Investigation enzymatic hydrolysis of poplar wood polysaccharides for bioethanol production

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The aim of the project is to solve a question of obtaining simple sugars from wood biomass, which is a crucial step of method development of bioethanol production. Wood of various poplar species, including GMO, will be model lignocellulosic sources, due to perspectives of its industrial use (Shin et al., 2013). Commercial enzymes for cellulose and xylan decomposition will be used. The project fulfils requirements of the research on renewable energy sources and the second generation biofuels (Ana Ares-Peon et al., 2013).

Enzymatic technology based on lignocellulosic materials starts from raw material and consist in three main steps – pretreatment, hydrolysis and fermentation, though the last two steps can be conducted simultaneously (Ahmed et al., 2013). From the economical point of view, enzyme efficiency is the most important factor. Due to high cost of enzymes, this stage efficiency is crucial for the resulting ethanol price and competitiveness of biofuel energy (Walker 2010). Thus, optimisation of the reaction parameters is required to ensure the highest rate of hydrolysis. Temperature, pH, ions concentration, complex-forming additives or surfactants are the factors, which will be tested for the influence on enzyme activity. The yield of simple sugars (glucose and xylose), ready for yeast or bacterial fermentation, will be determined by HPLC as the main indicator of reaction advancement (Antczak *et al.* 2012). Ethanol production tests will be conducted as well.

Mesoporous structure of wood is another important factor, due to limited availability cell wall for enzyme penetration (Verardi *et al.* 2012). The attention will be focused on possibilities of enzyme-permeable pore forming, for example by vapour expanding in biomass due to violent boiling of water or carbon dioxide (Romani et al. 2013), saturating biomass, or limited delignification, conducted without chlorine compounds.

The last subject of interest are hydrolysis inhibitors, like phenolics and fatty acids, which naturally occur in wood, or some of products of wood conversion, like furfural and its derivatives (Chandel, 2011). Those substances may act as fermentation inhibitors (Szadkowski, 2011). Preventing their formation or selective removal has a big impact on final bioethanol output.

The end result of the project will be determination of conditions leading to the highest efficiency of enzymatic hydrolysis of wood biomass, including changes of the physical and chemical structure of poplar wood, which can improve the process rate and the yield of sugars and subsequently bioethanol yield (Lima et al., 2013).

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