YEAST

Biotechnology and Biocatalysis

edited by
Hubert Verachtert • René De Mot

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Hubert Verachtert
René De Mot
Catholic University of Leuven
Louvain, Belgium

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Bioprocess Technology

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Series Introduction

The revolutionary developments in recombinant DNA and hybridoma technologies that began in the mid-1970s have helped to spawn several hundred new business enterprises. Not all these companies are aimed at producing gene products or cell products, as such. Many are supportive in nature: that is, they provide contract research, processing equipment, and various other services in support of companies that actually produce cell products. With time, some small companies will probably drop out or be absorbed by larger, more established firms. Others will mature and manufacture their own product lines. As this evolution takes place, an explosive synergism among the various industries and the universities will result in the conversion of laboratory science into industrial processing. Such a movement, necessarily profit driven, will result in many benefits to humanity.

New bioprocessing techniques will be developed and more conventional ones will be revised because of the influence of the new biotechnology. As bioprocess technology evolves, there will be a need to provide substantive documentation of the developments for those who follow the field. It is expected that the technologies will continue to develop rapidly, just as the life sciences have developed rapidly over the past 10–15 years. No single book could cover all of these developments adequately. Indeed, any single book will be in need of replacement or revision every few years. Therefore, our continuing series in this rapidly moving field will document the growth of bioprocess technology as it happens.

The numerous cell products already in the marketplace, and the others expected to arrive, in most cases come from three types of bioreactors: (a) classical fermentation; (b) cell culture technology; and (c) enzyme bioreactors. Common to the production of all cell products or cell product analogs will be bioprocess control, downstream processing (recovery and purification), and bioproduct finishing and formulation. These major branches of bioprocess technology will be represented by cornerstone books, even though they may not appear first. Other subbranches will appear, and over time, the bioprocess technology "tree" will take shape and continue growing by natural selection.

W. Courtney McGregor

Preface

Ever since Pasteur's discovery (around 1870) that living organisms are capable of biotransformations and the discovery by the Buchner brothers and Hahn (1897) that cell-free extracts can do the same, there have been innumerable advances in the field of microbial biochemistry. In fact, these discoveries mark the birth of biochemistry.

The bacterium *Escherichia coli* became the subject of choice, but it should not be forgotten that the first living microbial cell ever observed was a yeast (by Anton van Leeuwenhoek around 1680) and that the first experiments with cell-free extracts were also done using yeast. Moreover, the first biochemical intermediates ever discovered in metabolism came from yeast, as evidenced by Harden and Young in 1905. Finally, the first application of pure yeast cultures in a biotechnological process probably was in the brewing industry, after the history-making work of Hansen in Denmark (around 1885). Later, the process was applied to the baking industry.

In spite of the sudden spectacular regained interest in technological processes involving living organisms, yeasts, at the beginning, seemed forgotten while *Escherichia coli* became the first listed in the many papers and patents providing data for improved or new biotechnological applications. With improved knowledge of yeast genetics and the strong development of the "new" yeast genetics involving protoplast fusion and genetic transformation using construction DNA, it was realized somewhat later that yeast might be the eukaryotic organism best suited for studies of biotransformations involving some eukaryotic proteins or enzymes. Also, for some industrial applications, yeasts remain of capital importance. Although ethanol production,

with bacteria, in which direct fermentation of cellulose yields solvents and ethanol, may present some advantages over yeast, a processing yeast is still preferable since the greater final ethanol concentration that can be reached is of primary importance from an economic point of view.

Just as yeast is the organism of choice for the production of alcoholic beverages, for the baking industry, and as a source of microbial proteins, its position in biotechnology remains unchallenged. Many interesting enzymes, such as amylases, inulinases, lactase, invertase, and possibly proteinases and lipases, are also produced by yeasts, and recent studies show that they may be valuable tools in applied biocatalysis.

Yeasts and yeastlike organisms form a large and heterogeneous group of fungi and comprise some 500 species. Only in the last decade have yeasts other than *Saccharomyces* been studied in more detail with respect to their biochemistry and enzymatic activities, and several promising features have been disclosed. It is our conviction that biocatalysis and biotechnology with yeasts merit all possible attention. It therefore seemed appropriate to assemble some of the more important and interesting data concerning the position of yeasts in the field of biotechnology and to provide some discussion on future developments, applications, and improvements of biological processes involving the yeasts. May our conviction and the following chapters stimulate all those working with the organism to pursue their efforts to gain a better knowledge of the yeasts: *les levures, die Hefen, levuduras, drozzi.*

We are glad to express our gratitude and appreciation to the specialists who have contributed to make this book possible and to the late Professor J. Frateur of our university, who introduced us to yeasts and their outstanding position in the living world.

Hubert Verachtert
René De Mot

Contributors

Robert F. Beudeker Department of Research and Development, Gistbrocades N.V., Delft, The Netherlands

Carl A. Bilinski Research Department, Labatt Brewing Company Limited, London, Ontario, Canada

Anthony G. Brooke* Laboratorium Microbiologie, University of Groningen, Haren, The Netherlands

Francisco J. Castillo Department of Cell Culture Development, Xoma Corporation, Berkeley, California

Ensaf Dawoud† Laboratory of Industrial Microbiology and Biochemistry, Catholic University of Leuven, Louvain, Belgium

René De Mot‡ Laboratory of Industrial Microbiology and Biochemistry, Catholic University of Leuven, Louvain, Belgium

Michel J. De Wilde Department of Molecular and Cellular Biology, Smith Kline Biologicals, Rixensart, Belgium

Pierre Galzy Chaire de Microbiologie, Industrielle et de Génétique des Microorganismes, Ecole Nationale Supérieure Agronomique de Montpellier, Montpellier, France

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Present affiliation:
*Fermentation Research Laboratories, RTZ Chemicals, ABM Sturge Division, John & E. Sturge Ltd., Selby, North Yorkshire, England
†Department of Microbiology, Caizo University, Giza, Egypt
‡F. A. Janssens Memorial Laboratory of Genetics, Catholic University of Leuven, Louvain, Belgium

Joseph-Pierre Guiraud Laboratoire de Microbiologie Industrielle, Centre de Génie et Technologie Alimentaries, I.S.I.M. Université des Sciences et Techniques du Languedoc, Montpellier, France

Wim Harder Department of Microbiology, University of Groningen, Haren, The Netherlands

Dirk Iserentant Department of Research and Development, Artois Piedboeuf Interbrew, Louvain, Belgium

Thomas W. Jeffries Institute for Microbial and Biochemical Technology, United States Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin

H. M. C. Shanta Kumara Laboratory of Industrial Microbiology and Biochemistry, Catholic University of Leuven, Louvain, Belgium

Cletus P. Kurtzman Microbial Properties Research, Northern Regional Research Center, Agricultural Research Service, United States Department of Agriculture, Peoria, Illinois

Minoru Nagashima Tsukuba Research Laboratories, Kyowa Hakko Kogyo Co., Ltd., Tsukuba City, Japan

Koichi Nakanishi* Laboratory of Brewing Science, Kirin Brewery Co., Ltd., Takasaki, Japan

Halina Y. Neujahr Department of Biochemistry and Biotechnology, The Royal Institute of Technology, Stockholm, Sweden

Colin Ratledge Department of Applied Biology, University of Hull, Hull, England

Graham G. Stewart Technical Affairs Group, Labatt Brewing Company Limited, London, Ontario, Canada

Kang-Hai Tan Fresh Meat Section, Science Division, Meat Industry Research Institute of New Zealand Inc., Hamilton, New Zealand

Henk W. van Dam† Department of Research and Development, Gist-brocades N. V., Delft, The Netherlands

Johannes B. van der Plaat Department of Research and Development/SCS, Gist-brocades N.V., Delft, The Netherlands

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Present affiliation:
*Department of Marine Biotechnology, Marine Biotechnology Institute Co., Ltd., Tokyo, Japan
†Technology and New Business Development Department, Food Ingredients Divison, Gist-brocades N.V., Delft, The Netherlands

K. Vellenga Department of Research and Development, Gist-brocades N.V., Delft, The Netherlands

Hubert Verachtert Laboratory of Industrial Microbiology and Biochemistry, Catholic University of Leuven, Louvain, Belgium

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