

# Preface

Hemicellulose, the second most abundant polysaccharide in nature, is well suited for the production of value-added products like xylitol, ethanol, protein rich food and fodder due to its enormous availability, low cost and environmentally benign process. In general, the major fraction in hemicellulose is pentosans (xylan), and the microbial conversion of xylan into xylitol is now possible on an industrial scale. D-Xylitol is found in low content as a natural constituent of many fruits and vegetables. It is a five-carbon sugar polyol and has been used as a food additive and sweetening agent to replace sucrose, especially for non-insulin dependent diabetics. It has multiple beneficial health effects such as the prevention of dental caries, osteoporosis and acute otitis media. In industries, it has been produced by chemical reduction of D-xylose, presented in xylan. Advancements in biotechnology such as screening of microorganisms, manipulation of pentose-utilizing microorganisms by molecular biology-based approach modifications, developments in fermentation processes and downstream processing could enhance the production of xylitol. Commercially, cheaper sources of carbohydrates, derived from photosynthetic biomass and modified fermentation conditions, could lead to more cost-effective production of xylitol. These methodologies would open new markets and create new applications of xylitol. This book was written keeping in mind the fundamental aspects of hemicellulose break-down into its monomeric constituents: D-xylose utilization for xylitol production by different bioconversion methods, xylitol recovery and its analysis in laboratories, economic evaluation and diverse applications of xylitol.

This book has been divided into five parts. Part I deals with the different kinds of hydrolytic methods applied to different kinds of biomass sources for xylose recovery and detoxification of xylose rich hydrolysates. In this part, three chapters are included. [Chapters 1 and 2](#) highlight the hydrolytic methods for hemicellulosic fraction of various lignocellulosic materials. For depolymerisation of the hemicellulosic fraction of the plant cell wall, generally acid-catalysed processes are employed at high temperature and pressure. During the deconstruction of hemicelluloses, other unwanted products such as furans, phenolics and weak acids are also generated in addition to sugars. It is necessary to eliminate these inhibitors

from the hydrolysates prior to fermentation in order to get satisfactory product yields and productivities. [Chapter 3](#) summarizes the different methods explored for detoxification of lignocellulose hydrolysates. Part II aims to explore the microorganisms, media formulations, and fermentation methods, as well as the enzymatic production of xylitol and bioenergetics analysis for xylitol production. This part constitutes the major part of the book and contains six chapters. Microbial strains, particularly yeasts used for xylitol production, metabolic pathways, physiological pathways, strain improvement methods, statistical optimization of various influential parameters, fermentation strategies and enzymatic production of xylitol have been discussed in detail in [Chaps. 4–8](#), respectively. In addition, bioenergetic analysis of xylitol production (carbon balance and xylitol yields, and productivities from different kind of substrates adopting various fermentative strategies) employing different microorganisms has been summarized in [Chap. 9](#). Part III describes the xylitol recovery and the analytical methods explored for xylitol quantification. [Chapter 10](#) is concerned with xylitol recovery and crystallization from chemical synthesis and biotechnologically-based production strategies. [Chapter 11](#) presents an appraisal on the analytical methods for xylitol quantification. Analysis on economic feasibility of biotechnological production of xylitol and market demand has been summarized in Part IV. [Chapter 12](#) describes the key factors which influence the large-scale production of xylitol. This chapter concludes the technological barriers and methods to overcome for successful xylitol production on an industrial scale. [Chapter 13](#) provides an overview on commercialization of xylitol, economic analysis of fermentative production of xylitol and recovery and a brief research on market demands of xylitol in future. Finally, Part IV is dedicated to the applications (medical and non-medical) of xylitol. [Chapter 14](#) describes the application of xylitol in food/feed-based industrial sectors and summarizes the health benefits of xylitol. [Chapter 15](#) provides an overview on the medical applications of xylitol in addition to promising future applications which may have impact on increased xylitol demands.

We sincerely believe that this book should cater to the needs of graduate and post graduate students, researchers of the biochemistry, microbiology, biotechnology, biochemical engineering, pharmacy, medicine, scientists and engineers both in academia and industry and business entrepreneurs. We would like to thank our colleagues MGA Felipe, Ines C. Roberto, Walter de Carvalho, Attilio Converti, M. Vitolo, Hou-Rui Zhang, Om V. Singh, Ricardo de Freitas Branco, R. C. L. B Rodriguez, Larissa Canilha, Solange I. Mussatto and Felipe F. A. Antunes for their constant help and encouragement. We also appreciate the timely help of our departmental staff (Nicanor, Paulo Roberto, Nadir, Walkiria, Isnaldi and Cibele) for the completion of this book. We are also thankful to doctoral and masters students of our department for their necessary help. We are grateful to the publishers for their necessary help and cooperation. Anuj would like to express sincere thanks to his wife, Meenakshi, and son, Abhay, for their patience and immense support during editing of this book. Silvio Silvério is also thankful to his wife, Deyse, and daughter, Isabela, for their cooperation while editing this book.

Editors are also thankful to EEL/USP for providing necessary facilities and basic infrastructure. We are grateful to the Government funding agencies of Brazil, particularly FAPESP, CNPq and CAPES, for the financial assistance to our lab to carry out the research work on various aspects of lignocellulose biotechnology. Last, but certainly not least, we welcome the reader's opinions and suggestions to improve future editions. Readers' benefits will be the best reward for the authors.



<http://www.springer.com/978-3-642-31886-3>

D-Xylitol

Fermentative Production, Application and  
Commercialization

da Silva, S.S.; Chandel, A.K. (Eds.)

2012, XVI, 348 p., Hardcover

ISBN: 978-3-642-31886-3