

Table of Contents

- Related titles
- List of contributors
- Woodhead Publishing Series in Food Science, Technology and Nutrition
- Preface
- Introduction to brewing microbiology
- Acknowledgments
- Part One. Yeast: properties and management
 - 1. Yeast: an overview
 - 1.1. Yeast species/strains used in brewing and distilling
 - 1.2. Yeast cell structure
 - 1.3. Comparison of lager and ale yeast
 - 1.4. Flocculation
 - 2. Yeast quality assessment, management and culture maintenance
 - 2.1. Introduction
 - 2.2. Objectives of wort fermentation
 - 2.3. Brewer's yeast species
 - 2.4. Yeast management
 - 2.5. Storage of yeast stock cultures between propagations
 - 2.6. Preservation of yeast strains
 - 2.7. Yeast propagation
 - 2.8. Yeast collection
 - 2.9. Yeast storage
 - 2.10. Yeast washing
 - 2.11. Yeast stress
 - 2.12. Dried yeast
 - 2.13. Conclusions
 - 3. Modelling yeast growth and metabolism for optimum performance
 - 3.1. Introduction
 - 3.2. Parameters influencing yeast growth and fermentation of barley malt
 - 3.3. Modelling: techniques and applications
 - 3.4. Advanced fermentation techniques
 - 3.5. Future trends and sources for further information
 - 3.6. Closing remarks
 - 4. Advances in metabolic engineering of yeasts
 - 4.1. Introduction
 - 4.2. Metabolic engineering
 - 4.3. Tools for metabolic engineering
 - 4.4. Strategies for metabolic engineering
 - 4.5. Brewing yeast genetics
 - 4.6. Targets for engineering of brewing yeast
 - 4.7. Future perspective
 - 4.8. Additional sources of further information
 - 5. Yeast identification and characterization
 - 5.1. Biodiversity and characterization of yeast species and strains from a brewing environment
 - 5.2. Microbiological, physiological, identification, and typing methods
 - 5.3. Brewing yeast cell count/viability/vitality methods
 - 5.4. Monitoring yeast and fermentation

- Part Two. Spoilage bacteria and other contaminants
 - 6. Toxigenic fungi and mycotoxins in the barley-to-beer chain
 - 6.1. Introduction
 - 6.2. Barley malt: a key raw material in brewing
 - 6.3. Evolution of fungi in the barley–malt ecosystem
 - 6.4. Impacts of barley-associated fungi on malt quality
 - 6.5. *Aspergillus*, *Penicillium* and *Fusarium* mycotoxins
 - 6.6. Fate of mycotoxins in the barley-to-beer chain
 - 6.7. Regulation of mycotoxins in Europe
 - 6.8. Emerging mycotoxin issues
 - 6.9. Preventive actions
 - 6.10. Future trends
 - 6.11. Sources of further information and advice
 - 7. Gram-positive spoilage bacteria in brewing
 - 7.1. Introduction
 - 7.2. Beer-spoilage LAB
 - 7.3. Hop resistance mechanisms in beer-spoilage LAB
 - 7.4. Subculture and preservation methods of beer-spoilage LAB
 - 7.5. Other Gram-positive bacteria in brewing
 - 7.6. Concluding remarks
 - 8. Gram-negative spoilage bacteria in brewing
 - 8.1. Introduction: Gram-negative bacteria in brewing
 - 8.2. Acetic acid bacteria
 - 8.3. *Zymomonas*
 - 8.4. Brewery-related *Enterobacteriaceae*
 - 8.5. Conclusion
 - 8.6. Further reading
 - 9. Strictly anaerobic beer-spoilage bacteria
 - 9.1. Introduction
 - 9.2. The types of strictly anaerobic beer-spoilage bacteria
 - 9.3. Occurrence in artificial and natural environments
 - 9.4. Appearance of cells and laboratory cultures
 - 9.5. General physiology and metabolism
 - 9.6. Growth and effects in beer
 - 9.7. Management of contaminations
 - 9.8. Future outlook and research needs
 - 9.9. Sources of further information and advice
- Part Three. Reducing microbial spoilage: design and technology
 - 10. Hygienic design and Cleaning-In-Place (CIP) systems in breweries
 - 10.1. Introduction
 - 10.2. Brewery contamination
 - 10.3. The main principles of hygienic design as applied in the brewery
 - 10.4. An overview of CIP systems used in the brewery
 - 10.5. Conclusions
 - 10.6. Future trends
 - 10.7. Sources of further information and advice
 - 11. Reducing microbial spoilage of beer using filtration
 - 11.1. Introduction
 - 11.2. Filtration technologies in brewing
 - 11.3. Filter aid filtration
 - 11.4. Crossflow microfiltration

- 11.5. Sterile filtration
 - 11.6. Improving filtration performance
 - 11.7. Future trends
 - 11.8. Sources of further information and advice
 - 12. Reducing microbial spoilage of beer using pasteurisation
 - 12.1. Introduction
 - 12.2. History
 - 12.3. Principles of pasteurisation
 - 12.4. D value, z value, *P* value, process time, Pasteurisation Units and L value
 - 12.5. Spoilage hurdles
 - 12.6. Microorganism heat resistance
 - 12.7. Tunnel pasteurisation
 - 12.8. Flash pasteurisation
 - 12.9. Flavour change
 - 12.10. Good practice and quality control
 - 12.11. Future trends
 - 12.12. Sources of further information and advice
 - 13. Traditional methods of detection and identification of brewery spoilage organisms
 - 13.1. Detection of brewery spoilage organisms
 - 13.2. Identification of brewing spoilage organisms
 - 13.3. Summary
 - 14. Rapid detection and identification of spoilage bacteria in beer
 - 14.1. Introduction
 - 14.2. Hygiene tests (ATP bioluminescence, oxidoreductase)
 - 14.3. Direct epifluorescence filter technique
 - 14.4. Antibody-direct epifluorescent filter technique
 - 14.5. Oligonucleotide-direct epifluorescent filter technique
 - 14.6. *In situ* hybridization detection systems
 - 14.7. Polymerase chain reaction
 - 14.8. MALDI-TOF mass spectroscopy
 - 14.9. Conclusions
 - 15. Beer packaging: microbiological hazards and considerations
 - 15.1. Introduction
 - 15.2. Microbiological hazards in the filling hall
 - 15.3. Biofilm growth in the packaging hall
 - 15.4. Minimization of risks
 - 15.5. Future trends
 - 16. Assuring the microbiological quality of draught beer
 - 16.1. Introduction
 - 16.2. Draught beer quality
 - 16.3. Microbiology of draught beer
 - 16.4. Managing the microbiological risk
 - 16.5. Innovation
- Part Four. Impact of microbiology on sensory quality
 - 17. Impact of yeast and bacteria on beer appearance and flavour
 - 17.1. Introduction
 - 17.2. Impact of yeast on beer appearance
 - 17.3. Impact of yeast on beer flavour
 - 17.4. Impact of bacteria on beer appearance and flavour

- 17.5. Future trends
 - 17.6. Further information
 - 18. Sensory analysis as a tool for beer quality assessment with an emphasis on its use for microbial control in the brewery
 - 18.1. Introduction
 - 18.2. Part 1: microbes, flavors, off-flavors, and taints in brewing
 - 18.3. The microbiology of “atypical flavor” production in brewing—an overview
 - 18.4. Specialty beer production and processes
 - 18.5. Conclusion—part 1
 - 18.6. Part 2: sensory evaluation
 - 18.7. Gathering data for sensory evaluation
 - 18.8. Sensory training
 - 18.9. Conclusion—part 2
- Part Five. Valorisation of microbiological brewing waste
 - 19. Anaerobic treatment of brewery wastes
 - 19.1. Introduction
 - 19.2. Key factors affecting the anaerobic digestion process
 - 19.3. Factors affecting the application of anaerobic digestion in waste treatment
 - 19.4. Anaerobic treatment of brewery wastes
 - 19.5. Conclusion and perspectives
 - 20. Water treatment and reuse in breweries
 - 20.1. Introduction
 - 20.2. Production and composition of brewery wastewater
 - 20.3. Pretreatment of brewery wastewater
 - 20.4. Advanced treatment of brewery wastewater
 - 20.5. Challenges and future prospects
 - 20.6. Conclusions
- Index