

ADVANCES IN MICROBIOLOGY

Editor

Pravin Chandra Trivedi

Ph.D., Post-Doct. (U.S.A.), F.L.S., F.B.S.,
F.P.S.I., F.N.S.I., F.B.R.S., F.M.A., F.E.S.

Professor of Botany,
University of Rajasthan,
Jaipur - 302 004, India



SCIENTIFIC PUBLISHERS (INDIA)
P.O. BOX 91 JODHPUR

Published by:
PAWAN KUMAR
Scientific Publishers (India)
5-A, New Pali Road, P.O. Box 91
JODHPUR - 342 001
Tel.: +91-291-2433323
Fax: +91-291-2512580
E-mail: scienti@sancharnet.in
<http://www.scientificpub.com>

© Trivedi, P.C., 2003

ISBN : 81-7233-332-3

Lasertype set : Rajesh Ojha
Printed in India

***Dedicated to
My Teacher
Dr. SUDHAKAR MISHRA***

LIST OF CONTRIBUTORS

A.K.Mathur

Atomic Minerals Division for Exploration and Research, BARC, Hyderabad

A.N. Balakrishna

Dept. of Agricultural Microbiology, University of Agricultural Sciences,
G.K.V.K. Campus, Bangalore - 560 065

Arun Sataraddi

College of Agriculture, Raichur - 584 101

B.V. Singh

National Centre for Conservation and Utilisation of Blue Green Algae, IARI,
New Delhi - 110 012

C.K.M. Tripathi

Fermentation Technology Division, Central Drug Research Institute,
Chattar Manzil Palace, Lucknow - 226 001

Chandra B. Sharma

Dept. of Microbiology, SBS (PG) Institute of Biomedical Sciences & Research,
Balawala, Dehradun - 248 161

D.A. Sumana

Dept. of Agricultural Microbiology, University of Agricultural Sciences,
G.K.V.K. Campus, Bangalore - 560 065

D.J. Bagyaraj

Dept. of Agricultural Microbiology, University of Agricultural Sciences,
G.K.V.K. Campus, Bangalore - 560 065

Deepak Chand Sharma

Department of Microbiology, University of Delhi, South Campus, Benito Juarez Road,
New Delhi - 110 021

Devyani, S. Nath

Division of Biochemical Sciences, National Chemical Laboratory, Pune - 411 008

Dolly Wattal Dhar

National Centre for Conservation and Utilisation of Blue Green Algae, IARI,
New Delhi - 110 012

G. Prasad

Dept. of Veterinary Microbiology, CCS Haryana Agricultural University, Hisar - 125 004

Geeta Singh

Division of Microbiology, Indian Agricultural Research Institute, New Delhi - 110 012

H. Polasa

Department of Microbiology, Osmania University, Hyderabad - 500 007

I.K. Sharma

Central Ground Water Board, State Unit Office, Kangra, H.P.

Jyoti Saxena

Dept. of Bioscience and Biotechnology, Banasthali Vidyapith,
P.O. Banasthali Vidyapith - 304 022 (Raj.)

K. Kumar

Azolla Laboratory, Tamilnadu Agricultural University, Coimbatore - 641 003 (TN)

M.K. Naik

College of Agriculture, Raichur - 584 101

M.N. Sreenivasa

College of Agriculture, Raichur - 584 101 (Karnataka)

Mahadeva Swamy

College of Agriculture, Raichur - 584 101 (Karnataka)

Mala B. Rao

Division of Biochemical Sciences, National Chemical Laboratory, Pune - 411 008

Minakshi

Dept. of Veterinary Microbiology, CCS Haryana Agricultural University, Hisar - 125 004

N. Anuradha

Department of Microbiology, Osmania University, Hyderabad - 500 007

N.S. Sashidhar

Department of Microbiology, Osmania University, Hyderabad - 500 007

Nandita Ashtaputre

Central Institute for Research on Cotton Technology, ICAR, Adenwala Road,
Matunga, Mumbai - 400 019

O.N. Tiwari

National Centre for Conservation and Utilisation of Blue Green Algae, IARI, New Delhi - 110
012

P. Kaushik

Department of Botany and Microbiology, Gurukul Kangri University, Haridwar - 249 404

P.C. Trivedi

Department of Botany, University of Rajasthan, Jaipur - 302 004

P.K. Singh

National Centre for Conservation and Utilisation of Blue Green Algae,
IARI, New Delhi - 110 012

P.S. Jain

Department of Botany, University of Rajasthan, Jaipur - 302 004

Padmanabh Dwivedi

Dept. of Botany, Arunachal University, Rono Hills, Itanagar - 791 111

R.H. Balasubramanya

Central Institute for Research on Cotton Technology, ICAR, Adenwala Road,
Matunga, Mumbai - 400 019

R.K.S. Kushwaha

Department of Botany, Christ Church College, Kanpur - 208 001

S. Bhosle

Dept. of Microbiology, Goa University, Taleigao Plateau, Goa

S. Borkar

Dept. of Microbiology, P.E.S. College, Farmagudi, Ponda, Goa

S. Kannaiyan

Azolla Laboratory, Tamilnadu Agricultural University, Coimbatore - 641 003 (TN)

S.K. Dwivedi

Department of Environmental Science, B.B. Ambedkar University,
Rae Bareli Road, Lucknow - 226 025

S.S. Kanwar

Department of Microbiology, College of Basic Sciences,
Himachal Pradesh Agricultural University, Palampur - 176 062

Sanjay Gupta

Dept. of Microbiology, SBS (PG) Institute of Biomedical Sciences & Research, Balawala,
Dehradun - 248 161

Saroj Bhosle

Department of Microbiology, Goa University, Taleigao, Plateau, Goa - 403 206

Sudeep P. George

Division of Biochemical Sciences, National Chemical Laboratory, Pune - 411 008

Sunita Devi

Department of Microbiology, College of Basic Sciences,
Himachal Pradesh Agricultural University, Palampur - 176 062

T. Satyanarayana

Department of Microbiology, University of Delhi, South Campus,
Benito Juarez Road, New Delhi - 110 021

Upal Roy

Department of Microbiology, Goa University, Taleigao, Plateau, Goa - 403 206

Vinay Sharma

Dept. of Bioscience and Biotechnology, Banasthanli Vidyapith,
P.O. Banasthali Vidyapith - 304 022 (Raj.)

Vinod Bihari

Fermentation Technology Division, Central Drug Research Institute,
Chattar Manzil Palace, Lucknow - 226 001

Yashpal Malik

Dept. of Veterinary Microbiology, CCS Haryana Agricultural University, Hisar - 125 004

PREFACE

Microbiology has become increasingly useful to our society now, and it has emerged as one of the most important branch of the Life sciences. Microbiologist have made significant contributions to basic biological science as well as in the applied areas of public health, medical sciences, agriculture, industry and environmental sciences. The most dramatic current development in applied microbiology is due to development of genetic engineering and recombinant DNA technology. Using these techniques, microorganism can be engineered through modification of its DNA to produce new substances such as human proteins. Bacteria have been modified to produce human insulin and interferon. Genetically engineered microorganisms hold great potentials for the production of drugs and vaccines, for improvement of agricultural crops and for other products and processes. There is growing recognition of the potential of microorganisms in many applied areas. The ability of micro-organisms to decompose materials such as — herbicides, pesticides and oils in oil spills, the potential of microorganism as food supplement, the exploitation of microbial activity to produce methane gas as energy sources for rural consumption and the potential of new therapeutic substances produced by microorganisms — these are and the other uses of microorganisms are also becoming attractive. Bio-remediation processes use microorganisms to clean-up toxic wastes. Microorganisms are being used as biological control agent for pests. In gene therapy, viruses are used to carry replacements for defective or missing genes into human cells. Genetically engineered bacteria are used in agriculture to protect plants from frost and insects and to improve the shelf-life of produce.

This book “Advances in Microbiology” provides a comprehensive and critical review of the work done on different areas of microbiology including agriculture, industry, medical science, bioremediation etc. The book contains 24 chapters, which include informations on the status of microbial diversity, applications of biosensors, *Azolla* as biofertilizer, *Frankia* - nitrogen fixing actinomycetes, extraction of metals from ores using bacteria, alkaliphiles, citric acid fermentation, biodiversity of cyanobacteria, microbial degradation of xenobiotics etc. Aspects, covering biotechnological applications of microbes for improved plant productivity and new approaches for development of vaccines have been

specially included to project out their role and use in the twenty-first century. Comprehensive account of microbes in the management of soil borne diseases and plant parasitic nematodes throw light on the importance of microbes in the management of plant pests.

This festschrift — *Advances in Microbiology* is a humble dedication to Dr. S. Mishra and to commemorate his outstanding contribution in the field of General Botany and Phytoplasma in particular. Dr. Mishra is a dedicated teacher and an accomplished researcher, which is testified by students who got their doctoral degree under his able supervision. He has published many research papers, completed research projects and participated in many national and international conferences. Dr. Mishra has been the sole worker in the field of Mycoplasma at the University of Rajasthan. He is a voracious reader and has a rich personal library. Dr. Mishra is not an armchair academician and is actively associated with science education centre and has extensive field knowledge. He taught me microbiology and molecular biology during my M.Sc., I wish and pray for a long, sustained creative life for him for many many more years to come.

The publication of this book could not have been possible without the sincere cooperation and hard work of the contributors. They are all specialists in their respective fields. Therefore, I have tried to honour their ideas in the original shape. While dealing with such a voluminous work, errors are likely to occur despite my best efforts. However, the onus of technical contents rests with the contributors.

I am highly thankful to all the learned contributors for their cooperation in compiling useful information on various facets of microbiology. I am sure, this detailed account on a wide variety of subjects will be of great help to researchers and teachers of microbiology and for planning future strategies for the development world over.

I wish to thank my wife Kusum, daughter Priyanka and son Rohit, who extended their cooperation in many invisible ways to me. I highly appreciate the all-round cooperation and support of Mr. Pawan Kumar, Scientific Publishers (India), Jodhpur for printing and publishing this book with patience, care and interest.

JAIPUR

P.C. Trivedi

CONTENTS

<i>Preface</i>	v
<i>List of Contributors</i>	vii
1. Significance and status of Microbial diversity	1-14
— <i>D.C. Sharma and T. Satyanarayana</i>	
2. Biosensors and their applications	15-26
— <i>S.S. Kanwar and Sunita Devi</i>	
3. Thermophilic xylanases — Molecular and biotechnological perspectives	27-41
— <i>S.P. George, D.S. Nath and M.B. Rao</i>	
4. Potential use of <i>Azolla</i> biofertilizer in sustainable rice production	43-58
— <i>K. Kumar and S. Kannaiyan</i>	
5. Phosphate solubilizing activity of microbes and their role as biofertilizer	59-73
— <i>Jyoti Saxena and Vinay Sharma</i>	
6. <i>Frankia</i> — A promising nitrogen fixing Actinomycetes	75-86
— <i>Mahadeva Swamy, M.N. Sreenivasa and M.K. Naik</i>	
7. Endophytic association of <i>Azorhizobium caulinodans</i> for nodulation and nitrogen fixation in Cereal crops	87-101
— <i>S. Kannaiyan and K. Kumar</i>	
8. Extraction of metals from ores using bacteria — A review	103-118
— <i>N. Anuradha, N.S. Sashidhar and H. Polasa</i>	
9. Biological remedies for groundwater pollution	119-127
— <i>R. Kaushik and I.K. Sharma</i>	
10. Optimization of factors affecting nickel bioleaching by two strains of <i>Thiobacillus ferrooxidans</i>	129-134
— <i>N. Anuradha, A.K. Mathur, N.S. Sashidhar and H. Polasa</i>	
11. Development of new antimicrobial agents — Issues and options	135-143
— <i>C.K.M. Tripathi and Vinod Bihari</i>	

12.	Biotechnological approaches in management of soilborne diseases — <i>M.K. Naik, Mahadevaswamy and Arun Sataraddi</i>	145-156
13.	Keratin colonizing Fungal Flora — <i>R.K.S. Kushwaha</i>	157-173
14.	Alkaliphiles — Microbes in alkaline environments — <i>S. Borkar and S. Bhosle</i>	175-209
15.	A novel inexpensive technique for isolation of Anaerobes — <i>Nandita Ashtaputre and R.H. Balasubramanya</i>	211-214
16.	Development and structure of nodules in Leguminous weeds — <i>P.S. Jain</i>	215-225
17.	Emerging new approaches for development of Vaccines — <i>G. Prasad, Minakshi and Yashpal Malik</i>	227-262
18.	Phosphate solubilising microbial systems — <i>Geeta Singh</i>	263-272
19.	Biotechnological application of microbes for improved plant productivity — <i>S.K. Dwivedi and P. Dwivedi</i>	273-280
20.	Mycorrhizal fungi as deterrents of root pathogens — <i>D.A. Sumana, A.N. Balakrishna and D.J. Bagyaraj</i>	281-291
21.	Microbial degradation of Xenobiotics in Marine environment — <i>Upal Roy and Saroj Bhosle</i>	293-301
22.	Biodiversity of <i>Cyanobacteria</i> — <i>B.V. Singh, O.N. Tiwari, Dolly Wattal Dhar and P.K. Singh</i>	303-319
23.	Citric acid fermentation — A current perspective — <i>Sanjay Gupta and Chandra B. Sharma</i>	321-340
24.	Microbes in the management of plant parasitic nematodes — <i>P.C. Trivedi</i>	341-355
	INDEX	357-367