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## Book Review

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Kirk, T. K.; Higuchi, T.; Hou-Min Chang (ed.): **Lignin Biodegradation: Microbiology, Chemistry, and Potential Applications**. Vol. I, 241 pp., Vol. II, 255 pp. Boca Raton, Florida: CRC Press 1980. Vol. I: US \$ 66.95. Outside US \$ 76.95. Vol. II: US \$ 69.95. Outside US \$ 79.95

The biodegradation of lignin is a very complex process because of the irregular structure of the substrate and the complicated interaction between the various microorganisms and enzyme systems involved. It is therefore not surprising that, in spite of many years' work, the understanding of the process is still incomplete. During the past two decades, results from studies of the biosynthesis of lignin and its analytical composition have led to a fairly good insight into the structural features characteristic of this natural polymer. This has made possible increased research efforts in the field of lignin biodegradation with the aim of elucidating the role of lignin in the earth's carbon cycle and, hopefully, also finding industrial applications for ligninolytic systems. Considerable progress has been made in the past 7–8 years and valuable results continue to be reported at a steadily increasing rate. As is true of all rapidly developing areas, there is a great need for collecting and summarizing the results obtained at certain intervals.

The international seminar on lignin biodegradation, held in May 9–11, 1978 at the US Forest Products Laboratory in Madison, Wisc., filled this need very well. A group of 43 researchers met to present their results, including their unpublished work, and to define the state-of-the-art in this field. The proceedings of this seminar have been collected in the present two volumes containing 11 and 16 chapters, most of them written by widely recognized experts. The three subject areas indicated in the book's title are well covered by the contributions.

After a short review of the biosynthesis and morphological distribution of lignin (Chapter 1), the microbial catabolism of lignin-related aromatic compounds is summarized (Chapter 2). Following these two introductory chapters, modern methodology in the study of lignin biodegradation using  $^{14}\text{C}$ -labelled synthetic and natural lignins is described in Chapter 3. This method of isotope labelling of the substrate is employed in some of the following papers dealing with the chemistry of soil humus formation (Chapter 4) and the degradation of lignin by micro- and macrofungi and by bacteria (Chapter 6). Remarkable progress in the elucidation of the chemistry of the lignin biodegradation is reported in the last four chapters of Vol. I. These are concerned with the microbial degradation of dehydrogenation polymerizates (DHPs) (Chapter 8) and of dilignols (Chapter 9) from coniferyl alcohol, with stereobiochemical aspects of the degradation process (Chapter 10), and with the characterization of lignin isolated from wood decayed by white-rot fungi (Chapter 11).

The importance of phenol oxidases and the possible role of cellobiose: quinone oxidoreductase in the microbial degradation of lignin is the subject of the first three chapters of Vol. II. Various culture parameters important for the development of ligninolytic activity are discussed in Chapter 4, and a genetic method for selecting mutants with high lignin degradation capacity is

reported in Chapter 5. The isolation of lignin-decomposing actinomycete strains by enrichment techniques is described in Chapter 7. Fungal (Chapter 6) and bacterial (Chapters 6, 8 and 9) metabolism and degradation of lignin-related compounds are also treated in Vol. II. Improved understanding of microbial lignin degradation has resulted in some possible applications that merit further studies. The synthesis of biodegradable polymers (lignin-related polystyrenes) containing structures susceptible to ligninolytic systems is one example given in Chapter 10. Microbial treatment of effluents containing lignin-derived wastes (Chapters 11 and 12) and microbial delignification to improve digestibility by cellulases (Chapter 13) or to reduce energy requirements for mechanical pulping (Chapter 14) constitute further intriguing possibilities.

A book comprising 27 chapters by 42 contributors is necessarily heterogeneous in nature and contains overlapping parts and sometimes even disturbing repetitions. The number of such repetitions has been kept at a low level. Another shortcoming, usually encountered in a book composed of different papers, is the lack of a clear overall disposition of the material presented. In this respect, it might have been of value to group the contributions under appropriate main headings, corresponding to the subtitles of the book. Fortunately, such a disposition is followed in the final chapter (Chapter 16) in which the editors summarize the content of the two volumes and of the discussions that took place at the Madison seminar. This chapter illustrates in an excellent way the considerable progress made in recent years in our understanding of lignin biodegradation and also suggests important topics of future research to fill the remaining gaps in our present knowledge. It would have been desirable if this chapter had also contained a brief comparison between microbial and purely chemical oxidative degradation of lignin. It is repeatedly stated in the book that lignin biodegradation is an aerobic process and that the metabolic pathways are restricted to "the feasibility of chemical reactions". There is, however, not a single reference to the non-enzymatic oxidative degradation of lignin. The chemical reactions of the latter process have been extensively studied using similar methods, model compounds and lignin preparations, and the results obtained could have been used, at least in part, to support the proposed mechanisms of the biodegradation.

The illustrations are of high quality. A subject and a chemical index at the end of the book together with the numerous citations of recent literature in the papers make these proceedings also very useful as a reference book. The very high price of this book could probably have been reduced, and the homogeneity would undoubtedly also have been improved if the two volumes had been combined into one.

Despite these few critical comments, this book can be warmly recommended to all who wish to be thoroughly informed about the present state of research in the rapidly expanding field of lignin biodegradation. The editors are to be congratulated for an outstanding work which certainly will stimulate continued research efforts in this area.

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