus J. Beck</i>	
Introduction	23
Biodegradation of PAHs by Aerobic Bacteria	24
Biodegradation of PAHs by Anaerobic Bacteria	25
Biodegradation of PAHs by Fungi	27
Biodegradation of PAHs by Algae	28
Conclusions	28
Biofiltration	31
<i>Eldon R. Rene</i>	
<i>D. Arulneyam</i>	
<i>T. Swaminathan</i>	
Introduction	31
History of Biofiltration	32
Process Description	32
Mechanism of Biofiltration	33
Microbial Aspects of Biofiltration	34
Biofilter Media	35
Characteristics of an "Ideal" Biofilter	36
Performance Parameters	37
Advantages and Disadvantages of Biofiltration	38
Commercial Application of Biofilters	39
Conclusions	39
Biological Control of Air Pollution	41
<i>S. N. Upadhyay</i>	
<i>V. Kumar</i>	
Introduction	41
Process Description	42
Process Modeling and Design	48
Operation and Maintenance	48
Conclusions	51

Biomethanogenesis	53
<i>Dalel Singh</i>	
<i>Poonam Nigam Singh</i>	
Introduction	53
Biomethanation Plants and Digestors	54
Substrates for Biogas Production	56
Microbiology of Biomethanation	58
Biochemistry of Methane Synthesis	60
Conclusions	62
Bioremediation	63
<i>Wan Azlina Ahmad</i>	
<i>Zainul Akmar Zakaria</i>	
Introduction	63
Bioremediation Methods	64
Applications of Bioremediation	66
Features of Bioremediation	68
Bioremediation—Success Stories	69
Conclusions	69
Methods for the Biological Treatment of Wastewater	71
<i>Biological Reactors</i>	71
<i>P. K. Mishra</i>	
<i>B. N. Rai</i>	
<i>S. N. Upadhyay</i>	
Principles of Biological Treatment	71
Reaction Kinetics	74
Bioreactors for Wastewater Treatment	76
Conclusions	80
<i>Membrane Bioreactor</i>	82
<i>C. Visvanathan</i>	
<i>R. Ben Aim</i>	
Introduction	82
Membrane Bioreactor Systems	83
Conclusions	91

<i>Rotating Biological Contactors</i>	92
<i>S. N. Upadhyay</i>	
<i>P. K. Mishra</i>	
<i>B. N. Rai</i>	
Introduction	92
Process Modeling	94
Process Design	95
Nitrification and Denitrification	98
Effect of Temperature	100
Conclusions	100
<i>Trickling Filters</i>	102
<i>B. N. Rai</i>	
<i>P. K. Mishra</i>	
<i>S. N. Upadhyay</i>	
Introduction	102
Recirculation	103
Process Microbiology	104
Process Modeling and Design	106
Conclusions	111
<i>Waste Stabilization Ponds</i>	113
<i>P. K. Mishra</i>	
<i>B. N. Rai</i>	
<i>S. N. Upadhyay</i>	
Introduction	113
Classification of Pond Systems	113
Conclusions	121
<i>Microbiologically Influenced Corrosion</i>	123
<i>R. S. Dubey</i>	
<i>S. N. Upadhyay</i>	
Introduction	123
Biofouling	125
Microorganisms Associated with Corrosion	126
Mechanism of Microbial Corrosion	129
Control and Monitoring of Microbial Corrosion	129
Conclusions	132

Treatment of Industrial Effluents	135
<i>Distillery Effluent</i>	135
Poonam Nigam Singh	
Tim Robinson	
Dalel Singh	
Introduction	135
Problems Associated with Distillery Effluent	136
Treatment Technologies	137
Bioremediation of Distillery Effluent	140
Recycling Treated Distillery Effluent	141
Conclusions	141
<i>Pulp and Paper Mill Effluent</i>	143
Indu Shekhar Thakur	
Introduction	143
Procedure of Pulping	144
Bleaching	144
Characteristics of Effluent	144
Problems Related to the Pulp and Paper Industry	145
Environmental Impact of the Pulp and Paper Mill	146
Effluent Treatment in the Pulp and Paper Mill	147
Conclusions	151
<i>Removal of Heavy Metals from Wastewater</i>	152
Wan Azlina Ahmad	
Jefri Jaapar	
Mior Ahmad Khushairi Mohd Zahari	
Introduction	152
Chemical Removal Processes	152
Biological Removal Processes	154
Conclusions	157
<i>Tannery Effluent</i>	158
Indu Shekhar Thakur	
Introduction	158
Leather Industry—World Scenario	158
Tanning Processes	158
Existing Pollution Problems	159

Leben and Other Related Products	204
Lactic Beverages	207
New Developments in Fermented Milk Products	207
Functional Dairy Foods	208
Fermented Vegetables	211
<i>Didier Montet</i>	
<i>Gérard Loiseau</i>	
<i>Nadine Zakhia</i>	
Introduction	211
Lactic Acid-Fermented Vegetables	211
Nutritional Value of Lactic Acid-Fermented Vegetables	218
Some Recipes	220
Food Additive Production by Fermentation	225
<i>Rekha S. Singhal</i>	
<i>Pushpa R. Kulkarni</i>	
Introduction	225
Food Additives of Fermentation Origin	225
Conclusions	235
Food-Grade Yeast Production	237
<i>Argyro Becatorou</i>	
<i>Costas Psarianos</i>	
Introduction	237
Yeasts	238
Commercial Food-Grade Yeasts	239
Raw Materials in Food-Grade Yeast Production	241
Stages of Industrial Food-Grade Yeast Production	243
Conclusions	245
Kefir Yeast Technology	247
<i>Matina Iconomopoulou</i>	
<i>Costas Psarianos</i>	
Introduction	247
Traditional Production of Kefir Grains	247
Morphology of Kefir Grains	248
Composition of Kefir Grains and Kefirlike Cultures	248

Fermentation and Chemical Composition of the Fermented Product	249
Parameters Affecting the Fermentation	250
Kefir Production	251
Preservation of Kefir Grains	253
Kefir Grains and Kefir As Probiotics	253
Conclusions	254

Molecular Methods for Microbial Detection and Characterization for Food Safety **255**

Suresh D. Pillai
James M. Totten

Introduction	255
Detection	256
Characterization	261
Conclusions	262

Mushroom Production **265**

Dan Levanon
Ofer Danai

Introduction	265
The Mushroom Production Industry: Past and Present	266
Compost-Based Mushroom Production	267
Lignocellulose-Based Mushroom Production	270
Environmental Aspects	273
Conclusions	275

Nutraceutical Production and Use **277**

Sudip Kumar Rakshit

Introduction	277
Mineral Fortification of Foods	278
Nutraceuticals from Plant Sources	278
Fish, Marine, and Dairy Products	281
Herbal Sources	283
Required Characteristics for Nutraceuticals	283
Consumer Concerns and the Future	284

Fermentation and Chemical Composition of the Fermented Product	249
Parameters Affecting the Fermentation	250
Kefir Production	251
Preservation of Kefir Grains	253
Kefir Grains and Kefir As Probiotics	253
Conclusions	254

Molecular Methods for Microbial Detection and Characterization for Food Safety 255

Suresh D. Pillai
James M. Totten

Introduction	255
Detection	256
Characterization	261
Conclusions	262

Mushroom Production 265

Dan Levanon
Ofer Danai

Introduction	265
The Mushroom Production Industry: Past and Present	266
Compost-Based Mushroom Production	267
Lignocellulose-Based Mushroom Production	270
Environmental Aspects	273
Conclusions	275

Nutraceutical Production and Use 277

Sudip Kumar Rakshit

Introduction	277
Mineral Fortification of Foods	278
Nutraceuticals from Plant Sources	278
Fish, Marine, and Dairy Products	281
Herbal Sources	283
Required Characteristics for Nutraceuticals	283
Consumer Concerns and the Future	284

Prebiotics and Probiotics 285

Sudip Kumar Rakshit

Introduction	285
Importance of Probiotics	286
Probiotic Organisms	287
Desirable Characteristics	288
Benefits of Probiotic Consumption	289
Sources of Prebiotics	290
Model Systems	291
Conclusions	291

Single-Cell Protein 293

Chundakkadu Krishna
Murray Moo-Young

Introduction	293
Need for Microbial Protein Production	294
Sources	294
Substrates	295
Nutritional Aspects of SCP	295
Limitations	297
Factors Affecting SCP Production	297
Commercial Production of SCP	298
Alternative Sources of SCP Production	298
Optimum SCP Production Parameters	300
Toxicity	301
Uses of SCP	303
Socioeconomic Problems and Cost Effectiveness	303
Conclusions	304

Vitamin Production by Fermentation 305

Rekha S. Singhal
Pushpa R. Kulkarni

Introduction	305
Microbial Production of Vitamins	305
Conclusions	312

Xanthan Gum Production 315

Maria Papagianni

Introduction	315
General Properties	316
Xanthan	316
Gellan	317
Dextran	318
Scleroglucan	319
Biosynthetic Mechanisms and Production Kinetics	319
Fermentation	320
Product Recovery	321

PART III: INDUSTRIAL BIOTECHNOLOGY

Alcoholic Fermentation 327

Bacterial Alcoholic Fermentation 327

K. Chandraraj

P. Gunasekaran

Introduction	327
Ethanol by Fermentation	327
Factors Affecting Ethanol Fermentation	328
Kinetics of Ethanol Fermentation	330
Process Improvement	331
Ethanol from Renewable Resources	332
Ethanol As an Automobile Fuel	333
Conclusions	333

Fruit-Based Alcoholic Beverages 335

Vinod K. Joshi

Somesh Sharma

Shashi Bhushan

Devender Attri

Quality Factors and Composition of Wines	335
Technology of Fruit Wine Preparation	339
Spoilage of Wine	343
Fruit Brandy: The Technology of Production	343
Conclusions	345

Fuel Ethanol Production from Renewable Biomass Resources **346**

James Chukwuma Ogbonna

Feedstocks—Introduction	346
Renewable Biomass Materials Used for Ethanol Production	346
Feedstocks—Conclusions	351
Process Strategies—Introduction	353
Processes for Ethanol Production from Sugar Materials	353
Processes for Ethanol Production from Starch and Lignocellulosic Materials	356
Bioreactors	358
Process Strategies—Conclusions	361

Grape-Based Alcoholic Beverages **363**

Ronald S. Jackson

Introduction	363
Table Wines	363
Sparkling Wines	368
Fortified Wines	369
Brandy	372
Wine Use	374

Malted Barley, Scotch Whiskey, and Beer **376**

G. H. Palmer

Introduction	376
Malt Production	378
The Malting Process	379
Malt Spirit and Grain Spirit Production	382
Beer Production	386
Conclusions	392

Thermotolerant and Osmotolerant Yeasts for Alcoholic Fermentation **394**

L. Venkateswar Rao

M. Sridhar

Introduction	394
Need for Thermotolerant and Osmotolerant Yeasts in the Ethanol Industry	395
Effect of Temperature on the Growth and Fermentation of Yeasts	396

Media Supplementation for Enhanced Osmotolerance and Thermotolerance	396
Mechanism of Osmotolerance and Thermotolerance	397
Fermentation Abilities of Isolated Osmotolerant and Thermotolerant Yeasts	400
Approaches for Obtaining Novel Thermotolerant and Osmotolerant Yeast Strains with Good Ethanol Yields	401
Conclusions	402
Alkaloids, Aflatoxins, and Other Secondary Metabolites: Production Techniques	403
<i>Javier Barrios-González</i>	
<i>Araceli Tomasini</i>	
<i>Francisco J. Fernández</i>	
<i>Armando Mejía</i>	
Introduction	403
Alkaloids	403
Aflatoxins	406
Other Secondary Metabolites	408
Conclusions	412
Amino Acid Production	413
<i>K. Madhavan Nampoothiri</i>	
Introduction	413
Production Strains	413
Commercial Need for and Application of Amino Acids	415
Amino Acid Secretion—Physiology and Metabolic Concept	416
Amino Acid Secretion—Mechanisms and Concepts	419
Other Amino Acids	421
Conclusions	422
Antibiotic Production	423
<i>Javier Barrios-González</i>	
<i>Araceli Tomasini</i>	
<i>Francisco J. Fernández</i>	
<i>Armando Mejía</i>	
Introduction	423
Secondary Metabolism	424

Regulation	427
Production	429
Genetic Improvement	430
Conclusions	431
Aroma Compound Production	433
<i>Ali Kademi</i>	
<i>Danielle Leblanc</i>	
<i>Alain Houde</i>	
Introduction	433
Production of Aroma Compounds	434
Aroma Compound Biosynthesis Mechanisms	437
Applications of Aroma Compounds	439
Conclusions	442
Bioconversion of Agroindustrial Residues for Bioprocesses	443
<i>Cassava Industry Residues</i>	443
<i>Carlos Ricardo Soccol</i>	
<i>Ashok Pandey</i>	
Introduction	443
Microbial Strains Cultivated on Cassava Bagasse	446
Bioprocesses Involving Cassava Bagasse	447
Conclusions	451
<i>Coffee Industry Residues</i>	453
<i>Carlos Ricardo Soccol</i>	
<i>Ashok Pandey</i>	
Introduction	453
Industrial Processing of Coffee Cherries	453
Physicochemical Composition of Coffee Pulp and Husk	455
Applications of Coffee Pulp and Husk	455
Conclusions	458
<i>Palm Oil Industry Residues</i>	460
<i>Poonsuk Prasertsan</i>	
<i>S. Prasertsan</i>	
Introduction	460
Residues from the Palm Oil Industry	460