

Table of contents

Foreword (J. Długoński) /	11
Foreword to the handbook Microbiological Biotechnology. Exercises and specialist laboratories from 1997 (J. Długoński) /	15
1. Methods of screening, culturing, improvement and storage of microorganisms of industrial importance /	17
1.1. General characteristics of microorganisms used in biotechnological processes (J. Długoński) /	19
1.2. Screening of microorganisms useful in microbiological processes (J. Długoński, K. Lisowska, N. Wrońska, K. Zawadzka, A. Felczak) /	21
1.2.1. Suitability of various environments for isolation of microorganisms used in industrial processes /	21
1.2.2. Soil as a source of potential producers of biologically active compounds /	22
1.2.3. Microbial screening /	24
1.2.4. Soil of polluted environments as a source of microorganisms used in environmental protection processes /	27
1.3. Methods of culturing and stabilisation of microorganisms under aerobic conditions (including bioreactors and immobilisation in gels) (J. Długoński, P. Bernat, K. Lisowska, S. Walisch) /	33
1.3.1. Batch culture /	34
1.3.2. Fed-batch culture – batch with continuous dosing of nutrient to the fermenter /	37
1.3.3. Continuous culture /	37
1.3.4. Bioreactors for submerged cultures /	40
1.3.5. Stabilisation of microorganisms by immobilization /	42
1.4. Microorganism culture in anaerobic conditions (M. Krupiński) /	47
1.5. Fungal protoplasts: release, properties and application (J. Długoński, K. Paraszkiwicz, M. Ślaba, K. Milczarek) /	53
1.6. Strain development – mutagenesis, fusion and electroporation of protoplasts (J. Długoński, D. Wilmańska, S. Różalska, K. Lisowska, K. Milczarek) /	58
1.7. Storage of industrial strains (K. Zawadzka, N. Wrońska, S. Walisch, K. Milczarek, D. Wilmańska) /	74
Literature /	79

2. Fundamentals of modern analytical techniques used in microbial biotechnology and related sciences / 83

- 2.1. Confocal, fluorescent microscopy and spectrofluorimetry (S. Różalska) / 85
 - 2.1.1. Fluorescence phenomenon / 85
 - 2.1.2. Spectrofluorimetry / 86
 - 2.1.3. Fluorescent and confocal microscopy – comparison / 87
 - 2.1.4. Autofluorescence and fluorescent markers / 89
 - 2.1.5. Fluorescent proteins / 89
- 2.2. Isotopic techniques (radioactive isotopes) (J. Długoński, S. Różalska) / 93
- 2.3. Chromatography (R. Szewczyk) / 96
 - 2.3.1. Basic parameters measured in chromatography / 96
 - 2.3.2. Liquid chromatography / 101
 - 2.3.3. Gas chromatography / 106
- 2.4. Mass spectrometry (R. Szewczyk) / 108
 - 2.4.1. Principle of mass spectrometer operation / 109
 - 2.4.2. Ion sources and ion types in mass spectrometry / 110
 - 2.4.3. Mass analysers / 113
 - 2.4.4. Basic scanning modes / 116
 - 2.4.5. Ion detection / 118
 - 2.4.6. Application of mass spectrometry / 119
- 2.5. Atomic absorption spectroscopy (M. Staba) / 119
- 2.6. Modern digital techniques used to record changes in the environment (A. Długoński) / 124
 - 2.6.1. Satellite imagery in analyzing historical and last landuse / 125
 - 2.6.2. Principles of detection selected remote sensing systems / 128
 - 2.6.3. Airplane scanning in terrain measurement / 130
- Literature / 133

3. Determining the taxonomic affiliation of microorganisms / 137

- 3.1. Genotypic techniques for differentiation and identification of bacteria (M. Krupiński) / 139
 - 3.1.1. Isolation from the soil and identification of anaerobes by multiplex PCR / 142
 - 3.1.2. Taxonomic classification of the genus *Streptomyces* based on PCR 16S rRNA method / 149
- 3.2. Fungi of the phyla Mucoromycota, Ascomycota and Basidiomycota – morphological, biochemical features and genetic analysis (M. Staba, S. Różalska) / 156
 - 3.2.1. Mucoromycota / 160
 - 3.2.2. Ascomycota / 161
 - 3.2.3. Basidiomycota / 164
 - 3.2.4. Molecular identification of filamentous fungi / 167
 - 3.2.5. Yeast / 171

3.3. Microbial biotyping by LC-MS/MS and MALDI-TOF/TOF methods (R. Szewczyk) /	175
3.3.1. LC-MS/MS biotyping on the example of <i>Mycobacterium</i> strains /	176
3.3.2. MALDI-TOF and MALDI-TOF/TOF biotyping /	182
Literature /	188
4. Industrial applications of microorganisms /	191
4.1. Biosynthesis processes (J. Długoński) /	193
4.1.1. Microbial biomass production and using (P. Bernat) /	194
4.1.2. Characteristics, classification and directions for practical use of surfactants. Screening of <i>Bacillus</i> strains capable of lipopeptide surfactants production. (K. Paraszkiwicz, A. Walaszczyk) /	198
4.1.3. Microbiological production of enzymes from the hydrolase class (J. Długoński, K. Paraszkiwicz, A. Jasińska, K. Milczarek) /	210
4.1.4. Polysaccharides biosynthesis (J. Długoński, S. Różalska) /	219
4.1.5. Antibiotic biosynthesis using tetracyclines as a study model (J. Długoński, P. Bernat) /	230
4.1.6. Production of bacterial lipopeptides (P. Bernat) /	237
4.1.7. Citric acid biosynthesis (S. Walisch, P. Bernat, K. Paraszkiwicz) /	239
4.2. Fermentation processes (J. Długoński) /	244
4.2.1. Winemaking and brewing (S. Walisch, P. Bernat, K. Paraszkiwicz) /	245
4.2.2. Practical use of lactic acid bacteria (S. Walisch, P. Bernat, K. Paraszkiwicz) /	251
4.2.3. Use of microorganisms in the baking industry and for the production of fermented meat and vegetable products (K. Paraszkiwicz, A. Jasińska, A. Góralczyk-Bińkowska) /	257
4.2.4. Asian food obtained by the use of microorganisms (A. Jasińska, A. Góralczyk-Bińkowska, K. Paraszkiwicz) /	270
4.3. Biotransformation processes (J. Długoński) /	277
4.3.1. Biotransformation of ethanol and sorbitol (J. Długoński, S. Walisch) /	277
4.3.2. Biotransformation of steroids (J. Długoński) /	282
Literature /	287
5. Microorganisms in environmental and human health protection /	295
5.1. Revitalisation of degraded urban green areas (A. Długoński) /	297
5.1.1. Interdisciplinary research in urban revitalisation: work stages /	298
5.1.2. Field research in the scope of landscape architecture and related disciplines /	300
5.1.3. Laboratory research in biotechnology, microbiology, environmental chemistry and related disciplines /	302
5.1.4. Total score and summary of research /	304
5.2. Microbiological analysis of polluted environments – Next generation sequencing (S. Różalska) /	310

5.3. Biological wastewater treatment processes	/ 317
5.3.1. Biological methods of wastewater treatment in municipal treatment plants (K. Lisowska, K. Zawadzka)	/ 318
5.3.2. Municipal-industrial wastewater treatment (A. Długoński)	/ 320
5.3.3. Wastewater treatment in scattered areas – small infrastructure (A. Długoński)	/ 322
5.4. Waste composting (A. Długoński, K. Lisowska)	/ 325
5.4.1. Waste composting in municipal composting plants	/ 325
5.4.2. Local use of waste from urban green areas	/ 327
5.5. Use of municipal green waste for energy production in local biogas and incineration plants and the synthesis of fungal laccases (A. Długoński, A. Góralczyk-Bińkowska)	/ 330
5.5.1. Energy production	/ 330
5.5.2. Use of urban green waste for biosynthesis of fungal enzymes on the example of laccases	/ 332
5.6. Biodegradation of toxic xenobiotics (J. Długoński)	/ 335
5.6.1. Bisphenol A (A. Jasińska)	/ 336
5.6.2. Organotin compounds (P. Bernat, A. Felczak, J. Długoński)	/ 341
5.6.3. Use of microorganisms to eliminate pesticides (P. Bernat)	/ 345
5.6.4. Nonylphenol (J. Długoński, S. Różalska)	/ 348
5.6.5. Simultaneous elimination of organic and inorganic pollutants based on the example of alachlor and zinc (M. Słaba, J. Długoński)	/ 350
5.6.6. Heterocyclic compounds (A. Felczak, N. Wrońska)	/ 354
5.6.7. Dyes (A. Jasińska, A. Góralczyk-Bińkowska)	/ 357
5.7. Microbiological elimination of heavy metals from the environment (M. Słaba, J. Nykiel-Szymańska)	/ 362
5.8. Detoxification processes of polluted environments. Ecotoxicological tests (M. Krupiński)	/ 371
5.9. Use of industrial waste in microbiological biotechnology (K. Paraszkievicz, A. Góralczyk-Bińkowska, A. Jasińska)	/ 377
5.10. Biodeterioration caused by fungi (S. Różalska, M. Słaba, A. Długoński)	/ 383
5.11. Characteristics and use of ligninolytic enzymes produced by fungi in environmental protection, industry and medicine (A. Jasińska, A. Góralczyk-Bińkowska, A. Długoński)	/ 391
5.12. Determination of antimicrobial properties of macromolecules (dendrimers) and newly synthesised silver compounds (A. Felczak, K. Zawadzka)	/ 398
5.13. Entomopathogenic fungi and their use in biocontrol (S. Różalska)	/ 403
5.14. Toxigenic fungi. Search for and identification of aflatoxins (K. Paraszkievicz, M. Słaba, R. Szewczyk)	/ 407
Literature	/ 418

6. Omics in microbial biotechnology / 431

- 6.1. Proteomics in microbiological analysis of xenobiotics degradation (R. Szewczyk) / 433
 - 6.1.1. Isolation and separation of proteins / 434
 - 6.1.2. Identification of proteins / 438
- 6.2. Metabolomic analysis as a tool for multi-level characterisation of the biodegradation process (R. Szewczyk) / 446
- 6.3. Application of lipidomics in the study of detoxification processes in microorganisms (P. Bernat) / 452
- 6.4. Search for biomarkers in industry and medicine (R. Szewczyk) / 459
 - 6.4.1. Analytical methods / 460
 - 6.4.2. Characteristics and sources of biomarkers / 460
- 6.5. Quantitative analysis of pesticides – multimethods (R. Szewczyk) / 464
 - 6.5.1. Multimethods / 464
 - 6.5.2. Method validation / 466
- Literature / 470

7. Media, buffers (K. Milczarek, N. Wrońska, A. Felczak) / 473

- 7.1. Media / 475
- 7.2. Buffers / 494
- Literature / 496

8. Macroscopic and microscopic images of fungal strains applied at the Department of Industrial Microbiology and Biotechnology at the University of Łódź / 497

- 8.1. Photographs of fungi cultured under laboratory conditions (K. Milczarek, S. Różalska) / 499
 - 8.1.1. *Aureobasidium pullulans* / 499
 - 8.1.2. *Ashbya gossypii* / 500
 - 8.1.3. *Aspergillus niger* / 501
 - 8.1.4. *Aspergillus versicolor* IM2161 / 502
 - 8.1.5. *Chaetomium globosum* / 503
 - 8.1.6. *Cunninghamella echinulata* IM1785 21Gp (previously *C. elegans*) / 504
 - 8.1.7. *Curvularia lunata* IM2901 / 507
 - 8.1.8. *Curvularia lunata* IM4417 / 510
 - 8.1.9. *Exophiala* sp. / 511
 - 8.1.10. *Kluyveromyces marxianus* / 512
 - 8.1.11. *Metarhizium robertsii* IM2358 / 513
 - 8.1.12. *Mucor ramosissimus* IM6203 / 514
 - 8.1.13. *Myrothecium roridum* IM6482 / 516

8.1.14. <i>Nectriella pironii</i> IM6443	/ 517
8.1.15. <i>Paecilomyces marquandii</i> IM6003 (currently <i>Metarhizium marquandii</i>)	/ 518
8.1.16. <i>Phanerochaete chrysosporium</i> DSM1556	/ 520
8.1.17. <i>Schizosacharomyces pombe</i>	/ 521
8.1.18. <i>Serpula himantoides</i> DSM6419	/ 523
8.1.19. <i>Stachybotrys chartarum</i> DSM2144	/ 524
8.1.20. <i>Trametes versicolor</i>	/ 525
8.1.21. <i>Trichoderma harzianum</i> QF10	/ 527
8.1.22. <i>Trichoderma viride</i> IM6325	/ 528
8.1.23. <i>Umbelopsis ramanniana</i> IM833	/ 529
8.2. Photographs of trees and wood infected by ligninolytic fungi (A. Długoński)	/ 530
8.2.1. <i>Pleurotus ostreatus</i> (oyster mushroom)	/ 530
8.2.2. <i>Trametes versicolor</i> (turkey tail)	/ 531
8.2.3. <i>Heterobasidion annosum</i> (annosum root rot)	/ 531
8.2.4. Brown wood rot	/ 532
8.2.5. White wood rot	/ 534
8.2.6. Soft wood rot	/ 535
8.2.7. <i>Tremella mesenterica</i> (yellow brain)	/ 536
8.2.8. <i>Phellinus pomaceus</i>	/ 538
8.2.9. <i>Piptorus betulinus</i> (birch polypore)	/ 539
8.2.10. <i>Fomes fomentarius</i> (tinder fungus)	/ 540
8.2.11. Interaction of pathogens causing the rot of trees	/ 541
8.2.12. <i>Schizophyllum commune</i> (split gill)	/ 542
Literature	/ 543
Authors	/ 545