

The background of the cover is a microscopic image of a neuron. The cell body and its branching processes are stained with a green fluorescent dye, while the surrounding environment and some internal structures show red fluorescence. The overall image has a dark, almost black, background, making the fluorescent colors stand out.

ADVANCED PROCESS BIOTECHNOLOGY

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**ADVANCED
PROCESS BIOTECHNOLOGY**

**This volume is edited in loving memories of
my parents, teachers, in-laws and well wishers and
for remembrance of 80th year of
Dr. Tarun K. Ghose,
Formerly Professor and Founding Head of BERC / DBEB,
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PREFACE

The editor of this volume/book had great opportunities to conduct his designed short term courses. He invited a large number of experienced and distinguished/established expert teachers/scientists to join in summer/winter to teach college teachers/scientists/scholars of various organizations' short-term course topics on advanced process biotechnology areas. Also he himself delivered a large number of lectures in various national and international course-cum-symposia and other courses. These courses were funded by various agencies and Govt. of India to make the area updated. This book has emerged mostly from the lectures delivered at different continuing education programme (CEP) and quality improvement programme (QIP), short term designed courses sponsored by DBT, MHRD, GOI. Most of the topics of this book represent the forefronts of Biochemical Engineering and Process Biotechnology advances/developments. The key lecture 'Patenting of Life Forms' delivered by Tarun K. Ghose, Formerly Professor and Founding Head, BERC/DBEB, IIT Delhi, in one of such courses has a great bearing to the profession of Biochemical Engineering and Biotechnology. It will provide readers of this book essential concerns of patenting living systems and product in the progress of biotechnology.

Process biotechnology fundamental principles and concepts have used system biology for various purposes. It has shown many possibilities. In more recent years advanced process biotechnologies have delivered many commercially/industrially important products and devices. These advancements have convinced many institutes/universities and industries that process biotechnology practice is one of the key areas for research based education encompassing new biology, biochemical/chemical engineering, food engineering and technology, and biotechnology disciplines in general. Biologists, physical, chemical and computer scientists, engineers and technologists with motivations and devotions in bioprocessing systems are contributing significantly towards advancing process biotechnology for the years to come.

All the chapters included in this edited volume have a great relevance in the new wave of current excitements and activities all over the world relating to modern biochemical engineering and biotechnology concerning very important R&D and industrial/commercial breakthrough achieved over the last few decades. These led to put so much efforts in basic, applied and advanced research based academics on the frontiers of biotechnology using engineering science principles and practices.

The contents of this book have been divided into four sections. Section I has included advanced cell biology in advancing process biotechnology. Section II includes topics and concerns of advanced upstream process biotechnology. Section III describes some of the advanced concerns of downstream processing in recovery and purification of process biotechnology products. Finally Section IV provides readers with some of the miscellaneous industrial concerns in process biotechnology sectors. Further reading references have also been provided in all chapters. On the whole for advanced level readers/students and for self/independent study in the area, this book will provide many new ideas.

The editor acknowledges with thanks the help received from DBT, DST, MHRD, GOI and IIT Delhi authority, faculty and staffs involved in the courses, participating universities/institutes, R&D sectors and industries in compiling the contents of this book. Also, he is grateful to the authors/contributors of the chapters who submitted their short articles in time. Like in earlier times encouragements received from my wife Sakuntala and daughter Paromita are highly acknowledged. In producing this academic deliverable materials in form of edited book appreciations received from my son Parag and daughter-in-law Pooja at Duke University, USA are also highly acknowledged.

Indeed it was great opportunities for the editor to organize the sponsored short-term courses and to deliver lectures to be able to put through this volume.

Finally, the editor thanks Mr. Nishikant Choudhary and the entire involved team of Viva Books Private Limited, for their keen interest in the publication of this volume.

S.N. Mukhopadhyay
Editor

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Section I : Advanced Cell Biology Concerns in Advancing Process Biotechnology

CHAPTER 1

Patenting of Life Forms

Tarun K. Ghose*

The first international organization that took note of and reacted to the upbeat of new biotechnology was the Organization of Economic Cooperation and Development (OECD).

Some key expressions of concepts of biotechnology include (a) biotechnology and genetic engineering are new (b) in biotechnology the unknown outweighs the known, (c) in the not so distant future non-pathogens will be transformed into pathogens and this may help creation of novel and dangerous organisms and the “New Biotechnology” will then produce new knowledge that may no longer be called biotechnology; physical and mathematical sciences will be intensively employed to help unfolding new areas of biotechnology.

Biotechnology's diversity imposes the regulations of so many end uses which must be accomplished by several government agencies. The end uses vary, so do agencies' jurisdiction and the nature of evaluation of the products. For example, a review of an enzyme used as a drain cleaner will be different from a review of the same enzyme injected into patients to disperse blood clots by another agency. The diversity of products and their applications argue against the usefulness of legislation or regulation that attempt to encompass unrealistic grouping which may occur under the general form of biotechnology such as genetically manipulated organisms or planned introduction of a compatible gene. The degree of novelty of microbes or those created by genetic recombination techniques has been both widely and poorly exaggerated. More than a dozen microbial biocontrol agents are approved and registered with Environmental Protection Agency (EPA) USA, some year ago; these organisms are sold as several different products for end use in agriculture, forestry and in homes.

It may be pointed out that the record of laboratory use of recombinant DNA (rDNA) techniques supports the prediction that the probability of inadvertently creating an organism capable of producing a medical or agricultural catastrophe must be vanishingly small. Despite the annual release of recombinant organism per investigator being in the order of ten to the power seven (10^7) from the standard BL-1 biosafety level laboratory (EPA, 1992) for more than 15 years, not a single adverse reaction has so far been observed in humans, animals or the environment.

* Based on key lecture delivered in CEP course “Conventional and Transfectional Fermentation Process Biotechnology” sponsored by DBT, Govt. of India, at DBEB, IIT Delhi, 1998.

INITIATIVES IN THE USA AND EUROPE

In applying the basic rules which the United States Supreme Court (US-SC) developed in 1980 (Diamond vs. Chakrabarty case) the US Patent and Trademark Office (US-PTO) granted numerous patents for many biotechnological processes such as the process of recombinant DNA techniques, micro-injection or hybridoma techniques (Cooper, 1982) and full length of gene sequences, viruses, plasmids, cell lines and monoclonal antibodies (Mab) (Figure 1.1). The first patent for a transgenic animal named “Harvard onco mouse” was issued by the USPTO in April 1988 (Markey, 1989). Following this patent several bills purporting to impose moratorium on animal patenting in respect of small farmers have been introduced into the US Congress. Interestingly, none of these bills were adopted (Delevia, 1992) and in course of next four years 145 patent applications claiming new animal life forms were pending before the PTO and by Dec. 1992 three further mouse patents were granted. Regarding reported applications of National Institute of Health (NIH) claiming protection of DNA stretches having yet unknown functions, it was finally rejected by the PTO examiner for lack of utility and/or novelty. NIH did not appeal the rejection. Moreover, NIH withdrew another patent application claiming 4446 additional sequences.

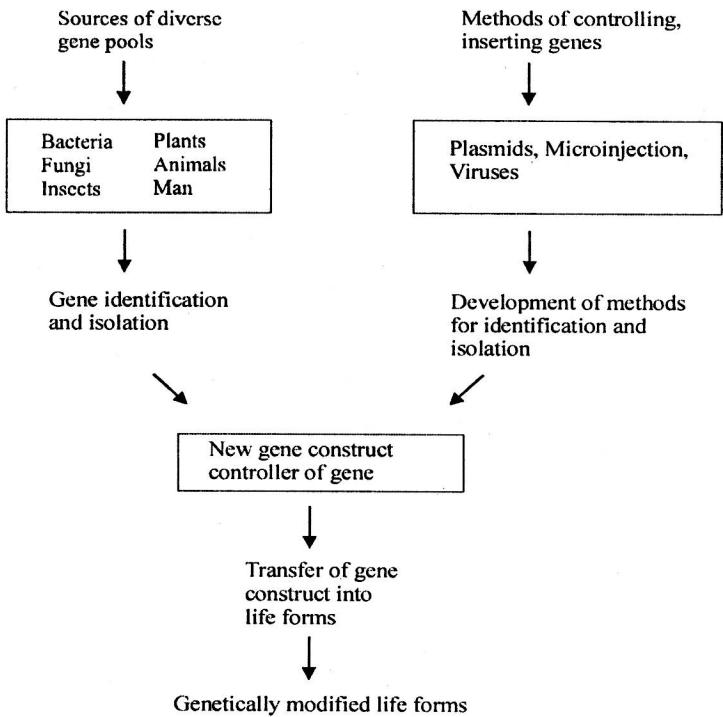


Fig. 1.1. Steps in genetic manipulation