Lignin biorefinery: Novel enzymes for selective ether bond cleavage

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Biomass degrading enzymes attract significant research interest for their application in the synthesis of chemicals and biofuels from renewable feedstocks. In that respect, lignin, a heterogeneous aromatic polymer present in lignocellulose, could serve as a renewable source of aromatic platform chemicals. We have identified a number of novel beta-etherases and glutathione lyases with potential applicability in lignin valorization [1-3]. These glutathione (GSH)-dependent enzymes selectively catalyze the reductive cleavage of beta-O-4 arylether bonds present in lignin. Biochemical and biocatalytic characterization of the novel enzymes with various model substrates revealed a remarkably high enantioselectivity in ether bond cleavage for all tested beta-etherases. In contrast, enanioselectivities of glutathione lyases varied significantly among the tested enzymes [3]. Using a fluorescently-labelled synthetic lignin as substrate, the enzymes' activity on polymeric substrates was also proven [2]. Some of the enzymes were even found to exhibit increased thermostability, thus, providing promising hints for further practical applications. Meanwhile, crystal structures of representative members of both enzyme groups, beta-etherases and glutathione lyases, are available enabling a deeper understanding of structure-function relationships as well as future optimization of enzyme characteristics by protein engineering.

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[3] P. Picart, M. Sevenich, P. Dominguez de Maria, A. Schallmey (2015) Green Chem, 17, 4931–4940