



LIGNOCELLULOSIC BIOMASS TO LIQUID BIOFUELS

Edited by: Abu Yousuf, Domenico Pirozzi and Filomena Sannino

Copyright © 2020 Elsevier Inc. All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

Library of Congress Cataloguing-in-Publication Data

A catalog record for this book is available from the Library of Congress

ISBN: 978-0-12-815936-1

For Information on all Academic Press publications
visit our website at <https://www.elsevier.com/books-and-journals>

Contents

3.5	Effect of fermentation inhibitors	96
3.6	Conclusion	108
	References	108
	Further reading	124
4.	Lignocellulosic biomass to biodiesel	127
	Gaetano Zuccaro, Domenico Prozzi and Abu Yousuf	
4.1	Introduction	127
4.2	Potentiality of lignocellulosic biomass as a source of biodiesel	128
4.3	Pathway: lignocellulosic biomass to lipids	133
4.4	Pre-processing of lignocellulosic biomass (mechanical, chemical, and biological)	135
4.5	Hydrolysis of lignocellulosic biomass	135
4.6	Oleaginous strains and their productivity	143
4.7	Fermentation process	150
4.8	Extraction of microbial lipids	153
4.9	Catalysts for biodiesel synthesis	156
4.10	Genetic and metabolic engineering of microbes	157
4.11	Future prospects and conclusions	158
	References	159
	Further reading	167
5.	Biobutanol from lignocellulosic biomass: bioprocess strategies	169
	Jeyaprakash Dharmaraja, Sutha Shobana, Sundaram Arvindnarayan, Manokaran Vadivel, A.E. Atibani, Arivalagan Pugazhendhi and Gopalakrishnan Kumar	
5.1	Introduction	169
5.2	Brief summary on lignocellulosic biomass material properties and their chemical compositions	171
5.3	Pretreatment of lignocellulosic biomass feedstocks	172
5.4	Biobutanol as a valuable fuel and chemical source	175
5.5	Production of biobutanol through microbial or acetone, butanol, and ethanol fermentation process	185
5.6	Concluding remarks and future outlook	185
	References	187
6.	Syngas fermentation to bioethanol	195
	Minhaj Uddin Monir, Abu Yousuf and Azrina Abd Aziz	
6.1	Introduction	196
6.2	Fermenter for syngas fermentation	201

Syngas fermentation to bioethanol

Minhaj Uddin Monir^{1,2}, Abu Yousuf³ and Azrina Abd Aziz¹

1 Faculty of Engineering Technology, Universiti Malaysia Pahang, Gambang, Malaysia

2 Department of Petroleum and Mining Engineering, Jessore
University of Science and Technology,
Jessore, Bangladesh

3 Department of Chemical Engineering and Polymer Science,
Shahjalal University of Science and Technology,
Sylhet, Bangladesh

Abstract:

Syngas fermentation is one of the most favorable biochemical conversion techniques for the production of biofuels [1-4]. In this process, syngas is used as a substrate for microorganisms [2], which is produced through a thermochemical process from biomasses [5-8]. Commonly, carbon-containing lignocellulosic biomass (forest residue, coconut shell, empty fruit bunch of palm oil, municipal solid waste, etc.) is converted into gases, such as carbon dioxide (CO₂), carbon monoxide (CO), and methane (CH₄) [5,6,9-11], and it is further converted into biofuels by utilizing carbon-fixing microbes [1,2,12]. Biomass-derived syngas fermentation from gasification of carbonaceous feedstocks is the most promising conversion technologies of biomass to liquid biofuels. Bioethanol along with acetate, butanol, butyrate, formaldehyde, peptone, and methane (produced from chemical catalytic and biosynthetic processes) is converted to clean and sustainable transportation fuel produced from the lignocellulosic biomasses, such as forest or agricultural biomass [4,5]. Syngas comprises various mixture of CO, CO₂, H₂, and CH₄, which can be produced through gasification of lignocellulosic biomass [6,13]. The composition of syngas varies with the type of biomass used as the feedstock. Different types of gasifiers, such as downdraft, fluidized-bed, and fixed-bed, are used to produce syngas, and it goes through several cleaning stages before entering to the fermenter. Up to this time, it is an on-going research at laboratory scale and novel concepts are integrating to develop the commercial scale.

Keyword: Microorganisms; Microbial culture medium; Acetogenic; Hydrogenogenic