Olga Muter

Subjects: Environmental Sciences
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Microbial ecology | Biodegradation | Ecotoxicity

Basic Information

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1. Acceleration of biodegradation processes in contaminated environments

Our studies on soil bioremediation, wastewater treatment and air biofiltration embrace a broad range of methodical approaches and target microorganisms. Application of biostimulation and bioaugmentation tools provide a great variety of biodegradation scenarios under contrast/seasonal/globally changing environmental conditions. Soil bioremediation: our studies showed a stimulating effect of the cabbage leaf extract (amended with molasses and inorganic salts) on the bacterial degrading activity towards nitroaromatic compounds [1][2]. The biomass preparation mode for bioaugmentation also plays an imperative role in increasing efficiency of biodegradation processes. In our earlier study, a population–reaction model based on a combination of microbial experimental ecosystems and a hierarchical dynamic model[3] was tested on the consortium of eight bacterial cultures belonging to the *Pseudomonas* spp. and *Stenotrophomonas maltophilia* groups. Serial batch cultivations (seven days each) with a

stepwise increase (1%, 3%, 5% w/w) in diesel oil concentration resulted in a considerable increase of biomass, production of biosurfactants and enzyme activity at the second step, i.e., with 3 % diesel oil. Furthermore, molasses concentrations below 1 % are likely to be more efficient for microbial activity when grown with diesel oil[4]. Wastewater treatment: biodegradation of pharmaceutical residues has been studied with emphasis on bioaugmentation and combined biodegradation/biosorption [5][6]. The response of microbial community of activated sludge to ibuprofen (IBP) was studied at the concentrations of 50–5000 mg/L. Batch incubation was performed in an OxiTop® device for 21 days. Massive DNA sequencing analysis of the activated sludge revealed that Proteobacteria became more dominant when grown in the presence of IBP. Incubation of activated sludge in the presence of 1000 mg/L IBP led to an increased occurrence of ciprofloxacin-resistant bacteria. The predominance of *Enterobacteriales* in the activated sludge is suggested as one of the possible explanations of the enhanced resistance to ciprofloxacin[7]. Industrial wastewaters were tested for the presence of heterotrophic nitrifiers. It has been suggested to strengthen the role of heterotrophic nitrifiers in the treatment of industrial wastewaters, where toxicity obstacles inhibited nitrification under conventional conditions[8]. Air biofiltration: Our experiments with hydroponic cultures in the green wall system module, which provides air biofiltration and automatic irrigation, showed a significant ($p<0.05$) effect of bioaugmentation for the growth of *Mentha aquatica* after 47 days of vegetation[9]. Sewage sludge treatment: sewage sludge (SS) disposal is one of the greatest challenges of the 21st century. It was recently reported, that wheat straw stabilized the SS better than faba bean straw and wood-chip pellets. Treatment of SS lead to an increase of Firmicutes, i.e., 32.70–53.84%. The incubated non-amended SS showed an increase in virus abundance. Bioaugmentation and amendments increased the yield of gene families GO ID[10].

2. Challenges and perspectives

An improvement of the biodegradation performance is related the problems of long-term residence of special functional bacteria and maintenance of multi-bacteria interactions[11]. If the total breakdown of the remaining contaminants is not achievable, immobilising and reducing the bioavailability of organic pollutants in soils is critical [12]. Multi-compound pollution, new findings in inoculum conservation for commercial uses, and the further development of process monitoring will be the main topics for further research in the field of bioaugmentation-assisted bioremediation[13].

3. Brief description of the research group activities

The research group: www.lu.lv/en/mbi/laboratories/laboratory-of-environmental-microbiology/

Managed projects (by Olga Muter):

- The use of microorganisms in biodegradation of exlposives. 2005-2006, 2009-2010. (Ministry of Defence, Republic of Latvia AĪVA 2008/220).

- Investigation of solid state and submerged fermentation processes. 2009-2012. (Latvian Council of Science LZP 09.1177).
- Interdisciplinary Team of Young Scientists for Assessment and Restoration of Soil Quality and Usage Potential in Latvia (ESF 2013/0020/1DP/1.1.1.2.0./13/APIA/VIAA/066, 2013-2015) (Head of a sub-group of the Project).
- State Research Program Y3-26493-270, sub-project „Novel biotechnological products and technologies based on ceramics" (2010-2013) ResProd (2014-2017).
- Development of environmentally friendly surface cleaning compositions with emphasis on their potential applications. (ERDF 2DP/2.1.1.1.0/14/APIA/VIAA/016) 2014-2017. (Head of a sub-group of the Project).
- Establishing of the scientific capacity for the management of pharmaceutical products residues in the environment of Latvia and Norway. (NFI/R/2014/010) 2014-2017. (Head of a sub-group of the Project).
- Development and introduction of innovative methods in clinical practice for the diagnosis and treatment of malignant tumors using molecularly targeted radionuclides produced in Latvia. (Funded by University of Latvia donor "Mikrotikls" Ltd. Donation) 2018-2019. (Head of a sub-group of the Project).
- Climate responsible agriculture in Latvia.**(**LIFE16 CCM/LV/000082). Quantification of the activity of soil microorganisms in agricultural soils, sub-contractor of the Institute for Environmental Solutions. 2019-2023.
- Research and development of bioremediation-based indoor air biofiltration system", in cooperation with Lafivent Ltd., funded by the agreement with Competence Center of Energy and Transport Ltd., Latvia. *(*2.1.1./18/A/001) 2019-2021.
- Antimicrobial resistance ecosystem in hospitals and environmental objects (WP3 of the State Research Project in the field of biomedicine, medical technologies and pharmacy) (VPP-EM-BIOMEDICINA-2022-1-0001) 2023-2024. (Head of a sub-group of the Project)
- Multidimensional characterisation of plastic waste biodegradation mechanisms in the municipal solid waste landfill (Latvian Council of Science LZP2022/139) 2022-2024. (Head of a sub-group of the Project)

Participated in projects

- Development and automation of microturbulence intensifying systems and biosynthesis conditions in bioreactors (Latvian Council of Science LZP 05.1558) 2005-2008.
- Changes of soil biological activity during cultivation of grain in different agricultural systems (Latvian Council of Science LZP 09.1047) 2009-2012.
- EUExNet – European Explosives Network (503572-LLP-1-2009-1-SE-LEONARDO-LNW) 2009-2011.
- Biochar as option for sustainable resource management. Management Committee. (COST *Action TD1107) 2011.-2015.*
- Anti-Microbial Coating Innovations to prevent infectious diseases (AMICI). Management Committee. http://www.cost.eu/COST_Actions/ca/CA15114 (COST Action 15114) 2016-2020.
- Development of new approaches for waste-less simultaneous production of bioethanol, furfural and other valuable products from local agricultural waste material . (1.1.1.1/16/A/113) 2017-2020.
- Application of modified cellulose fiber sorbents for concentration of radioactive hydrogen (tritium) and other radionuclides from contaminated environments and evaluation of toxic properties: approbation of the method for

purification of water residues from nuclear reactors stored in Latvia. (Latvian Council of Science LZP2020/2-0213 (LZP2020/87)) 2020-2021.
- Selection of chemical biomarkers for the risk assessment of exposure to food contaminants using wastewater samples (Latvian Council of Science LZP 2020/2-0128 (LZP2020/84) 2020-2021.

References

1. Muter, O.; Versilovskis, A.; Scherbaka, R.; Grube, M.; Zarina, Dz. Effect of plant extract on the degradation of nitroaromatic compounds by soil microorganisms. Journal of Industrial Microbiology and Biotechnology, 2008, 35(11), pp.1539-1543.
2. Muter, O., Potapova, K., Limane, B., Sproge, K., Jakobsone, I., Cepurnieks, G., Bartkevics, V. The role of nutrients in the biodegradation of 2,4,6-trinitrotoluene in liquid and soil. (2012) Journal of Environmental Management, 98 (1), pp. 51-55.
3. Hosoda, K.; Tsuda, S.; Kadowaki, K.; Nakamura, Y.; Nakano, T.; Ishii, K. Population-reaction model and microbial experimental ecosystems for understanding hierarchical dynamics of ecosystems. BioSystems 2016, 140, 28–34.
4. Muter, O., Makarenkova, G.; Vecstaudza, D.; Shvirksts, K.; Grube, M.; Kalnenieks, U. Optimization of bacterial biomass production for bioaugmentation of the hydrocarbons contaminated sites. Research Journal of Biotechnology 2019, 14(11), 39-51.
5. Muter, O., Pērkons, I., Bartkevičs, V. Removal of pharmaceutical residues from wastewater by woodchip-derived biochar. Desalination and Water Treatment, 2019, 159, pp. 110–120.
6. Muter, O., Perkons, I., Selga, T., Berzins, A., Gudra, D., Radovica-Spalvina, I., Fridmanis, D., Bartkevics, V. Removal of pharmaceuticals from municipal wastewaters at laboratory scale by treatment with activated sludge and biostimulation. Science of the Total Environment, 2017, 584-585, pp. 402–413.
7. Davids, M., Gudra, D., Radovica-Spalvina, I., Fridmanis, D., Bartkevics, V., Muter, O. The effects of ibuprofen on activated sludge: Shift in bacterial community structure and resistance to ciprofloxacin. (2017) Journal of Hazardous Materials, 340, pp. 291-299.
8. Kalniņš, M.; Bērziņš, A.; Gudrā, D.; Megnis, K.; Fridmanis, D.; Danilko, P.; Muter, O. Selective enrichment of heterotrophic nitrifiers Alcaligenaceae and Alcanivorax spp. from industrial wastewaters. AIMS Microbiology, 2020, 6(1), pp.32-42.
9. Kalnins, M.; Andersone-Ozola, U.; Gudra, D.; Sierina, A.; Fridmanis, D.; Ievinsh, G.; Muter, O. Effect of bioaugmentation on the growth and rhizosphere microbiome assembly of hydroponic cultures of Mentha aquatica. Ecological Genetics and Genomics, 2022, 22, 100107.

10. Rimkus, A., Gudrā, D., Dubova, L., Fridmanis, D.; Alsiņa, I., Muter, O. Stimulation of sewage sludge treatment by carbon sources and bioaugmentation with a sludge-derived microbial consortium. Science of the Total Environment, 2021, 783, 146989.
11. Chen, Y.; Wang, S.; Geng, N.; Wu, Z.; Xiong, W.; Su, H. Artificially constructing mixed bacteria system for bioaugmentation of nitrogen removal from saline wastewater at low temperature. J. Environ. Manag. 2022, 324, 116351.
12. Jabbar, N.M.; Alardhi, S.M.; Mohammed, A.K.; Salih, I.K.; Albayati, T.M. Challenges in the implementation of bioremediation processes in petroleum-contaminated soils: A review. Environ. Nanotechnol. Monit. Manag. 2022, 18, 100694.
13. Muter, O. Current trends in bioaugmentation tools for bioremediation: a critical review of advances and knowledge gaps. Microorganisms 2023, 11, 710.