YEAST STRAIN SELECTION

edited by
Chandra J. Panchal

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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 20 years. No single book will cover all of these developments adequately. Indeed, some books 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 (separation 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

Although aware of yeasts and their usage in traditional biotechnology industries, such as bread making and wine and beer production, we microbiologists continue to be fascinated by the intricacies of these rather unique organisms, which have contributed immensely to human civilization (as well as suffering). The developments in molecular biology and genetic engineering have quite naturally lent themselves to a more thorough investigation of yeasts at the molecular level.

And what have we found? We have seen that yeasts, particularly *Saccharomyces cerevisiae* and some of the *Kluyveromyces* species, are readily amenable to genetic manipulation and possess many properties that make them ideal candidates for commercial exploitation as well as academic research. It has been learned that a whole host of foreign proteins can be quite readily produced in and secreted by yeast strains. It has also been revealed that some yeasts possess viruslike particles, and lately we have been exposed to the striking similarities between yeast transposable elements (Ty) and human retroviruses. We have recently, however, also been privy to information showing major differences among yeast strains, particularly between "laboratory" yeasts and "industrial" yeasts. Thanks to the much-refined techniques of DNA karyotyping, some of these differences have been revealed clearly and some of the similarities among the species and genera have been highlighted. An increasing amount of attention is being paid to usage

of yeasts for commercial production of novel biologicals; it seems pertinent that greater emphasis be placed on selection of appropriate yeast strains for the desired processes.

A look at how this is accomplished in the traditional bread, wine, and beer industries would help one assess the criteria used in these particular enterprises to select appropriate yeasts—a decision that could arguably be the single most important one in some of these industries. Chapters addressing these issues reveal that some aspects of classical yeast genetics as well as some aspects of yeast selection in nature play important roles. The criteria, however, are radically different from those used for selecting yeasts for the production of enzymes, amino acids, or heterologous pharmaceutical proteins. In the latter case, emphasis has been placed on stability of plasmid vector systems or the inability of host yeast strains to degrade foreign proteins. Should this be the case, or should some lessons be learned from a long and successful history of yeast usage in industry, and these be adapted for the more recent and novel needs in biotechnology? It is hoped that some of the answers will flow from the chapters of this book.

The editor wishes to thank the publisher for initiating the project and the production staff, particularly Elaine Grohman, for continued support and help in completing the book. Sincere appreciation and gratitude go to all the authors for their time, efforts, and dedication to completing the chapters and above all for their patience.

Chandra J. Panchal

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Contents

1

Culture Collections as Sources of Strains for Industrial Uses

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I. INTRODUCTION

The rapid advances taking place in biotechnology have introduced large numbers of scientists and engineers to the need for locating yeasts and other microorganisms that have a diversity of metabolic functions. Questions frequently raised by these researchers concern general sources of cultures, location of strains with particular properties, requirements for handling cultures, preservation methods, and even taxonomic relationships. This chapter will focus on these questions and emphasize the importance of culture collections as a primary source of unique strains and of information on these strains. The organisms maintained in culture collections have originated from a wide variety of substrates and from many parts of the world. Consequently, the culture collection offers access to strains of demonstrated industrial significance as well as to taxa of varied genotype whose properties are yet to be exploited.

II. MAJOR COLLECTIONS

Many of the world's major yeast collections are listed in Table 1. The reasons for which these collections were initially established vary, and as a consequence, this has influenced the types of germplasm that predominate. Most maintain

Table 1. Major Yeast Culture Collections

USA

Agricultural Research Service Culture Collection (NRRL), Northern Regional Research Center, 1815 N. University St., Peoria, IL 61604

American Type Culture Collection (ATCC), 12301 Parklawn Dr., Rockville, MD 20852

Culture Collection, Department of Food Science and Technology (UCD), University of California, Davis, CA 95616

Yeast Genetic Stock Center (YGSC), Department of Biophysics and Medical Physics, University of California, Berkeley, CA 94720

The Netherlands

Centraalbureau voor Schimmelcultures (CBS), Yeast Division, Julianalaan 67A, 2628 BC Delft

Japan

Institute for Fermentation (IFO), 17-85 Juso-honmachi 2-chome, Yodogawa-ku, Osaka 532

Japan Collection of Microorganisms (JCM), RIKEN, Hirosawa, Wako-shi, Saitama 351-01

United Kingdom

National Collection of Yeast Cultures (NCYC), AFRC Food Research Institute, Colney Lane, Norwich NR4 7UA

Federal Republic of Germany

Deutsche Sammlung von Mikroorganismen (DSM), Grisebachstrasse 8, D-3400 Göttingen

Czechoslovakia

Czechoslovak Collection of Yeasts (CCY), Institute of Chemistry, Slovak Academy of Sciences, Dubravska cesta 9, 84238 Bratislava

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USSR

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