Abstract of doctoral dissertation

Chemoenzymatic plant biomass processing with deep eutectic solvents

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Due to the necessity to reduce the consumption of fossil fuels, there is a growing interest in the use of renewable raw materials in the industry, such as plant biomass. At the same time, technologies themselves are undergoing changes, replacing toxic chemicals with more ecological alternatives. An example is the application of deep eutectic solvents (DESs), which can be used in lignocellulose valorization processes. The aim of the conducted research was to develop methods for processing plant biomass using DESs through delignification and subsequent enzymatic hydrolysis as well as *via* the extraction of bioactive compounds.

Selected DESs provided a high degree of biomass delignification, particularly in processes carried out in the StatBioChem® basket reactor. Its design enables intensified mass transfer during the process and facilitates the separation of solid material from the solvent. The treatment of lignocellulose led to increased material porosity, which improved the efficiency of subsequent enzymatic hydrolysis using cellulases. However, most of the selected DESs showed a deactivating effect on the biocatalysts used, indicating the need to remove residual solvent from the lignocellulose after the delignification process.

DESs also proved to be effective solvents for the extraction of bioactive compounds from tomato leaves and calendula flowers (e.g., rutin, chlorogenic acid). Additionally, the yield of the extracted polyphenols was higher when using DESs compared to conventional organic solvents. Extracts obtained from tomato leaves showed antimicrobial and antioxidant properties, which allowed their use as active components in biodegradable chitosan-based packaging materials, extending the freshness of food products. The extraction of calendula flowers was carried out using a dual-solvent extraction system, which simultaneously employed two DESs, one hydrophilic and one hydrophobic. This allowed for the selective isolation of bioactive compounds, depending on the properties of extracted chemicals.