Enzymatic membrane reactors as versatile tools for sample preparation in analysis of new micropollutants

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Extensively growing market of goods and services as well as dynamic development of industry results in constantly raising amount of various pollutants in soil and water bodies. Beside well-known pollutants, such us heavy metal ions, oils or micropollutants including pharmaceuticals, dyes, personal care products or pesticides, nowadays new micropollutants, including microplastic, arouse particular interest [1]. Microplastics are synthetic, high-molecular weight compounds that due to the action of various factors have been micronized into particles smaller than 5 mm. Microplastic particles are known by their low biodegradation rate and mostly remain in the environment and adversely affect the entire ecosystems and human body [2]. Although the removal of microplastic is a final global goal, also developing of standardized methods for monitoring the occurrence, distribution, and movement of microplastics in the environment is a serious challenge [3]. For this reason a series of research has been initiated to determine the effect of various substances in the sample on microplastic analysis and to develop universal protocols for removal of such an impurities and inhibitors for effective microplastic examination [4]. Nevertheless, the challenge is to propose one-pot approach for sample purification and its further analysis with limited negative effect on microplastic structure.

Hence, in the main goal of the presented study is to develop multienzymatic biomembrane composed of enzymes from various catalytic groups, for use in enzymatic membrane reactors for sample purification prior to microplastic analysis. As a main component of the system, aluminium- and gold-coated membranes were applied on the surface of which enzymes such as cellulase, lipase, protease and laccase were deposited. These enzymes are capable of removal of the most common impurities including cellulose, lipids and oils, peptides and biomass residues, respectively. The purpose of this research was to determine the most suitable conditions for membrane preparation and to examine enzymes order for retention of high catalytic properties and for efficient sample purification. After obtaining, membranes were thoroughly characterized to evaluate their physicochemical and morphological properties and were finally tested in removal of model impurities affecting microplastic analysis.

References

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Acknowledgments

The research was funded under National Science Center research project No. 2022/47/D/ST8/02677.