
TU200
TU WIEN
BIOTRANS
2015
Vienna / Austria
July 26-30, 2015
organized by the
Institute of Applied Synthetic Chemistry
TU Wien

FROM WASTE TO VALUE – IONIC LIQUID BASED EXTRACTION MEETS WHOLE CELL MULTISTEP BIOCATALYSIS

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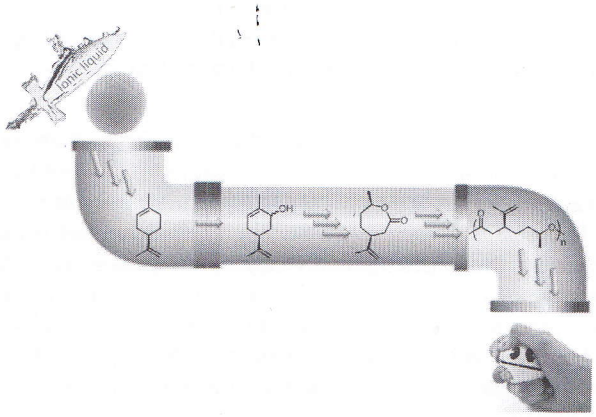

Ionic liquids, salts with a melting point below 100°C, are very well known for their ability to dissolve biomass. Various valuable natural products have already been isolated using ionic liquids in enhanced yields compared to conventional organic volatile solvents. Also the extraction of (*R*)-(+)-limonene from the waste product orange peel has been reported successfully.[1]

Limonene can serve as a precursor for the multistep synthesis of chiral monomers for polymer production. Taking nature as a model, application of cascade reactions in organic synthesis offers a lot of advantages over the classical step-by-step approach.[2] After specific hydroxylation of limonene to carveol by an oxygenase, an already established artificial 'minipathway' in *E. coli* was implemented for the formation of chiral dihydrocarvide.[3]

Combination of ionic liquids and a mixed culture multistep whole cell biotransformation allows the *in situ* extraction of limonene and its direct conversion to chiral dihydrocarvides that are valuable monomers for the production of mechanically robust thermoplastic polyurethanes.[4] Herein a new perspective to an environmentally benign process for the direct conversion of biomass to valuable products, avoiding multiple purification steps, is presented.

1 Bica, K., Gaertner, P. & Rogers, R. D. Ionic liquids and fragrances - direct isolation of orange essential oil. *Green Chemistry* **13**, 1997-1999, doi:10.1039/c1gc15237h (2011).

2 Muschiol, J. *et al.* Cascade catalysis - strategies and challenges en route to preparative synthetic biology. *Chemical Communications*, doi:10.1039/c4cc08752f (2015).

3 Oberleitner, N. *et al.* An Enzymatic Toolbox for Cascade Reactions: A Showcase for an In Vivo Redox Sequence in Asymmetric Synthesis. *ChemCatChem* **5**, 3524-3528, doi:10.1002/cctc.201300604 (2013).

4 Knight, S. C., Schaller, C. P., Tolman, W. B. & Hillmyer, M. A. Renewable carvone-based polyols for use in polyurethane thermosets. *RSC Advances* **3**, 20399-20404, doi:10.1039/c3ra44084b (2013).