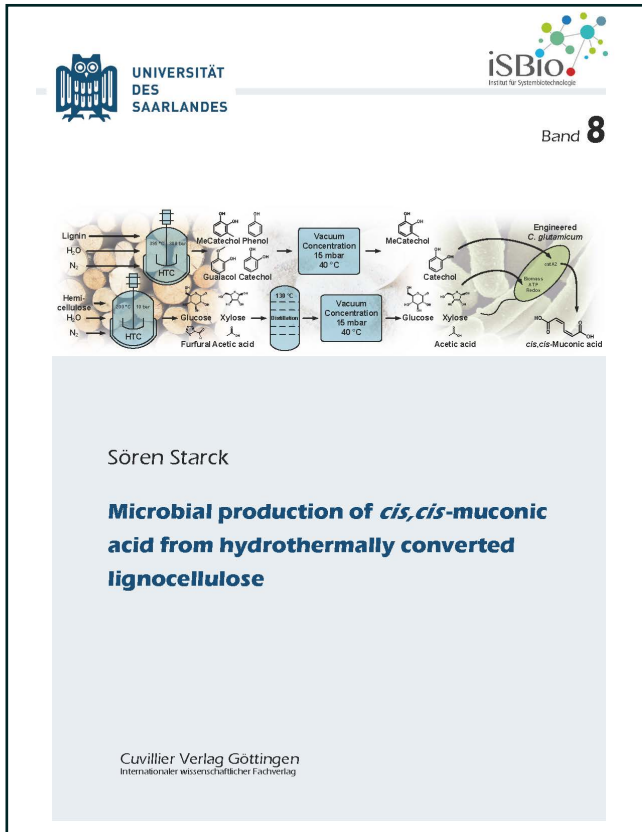




Sören Starck (Autor)

Microbial production of *cis,cis*-muconic acid from hydrothermally converted lignocellulose



<https://cuvillier.de/de/shop/publications/8615>

Copyright:

Cuvillier Verlag, Inhaberin Annette Jentsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen, Germany

Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>

Table of Contents

Summary	VIII
Zusammenfassung	IX
1 Introduction	1
<u>1.1 General introduction</u>	1
<u>1.2 Objectives</u>	2
2 Theoretical Background	3
<u>2.1 Biomass as a resource</u>	3
2.1.1 Economic perspectives	3
2.1.2 Lignin - a highly underexploited renewable	4
2.1.3 Hemicellulose – a very abundant polymer.....	11
<u>2.2 Depolymerization of biomass</u>	12
2.2.1 The pulping process	12
2.2.2 Biochemical lignin depolymerization in nature.....	15
2.2.3 Technical depolymerization of lignin.....	16
2.2.4 Use of genetically engineered plants.....	19
<u>2.3 Bioconversion of biomass-derived carbon</u>	20
2.3.1 <i>Pseudomonas putida</i>	20
2.3.2 <i>Corynebacterium glutamicum</i>	22
2.3.3 <i>Amycolatopsis sp.</i>	25
<u>2.4 Cis,cis-muconic acid - an important platform chemical</u>	25

3	Material and Methods	29
3.1	<u>Lignin and hemicellulose</u>	29
3.2	<u>Hydrothermal lignin conversion</u>	30
3.3	<u>Hydrothermal lignin conversion at miniaturized scale</u>	31
3.4	<u>Hydrothermal hemicellulose conversion</u>	32
3.5	<u>Fractionation of depolymerized hemicellulose by distillation</u>	32
3.6	<u>Distillation of lignin hydrolysate</u>	33
3.7	<u>Concentration of lignin and hemicellulose hydrolysates</u>	33
3.8	<u>Decolorization of hemicellulose hydrolysates</u>	34
3.9	<u>Microorganisms and plasmids</u>	34
3.10	<u>Media</u>	34
3.11	<u>Cultivation of <i>Pseudomonas putida</i></u>	37
3.12	<u>Cultivation of <i>Corynebacterium glutamicum</i> strains</u>	38
3.13	<u>Cultivation of <i>Amycolatopsis sp.</i></u>	39
3.14	<u>Fed-batch production of <i>cis,cis</i>-muconic acid</u>	39
3.15	<u>Quantification of glucose and xylose</u>	40
3.16	<u>Quantification of mono- and disaccharides</u>	40
3.17	<u>Quantification of aromatics and muconic acid derivatives</u>	41
3.18	<u>Fingerprinting of aromatics in lignin hydrolysates</u>	41
3.19	<u>Quantification of organic acids and alcohols</u>	42
3.20	<u>Quantification of cell concentration</u>	42

4	Results and Discussion	43
4.1	<u>Microbial production of <i>cis,cis</i>-muconic acid from aromatics</u>	43
4.2	<u>Cascaded production of <i>cis,cis</i>-muconic acid from Kraft lignin</u>	47
4.2.1	Hydrothermal conversion of Kraft lignin	47
4.2.2	Production of <i>cis,cis</i> -muconic acid from lignin hydrolysate	51
4.3	<u>Impact of the lignin-type on depolymerization</u>	54
4.3.1	Screening of hydrothermal conversion efficiency	54
4.3.2	Optimized conversion of Kraft and organosolv lignin	58
4.3.3	Improvement of the aromatic	59
4.3.4	Bioconversion of lignin hydrolysates	62
4.4	<u>Gram-scale production of <i>cis,cis</i>-muconic</u>	68
4.5	<u>Use of hemicellulose-derived sugars as co-substrate</u>	74
4.5.1	Hemicellulose depolymerization into sugar monomers	74
4.5.2	Purification and vacuum concentration	82
4.5.3	<i>Cis,cis</i> -muconic acid production using xylose	84
5	Conclusion and Outlook	92
6	Appendix	96
6.1	<u>Abbreviations</u>	96
6.2	<u>Cultivation of <i>P. putida</i> MA-9 on organosolv lignin hydrolysate</u>	97
6.3	<u>Monomers obtained from multiple runs of HTC</u>	98
6.4	<u>Cultivation on hemicellulose hydrolysate</u>	99
7	References	102