Streszczenie w języku angielskim

Personal Care Products (PCPs) are micropollutants that are increasingly identified in various environmental matrices. Of particular concern is the contamination of ecosystems with additives to PCPs, such as preservatives, until recently considered harmless to the environment. Despite the fact that these compounds occur in the environment in low concentrations, they are characterized by high biological activity, the potential for bioaccumulation and low biodegradability. The presence of preservatives in the natural environment poses a serious threat to the functioning of water and soil ecosystems, which creates the need to search for effective methods of elimination and detoxification.

A review of the literature data showed that, due to their widespread use in many personal protection products and ineffective elimination in sewage treatment plants, preservatives such as triclocarban, chloroxylenol (PCMX), methylisothiazolinone (MIT) and benzalkonium chloride, are identified in surface waters, bottom sediments, and soils. Scientific reports also indicate the toxicity of these preservatives. However, data on their microbial degradation are minimal. Of the described compounds, the least known are MIT and PCMX, therefore these preservatives were selected for the study.

The aim of the doctoral dissertation was to investigate the environmental changes that both xenobiotics are subject to, assess their toxicological risk to aquatic and soil organisms, as well as find microorganisms capable of eliminating these compounds.

It was demonstrated for the first time that MIT is found in soil and sewage samples in Poland. It was revealed that the strain *Phanerochaete chrysosporium* DSM 1556 was characterized by the highest tolerance to MIT among the tested microorganisms. Therefore, the ability of this microorganism to eliminate the tested xenobiotic was assessed. The *P. chrysosporium* strain was shown to completely eliminate MIT from the growth medium. LC-MS/MS and GC-MS/MS analyses of post-culture extracts enabled the identification of three new biodegradation products: hydroxymethylisothiazolinone, dihydroxymethylisothiazolinone and N-methylmalamic acid. The participation of laccase in this process was also demonstrated. The analysis of the toxicity of the tested compound and the formed metabolites with the use of *Daphnia magna* crustaceans showed that the process of MIT elimination is based on detoxification.

In the next stage of the research, the mechanism of chloroxylenol biodegradation by the strains *Cunninghamella elegans* IM 1785 / 21GP and *Trametes versicolor* IM 373, which were characterized by the highest degradation potential, was analyzed. It was found for the

first time that the metabolism of this preservative by *C. elegans* proceeds by dehalogenation, hydroxylation of the aromatic ring and oxidation of the methyl group with the formation of two chloroxylenol metabolites. In the case of *T. versicolor*, three metabolites were identified for the first time, showing that the biodegradation of PCMX by this strain proceeds by dehalogenation, hydroxylation and oxidation leading to ring cleavage. It was revealed that the degradation of chloroxylenol is mediated by cytochrome P450 enzymes in *C. elegans* and laccase in *T. versicolor*, and the process is based on detoxification.

The last stage of the research was the assessment of the environmental toxicity of methylisothiazolinone and chloroxylenol against soil bacteria *Pseudomonas putida* DSM 291, *Pseudomonas moorei* DSM 12647, *Sphingomonas mali* DSM 10565 and *Bacillus subtilis* DSM 3657. It was found that both MIT and PCMX caused a reduction of vitality and the ability to form biofilm, as well as inhibited phytohormone synthesis - indole-3-acetic acid, and increased the number of reactive oxygen species in the tested bacteria. Changes in the permeability of the cell membranes and in the phospholipid profile of the tested bacteria were also demonstrated in response to the toxic effects of MIT and PCMX.

The conducted research showed the possibility of using microorganisms capable of efficient elimination and detoxification of methylisothiazolinone and chloroxylenol in biotechnological processes. Moreover, the obtained results made it possible to learn about the potential environmental changes of the xenobiotics studied and to assess their toxicological risk to aquatic and soil organisms.