

Current Developments in Yeast Research

Edited by

GRAHAM G. STEWART and INGE RUSSELL

ADVANCES IN BIOTECHNOLOGY

PERGAMON PRESS

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ADVANCES IN BIOTECHNOLOGY

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Current Developments in Yeast Research

ADVANCES IN BIOTECHNOLOGY

Proceedings of the
Fifth International Yeast Symposium
held in London, Canada, July 20-25, 1980

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Preface

The association between yeast and fermentation is an inseparable one. Consequently, it was logical to consolidate the Vth International Symposium on Yeasts (ISY) and the VIth International Fermentation Symposium (IFS) into a joint symposium. It was also most appropriate that the International Symposium on Yeasts should have been held in 1980, because it was exactly 300 years ago in 1680 that the Dutch draper Antonie van Leeuwenhoek reported the microscopic examination of yeast cells.

The group of microorganisms known as the "yeasts" is by traditional agreement limited to the fungi in which the unicellular form is predominant. Vegetative reproduction is usually but not always by budding. This group does not constitute a taxonomic entity, although it comprises subdivisions of narrowly related species. Compared to other major groups of microorganisms - algae, bacteria and protozoa - the yeasts are represented by comparatively few genera or species. It is thought that there are only about 350 species of yeast grouped into 39 genera.

Yeasts are, without doubt, both quantitatively and economically the most important group of microorganisms commercially exploited by man. The total amount of yeast produced annually, including that formed during brewing and in distilling practice, is in excess of a million tons and ethanol made for all purposes by fermentation processes involving yeast totals many millions of liters. The benefit to national exchequers is counted in billions of dollars.

No other group of microorganisms has been more intimately associated with the progress and well-being of the human race than the yeasts. Their contribution to man's progress has been based very largely on the capacity of certain yeasts to effect a rapid and efficient conversion of sugars into alcohol and carbon dioxide, and so conduct an alcoholic fermentation of sugary liquids such as grain extracts, grape juice and milk. It has often been said that yeasts are the oldest of cultivated plants.

Another major contribution which yeasts have made to man's progress has been the elucidation of the basic biochemical, metabolic and genetic processes of living cells. *Saccharomyces cerevisiae* and related species are currently much in favor, because they are eucaryotes that can be grown and analyzed genetically with

similar ease to bacteria. Many investigators emphasize that, although yeasts can be manipulated like procaryotes (bacteria and viruses), they are essentially similar to higher eucaryotes (plants and animals) in cellular structure and behavior. There are features of yeast structure and behavior however that are rather different from those of higher eucaryotes. Nevertheless, studies on yeasts have provided and will continue to provide valuable information that is pertinent to all eucaryotes.

This publication contains many of the papers that were presented at the Vth ISY. The papers are grouped into the following sections: Industrial and Agricultural Uses, Genetics, Sporulation and Conjugation, Biochemistry, Taxonomy and Ecology, Cell Cycle and a special symposium held by the former and present associates of Herman Phaff to honor their colleague. Each of these papers has been subjected to independent review. In addition three of the Plenary Lectures that opened the symposium are included.

A companion series to this publication entitled "Advances in Biotechnology" is comprised of three volumes based on the proceedings of the VI International Fermentation Symposium. The Tables of Contents of these three volumes are included at the end of this book as a service to our readers.

In the preparation of this book, invaluable assistance has been received from the panel of referees:

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Special gratitude is due to Margot and Udo Dargatz and Vivian Silberstein for proof-reading and re-writing many of the manuscripts, to Cathy Hanas and Barbara Kennedy for arranging and indexing the volume, and finally, but by no means least, to Joyce Wood for patiently re-typing and correcting many of the papers.

March, 1981
London and Ottawa
Canada

G. G. Stewart
I. Russell
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M.-A. Lachance
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Section I
Industrial and Agricultural Uses

1. YEAST - ALCOHOL PRODUCTION AND BREAD MAKING

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ABSTRACT

Aspects of fuel alcohol production, aroma of alcoholic beverages and leavening of bread, in all of which yeast plays a decisive role, are described.

KEYWORDS

Yeast, fuel alcohol, aroma, esterases, baking, baker's yeast production

FUEL ALCOHOL

The energy crisis has made the terms exploitation of renewable natural resources, liquefaction of biomass, fuel alcohol and gasohol known to the public at large, and in many parts of the world unprecedented efforts are being concentrated on the problems associated with the liquefaction of biomass. One link in the long and complicated process chain is extremely familiar: the alcoholic fermentation with yeast. The several stages of the processes involved and the whole production philosophy need to be rethought from beginning to end. Three main principles must be kept in mind when modifying the processes:

- efficiency of conversion to ethanol (yield)
- energy consumption (conservation)
- effluent pollution (environmental protection)

It is so, however, that plants continue to be built using conventional technology and ignoring these three principles: a prime example being Brazil. The alcohol industry there is based mainly on sugar cane, and waste bagasse from the cane, when burnt, provides so much energy that it is not thought necessary to include energy-saving designs in the process.

Calculations show that cultivating 2 % of the land area of Brazil with sugar cane would provide raw material for enough alcohol to replace all imported oil, which is currently 80 % of the total consumption. Of course, on the European scale this 2 % of Brazil's land area would be substantial, e.g. more than 30 % of the German Federal Republic. This gives some idea of the magnitude and the possibilities in Brazil.