71

Advances in Biochemical Engineering/Biotechnology

Managing Editor: T. Scheper

Springer

Berlin
Heidelberg
New York
Barcelona
Hong Kong
London
Milan
Paris
Singapore
Tokyo

Biopolyesters

Volume Editors: W. Babel, A. Steinbüchel

With contributions by
J.-U. Ackermann, W. Babel, U. Breuer, J. Choi,
G. Eggink, S. Hein, D. Jendrossek, B. Kessler,
Y. B. Kim, S. Kobayashi, P. E. Kolattukudy,
S. Y. Lee, R. W. Lenz, Y. Poirier, G. J. M. de Koning,
A. Steinbüchel, H. Uyama, G. A .M. van der Walle,
R. A. Weusthuis, B. Witholt

Springer

Advances in Biochemical Engineering/Biotechnology reviews actual trends in modern biotechnology. Its aim is to cover all aspects of this interdisciplinary technology where knowledge, methods and expertise are required for chemistry, biochemistry, microbiology, genetics, chemical engineering and computer science. Special volumes are dedicated to selected topics which focus on new biotechnological products and new processes for their synthesis and purification. They give the state-of-the-art of a topic in a comprehensive way thus being a valuable source for the next 3–5 years. It also discusses new discoveries and applications.

In general, special volumes are edited by well known guest editors. The managing editor and publisher will however always be pleased to receive suggestions and supplementary information. Manuscripts are accepted in English.

In references Advances in Biochemical Engineering/Biotechnology is abbreviated as Adv. Biochem. Engin./Biotechnol. as a journal.

ISSN 0724-6145
ISBN 3-540-41141-0
Springer-Verlag Berlin Heidelberg New York

Library of Congress Catalog Card Number 72-152360

Springer-Verlag Berlin Heidelberg New York
a member of BertelsmannSpringer Science+Business Media GmbH

Printed in Germany

Typesetting: Fotosatz-Service Köhler GmbH, Würzburg
Cover: E. Kirchner, Heidelberg
Printed on acid-free paper SPIN: 10719473 02/3020hu – 5 4 3 2 1 0

Preface

Living systems synthesize seven classes of polymers. Some of them, for instance water insoluble polyesters, have become commercially attractive. Water insoluble polyesters are synthesized by a wide range of different prokaryotic microorganisms including eubacteria and archaea mostly as intracellular storage compounds for energy and carbon. They represent a rather complex class consisting of a large number of different hydroxyalkanoic acids and are generally referred to as polyhydroxyalkanoates (PHA). Water insoluble polyesters are also synthesized by plants as structural components of the cuticle that covers the aerial parts of plants. Eukaryotic microorganisms and animals are not capable of synthesizing water insoluble polyesters; only some eukaryotic microorganisms have been known which can synthesize the water soluble polyester polymalic acid.

The water insoluble polyesters possess interesting properties. They are biodegradable and biocompatible and exhibit physical and material properties making them suitable for various technical applications in industry, agriculture, medicine, pharmacy and some other areas. The microbial polyesters can be produced easily by means of well-known fermentation processes from renewable and fossil resources and even from potentially toxic waste products. However, the price of PHAs is rather high compared with conventional synthetic polymers. If we want to use these biopolymers, it is necessary to improve the economic viability of production process. Therefore, a lot of research work has been done. During the last decade significant progress has been made in elucidating the physiological, biochemical and genetic basis for the biosynthesis and biodegradation of these polyesters and also in developing effective process regimes. Novel applications have been found. The synthesis and intracellular as well as extracellular depolymerization of these polyesters are now understood quite well. The genes encoding the enzymes of the pathways or structural proteins attached to the PHA granules in bacteria have been cloned and characterized from many bacteria. The availability of this knowledge has contributed significantly to establishing new processes for the production of PHAs by means of recombinant bacteria and to tailoring the properties of these polyesters for instance by modifying the synthesis. Meanwhile production of PHAs by transgenic plants has come about, too, and in addition to the in vivo synthesis, purified enzymes are used to prepare this type of polyester in vitro.

This issue of Advances in Biochemical Engineering/Biotechnology presents 10 chapters dealing with different aspects of polyesters from microorganisms

and plants, the biochemistry and molecular biology of the synthesis and degradation as well as the technical production and applications of these polyesters. It provides the state-of-the-art knowlegde in this rather rapidly developing, exciting and promising area.

The volume editors are indebted to the authors for their excellent contributions and cooperation in assembling this special volume.

November, 2000 Wolfgang Babel, Alexander Steinbüchel

Contents