Streszczenie w języku angielskim

The development of technology in recent decades has led to a rapid increase in the production of polymeric materials, which are now used in almost every area of life, including industry, transportation, construction, and health care. However, the recycling of these compounds is limited, as they lose their original properties during successive cycles. The lack of efficient and environmentally friendly methods for polymer disposal necessitates the search for new solutions.

A specific type of pollution involves microplastics-particles ranging in size from 1 μm to 5 mm, which are formed either through technological processes or the breakdown of larger plastic fragments. Due to their small size, microplastics can migrate within living organisms, even at the cellular level, posing threats to both the environment and human health. Their presence disrupts metabolic processes, reproductive functions, and immune system activity.

Microplastic degradation by microorganisms has become a focus of intensive scientific research. Previous studies have primarily concentrated on the biodegradation of polymers such as polyethylene (PE) and polypropylene (PP) by single strains of microorganisms.

This dissertation presents research on the isolation of microorganisms-bacteria and fungi-capable of degrading selected polymers: PE, PP, polyvinyl chloride (PVC), polylactide (PLA), and polycarbonate (PC). Microorganisms were isolated from three different environments: soil from a landfill, sewage sludge, and river water. The isolation process employed an original method involving the incubation of sterile polymeric material as the sole energy source for the microorganisms present in the samples. Strain identification was conducted using classical molecular techniques (e.g.: DNA isolation, PCR, electrophoresis) and bioinformatics approaches (sequence analysis).

Fourier transform infrared spectroscopy (FTIR) was used to assess biodegradation, allowing the identification of changes in polymer structure, particularly in the region associated with carbonyl groups (>C=O). Additionally, scanning electron microscopy (SEM) was employed to observe surface changes in the microplastics and the formation of biofilms. For samples incubated with bacterial microbiomes, spectrophotometric measurements were performed to quantify biofilm formation. Furthermore, a metagenomic

analysis was conducted, enabling a comprehensive assessment the diversity of the studied microbiomes.

The results confirmed the ability of the isolated microorganisms to biodegrade all the tested polymers. SEM analysis revealed differences in the affinity of microorganisms for various plastics. FTIR analysis identified the presence of carbonyl groups in PVC samples incubated with soil material and sewage sludge. The smallest changes were observed for PP, which is considered the most resistant to biodegradation; however, a well-developed bacterial biofilm was detected on its surface. For PLA and PC, a reduction in the number of carbonyl groups was noted, suggesting that the degradation process had progressed. Metagenomic analysis showed that microbial diversity does not always correlate with biodegradation efficiency, with plastisphere-associated strains playing a pivotal role.

The results obtained confirm the effectiveness of the original method of isolation and selection of microorganisms capable of degrading specific polymers, which opens new perspectives in the study of biodegradation of plastics.