Screening of lactic acid bacteria for their potential as microbial cell factories for bioconversion of lignocellulosic feedstocks - DTU Orbit (07/08/2019)

Screening of lactic acid bacteria for their potential as microbial cell factories for bioconversion of lignocellulosic feedstocks

Background: The use of fossil carbon sources for fuels and petrochemicals has serious impacts on our environment and is unable to meet the demand in the future. A promising and sustainable alternative is to substitute fossil carbon sources with microbial cell factories converting lignocellulosic biomass into desirable value added products. However, such bioprocesses require availability of suitable and efficient microbial biocatalysts, capable of utilizing C5 sugars and tolerant to inhibitory compounds generated during pretreatment of biomass. In this study, the performance of a collection of lactic acid bacteria was evaluated regarding their properties with respect to the conversion of lignocellulosic feedstocks. The strains were examined for their ability to utilize xylose and arabinose as well as their resistance towards common inhibitors from pretreated lignocellulosic biomass (furan derivatives, phenolic compounds, weak acids). Results: Among 296 tested Lactobacillus and Pediococcus strains, 3 L. pentosus, 1 P. acidilactici and 1 P. pentosaceus isolates were found to be both capable of utilizing xylose and arabinose and highly resistant to the key inhibitors from chemically pretreated lignocellulosic biomass. When tested in broth with commonly found combinations of inhibitors, the selected strains showed merely 4%, 1% and 37% drop in growth rates for sugarcane bagasse, wheat straw and soft wood representatives, respectively, as compared to Escherichia coli MG1655 showing decreased growth rates by 36%, 21% and 90%, respectively, under the same conditions. Conclusion: The study showed that some strains of Lactobacilli and Pediococci have the potential to be used as production platforms for value-added products from pretreated lignocellulosic biomass. Selected Lactobacilli and Pediococci strains were able to tolerate the key inhibitors in higher concentrations compared to E. coli; in addition, as these isolates were also capable of fermenting xylose and arabinose, they constitute good candidates for efficient lignocellulosic feedstock bioconversions.

General information
Publication status: Published
Organisations: Department of Systems Biology, Metabolic Signaling and Regulation, Systems Biotechnology, National Food Institute, Division of Industrial Food Research, Université de Strasbourg
Contributors: Boguta, A. M., Bringel, F., Martinussen, J., Jensen, P. R.
Number of pages: 16
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Microbial Cell Factories
Volume: 13
Issue number: 1
Article number: 97
ISSN (Print): 1475-2859
Ratings:
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.25 SJR 1.757 SNIP 1.501
Web of Science (2014): Impact factor 4.221
Web of Science (2014): Indexed yes
Original language: English
Keywords: sugarcane bagasse, wheat straw, Eubacteria Bacteria Microorganisms (Bacteria, Eubacteria, Microorganisms) - Gram-Positive Cocci [07700] Pediococcus pentosaceus species Pediococcus acidilactici species, Eubacteria Bacteria Microorganisms (Bacteria, Eubacteria, Microorganisms) - Regular Nonsporing Gram-Positive Rods [07830] Lactobacillus pentosus species fermentation agent, Facultatively Anaerobic Gram-Negative Rods Eubacteria Bacteria Microorganisms (Bacteria, Eubacteria, Microorganisms) - Enterobacteriaceae [06702] Escherichia coli species strain-MG1655, arabinose 147-81-9, C5 sugar, carbon 7440-44-0, furan 110-00-9, lignocellulosic, xylose 25990-60-7, 10060, Biochemistry studies - General, 10068, Biochemistry studies - Carbohydrates, 31000, Physiology and biochemistry of bacteria, 39008, Food microbiology - General and miscellaneous, fermentation method applied and field techniques, Biochemistry and Molecular Biophysics, Bioprocess Engineering, BIOTECHNOLOGY, ETHANOLOGENIC ESCHERICHIA-COLI, HEMICELLULOSE HYDROLYSATE, SACCHAROMYCES-CEREVISIAE, DEGRADATION-PRODUCTS, PICHIA-STIPITIS, WHEAT-STRAW , FERMENTATION, GROWTH, BIOMASS, INHIBITORS, Lactic acid bacteria, Fermentation inhibitors, Furfural, HMF, Lignocellulosic biomass, C5 sugars
Electronic versions:
Screening_of_lactic_acid_bacteria.pdf
DOIs:
10.1186/s12934-014-0097-0

Bibliographical note
© 2014 Boguta et al.; licensee BioMed Central Ltd. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and