Toxicity of synthetic herbicides containing 2,4-D and MCPA moieties towards Pseudomonas putida mt-2 and its response at the level of membrane fatty acid composition

ALEKSANDRA PIOTROWSKA¹, ANNA SYGUDA¹, ŁUKASZ CHRZANOWSKI¹, HERMANN J. HEIPIEPER²

¹ Faculty of Chemical Technology, Poznan University of Technology, ul. Berdychowo 4, 60-965 Poznan, Poland <u>aleksandra.k.piotrowska@gmail.com</u>

²Department of Environmental Biotechnology, Helmholtz Centre for Environmental Research-UFZ, Permoserstrasse 15, 04318 Leipzig, Germany <u>hermann.heipieper@ufz.de</u>

A new form of phenoxyherbicides defined as herbicidal ionic liquids (HILs) have been recognized as efficient alternative to commercial herbicides, 2,4-D or MCPA. These compounds are quaternary ammonium salts with an ester functional group, so called esterquats, in which 2,4-D and MCPA are incorporated in the cation. HILs are more effective, less volatile, more thermally stable, and exhibit superior efficacy in comparison to typically employed herbicides. Prior to widespread application in agriculture, studies focusing on potential hazard for both aquatic and terrestrial ecosystems should be examined. Without a proper evaluation of the influence of ionic liquid-based herbicides on the natural environment, it will not be possible to use such novel compounds and support the development of environmentally-friendly agriculture.

The aim of the studies was to investigate potential toxicity of HILs precursors containing 2,4-D or MCPA moieties. The toxicity of esterquats was investigated regarding growth and adaptive mechanisms of *Pseudomonas putida* mt-2, in a direct comparison with the synthetic commercialized herbicides 2,4-D and MCPA as reference compounds. Next to growth inhibition, given as EC50, changes in the isomerization of *cis* to *trans* unsaturated fatty acids were applied as proxy for cellular stress adaptation to toxic solvents. The obtained results revealed that all investigated precursors of HILs showed lower toxicity compared to commercialized synthetic herbicides 2,4-D and MCPA. The collected data on toxicity of HILs together with their physico-chemical properties will be useful for assessing the potential risk of the environmental pollution as well as guidelines for setting the legislation for their future use.

Pernak, J., Syguda, A., Materna, K., Janus, E., Kardasz, P., Praczyk, T., 2012. 2,4-D based herbicidal ionic liquids. Tetrahedron. 68, 4267-4273.

Heipieper, H.J., Loffeld, B., Keweloh. H., de Bont J.A.M., 1995. The cis/trans isomerisation of unsaturated fatty acids in Pseudomonas putida S12: An indicator for environmental stress due to organic compounds. Chemosphere. 30, 1041-1051.