5TH INTERNATIONAL CONFERENCE
19-22 MAY · 2019
CAVTAT · CROATIA

IMPLEMENTATION OF MICROREACTOR TECHNOLOGY IN BIOTECHNOLOGY

BOOK OF EXTENDED ABSTRACTS

Cavtat, 2019

Published by: Faculty of Chemistry and Chemical Technology, University of Ljubljana

Text prepared by:

AUTHORS, who are fully responsible for the text and its quality. Language corrections were not made.

ISBN 978-961-6756-99-0

A CIP catalogue record for this book is avaliable from the Narodna in univerzitetna knjižnica, Ljubljana under 60:66.023.2-022.513(082)(0.034.2)

POSTER PRESENTATIONS

SESSION A: ENZYMATIC MICROREACTORS

AP1 *Co-encapsulation of glucosidase and pectinase in microbeads and nanofibers in microbioreators towards wine industry application*
Maria H. Ribeiro, Maria Emilia Rosa, Maria Luisa Machado
University of Lisbon, Portugal

AP2 *Enzyme synthesis of cephalexin in aqueous two-phase systems*
Lucie Vobecká, Linda Tichá, Jakub Tuček, Aleksandra Atanasova, Karel Mařík, Zdeněk Slouka, Pavel Hasal, **Michal Přibyl**
University of Chemistry and Technology Prague, Czech Republic

AP3 *Kinetic modelling of an enzyme cascade reaction for chiral amino alcohol synthesis*
Nihal Bayir, Frank Baganz
European University of Lefke, Turkey; University College London, United Kingdom

AP4 *Multi-scale-optimization of a micro-bio-reactor for chiral reduction*
Philip Pietrek, Teresa Burgahn, Kersten S. Rabe, Christof M. Niemeyer, Roland Dittmeyer
Karlsruhe Institute of Technology, Institute for Micro Process Engineering; Karlsruhe Institute of Technology, Institute for Biological Interfaces, Germany

AP5 *Immobilization and continuous-flow application of transaminases*
Emese Abaházi, László Nagy-Győr, Zsófia Molnár, Emese Farkas, Diána Balogh-Weiser, Csaba Paizs, **László Poppe**
Budapest University of Technology and Economics, Hungary; University of Cluj-Napoca, Romania

AP6 *Scalability of Gallic Acid Biotransformation by Laccase*
Marina Tišma, Darijo Šibalić, Roberto Šimunović, Mirela Planinić, Ana Bucić-Kojić, Marco PC Marques, Nicolas Szita
University of J. J. Strossmayer in Osijek, Croatia; University College London, United Kingdom

AP6 *Molecular Mechanism of Enzymes*
Jennifer Littlechild, Frank Vollmer
University of Exeter, United Kingdom

SESSION B: CELLS WITHIN MICROREACTORS

BP1 *A Bioreactor for Basic Studies on the Miniaturization of Biosynthesis*
Anja Straube, Sebastian Köhring, Mike Stubenrauch,Holger Rothe, Klaus Liefeith, Hartmut Witte
Technical University of Ilmenau, Germany; Institute for Bioprocessing and Analytical Measurement Techniques, Germany

BP2 *Diffusiophoresis in microcavities: passive migration of blood cells and lipid vesicles induced by transient concentration gradients*
Saša Vrhovec, Bojan Božič, **Jure Derganc**
University of Ljubljana, Slovenia

BP3 *Biocatalytic oxygenation driven by photosynthesis*
Anna Hoschek, **Rohan Karande**, Katja Bühler, Andreas Schmid, **Bruno Bühler**
Helmholtz Centre for Environmental Research, Germany

BP4 *Immobilizaton of cells in a microreactor using copolymer hydrogel*
Tadej Menegatti, Polona Žnidaršič Plazl
University of Ljubljana, Slovenia

BP5 *Pectinolytic, xylanolytic and cellulolytic potential of the mixed population during acidogenesis of orange juice processing wastewater in ananaerobic bioreactor system*
Ioanna Zerva, Nikolaos Remmas, Spyridon Ntougias
Democritus University of Thrace, Greece

BP6 *Bacillus subtilis - a model bacterium to investigate mechanisms and consequences of microbial "sociality" at micrometer distances*
Mandić-Mulec Ines, Štefanič Polonca, Kraigher Barbara, Belcijan Katarina, Danevčič Tjaša, Špacapan Mihael, Dogša Iztok, Bolješić Maja, Kovačec Eva, Erega Andi, Polšak Alja.
University of Ljubljana, Slovenia

SESSION C: ANALYTICAL MICRODEVICES

CP1 *Optical ammonia sensor for continuous bioprocess monitoring*
Maximilian Maierhofer, Sergey M. Borisov, **Torsten Mayr**
Graz University of Technology, Austria

CP2 *Inline monitoring of oxygen in organic solvents in flow reactors at high pressures*
Philipp Sulzer, Rene Lebl, **Torsten Mayr**
Research Center Pharmaceutical Engineering GmbH, Austria; Graz University of Technology, Austria; University of Graz; Austria

CP3 *Analysis of cardiac troponin I using surface acoustic wave biosensors and accurate fluidic control*
Soo Suk Lee, Jiwon Kwak
Soonchunhyang University, Republic of Korea

SESSION D: BIOPROCESS INTENSIFICATION AND INTEGRATION

DP1 *A flow approach to the production of cis-4-(tert-butyl)cyclohexyl from 4-(tert-butyl)cyclohexanone via a two-steps enzymatic synthesis Study of plastics for 3D printing of microreactors*
Francesca Tentori, Elisabetta Brenna, Michele Crotti, Giuseppe Pedrocchi-Fantoni, Maria Chiara Ghezzi, and Davide Tessaro
Polytechnic University of Milan, Italy; Institute of chemistry of molecular recognition, Italy

DP2 *Packed-bed Flow Reactors and Integrated Cofactor Regeneration System to Achieve Redox Biocatalysis in Continous Processing*
María Romero-Fernández, Francesca Paradisi
University of Nottingham, United Kingdom

DP3 *Biodiesel production in micro systems – macro impact?*
Martin Gojun, Anita Šalić, Ana Jurinjak Tušek, Bruno Zelić
University of Zagreb, Croatia

DP4 *Flow intensified biocatalytic production of esters and amides in water*
Martina Letizia Contente, Stefano Farris, Francesco Molinari, Lucia Tamborini, Francesca Paradis
University of Nottingham, United Kingdom; University of Milan, Italy

DP5 *Penicillin acylase kinetics and its effects on reaction and separation in a microfluidic reactor*
Linda Tichá, **Pavel Hasal**, Michal Přibyl
University of Chemistry and Technology, Prague

Pectinolytic, xylanolytic and cellulolytic potential of the mixed population during acidogenesis of orange juice processing wastewater in an anaerobic bioreactor system

Ioanna Zerva, Nikolaos Remmas and Spyridon Ntougias *

Laboratory of Wastewater Management and Treatment Technologies, Department of Environmental Engineering, Democritus University of Thrace, Vas. Sofias 12, GR 67132 Xanthi, Greece

**email: sntougia@env.duth.gr*

Processing of oranges constitutes a major sector of the agro-industrial businesses around the globe. The main orange juice producers are located in the Mediterranean basin, the United States, Brazil, Mexico and China (1). More particularly, Greece's orange juice industries represent the 1.5% of the global production, making this manufacturing sector a main pillar of the Greek economy (2). However, this manufacturing sector generates high quantities of waste, which represent over 50% of the processed fruit and are composed of soluble and insoluble carbohydrates, such as pectin, hemicellulose and cellulose, which approximately corresponds to 50% of orange's dry weight (3). Among such biopolymers, hemicellulose and cellulose are slowly hydrolyzed, thus resisting biodegradation and compromising energy recovery during anaerobic digestion of orange processing wastes. For this reason, the hydrolysis of such polysaccharides should be carried out by specialized microbial consortia capable of breaking down the β-glycosidic bond, releasing sugar monomers and facilitating their enzymatic hydrolysis. On the other hand, despite the slowly hydrolysis of hemicellulose and cellulose content of such wastes, wastewaters generated by the orange juice producing factories are characterized by high organic load, making them a suitable source for anaerobic digestion and energy gain from the biogas production (4). Thus, the aim of this work is to uncover the pectinolytic, xylanolytic and cellulolytic potential of the mixed microbial population during acidogenesis of the orange juice processing wastewater in an anaerobic bioreactor system, treating such effluent under mesophilic conditions. Methodologically, the pectinolytic, xylanolytic and cellulolytic potential in the acidogenic reactor was assessed through the determination of intracellular and extracellular polygalacturonase, endo-1,4-β-xylanase, 1,4-β-xylosidase, endo-1,4-β-D-glucanase, exo-1,4-β-D-glucanase and β-1,4-D-glucosidase activities. Extremely low extracellular and intracellular endo-1,4-β-D-glucanase, β-1,4-D-glucosidase, 1,4-β-xylosidase and exo-1,4-β-D-glucanase activities were detected, although high polygalacturonase and endo-1,4-β-xylanase activities were detected at steady state conditions, reaching values up to 7.47 and 17.04 U/mg protein, respectively. The fact that higher intracellular than extracellular polygalacturonase and endo-1,4-β-xylanase activities were detected indicates that surface cell-bound pectinases and xylanases were involved in wastewater hydrolysis (5,6). It is concluded that the high pectin and hemicellulose content of such wastewater was degraded by a specialized pectinolytic and xylanolytic mixed population, which was favored during acclimatization of the acidogenic biomass in this anaerobic bioreactor.

Keywords: orange juice processing wastewater, anaerobic digestion, glucanases, xylanases, pectinases

References

(1) Koppar, A.; Pullammanappallil, P. *Energy* **2013**, *60*, 62-68.

(2) *Citrus Fruit - Fresh and Processed, Statistical Bulletin, 2016*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2017.

(3) de la Torre, I.; Ravelo, M.; Segarra, S.; Tortajada, M.; Santos, V.E.; Ladero, M. *Bioresour. Technol.* **2017**, *245*, 906-915.

(4) Pourbafrani, M.; Forgács, G.; Horváth, I.S.; Niklasson, C.; Taherzadeh, M.J. *Bioresour. Technol.* **2010**, *101 (11)*, 4246-4250.

(5) Tanaka, T.; Shimomura, Y.; Himejima, M.; Taniguchi, M.; Oi, S. *Agric. Biol. Chem.* **1986**, *50 (9)*, 2185-2192.

(6) Zerva, I.; Remmas, N.; Ntougias, S. *Water* **2019**, *11*, 274.

Acknowledgements

This work was carried out in the frame of the research project "Optimizing the energy recovery of waste from oranges juice industries using specialized native microorganisms as a starting culture, code MIS (OPS) 5006203, which is implemented through the Operational Program "Human Resources Development, Education and Lifelong Learning" and is co-financed by the European Union (European Social Fund) and Greek national funds.