Green surfactants of the future – a new path to rhamnolipid synthesis without pathogens

Rhamnolipids are natural compounds produced by bacteria. They act as biosurfactants – substances that lower the surface tension of liquids and enable the mixing of substances that normally don't combine, such as oil and water. These properties make rhamnolipids useful in environmental cleanup, cosmetics, pharmaceuticals, and medicine – includingas antimicrobial agents and potential anti-cancer drugs.

Until now, rhamnolipids have been mainly produced by *Pseudomonas aeruginosa*, a pathogenic bacterium. Its industrial use poses biosafety risks and faces regulatory limitations. Alternatives such as genetic engineering and chemical synthesis exist but can be environmentally harmful or rely on toxic solvents.

Our project aims to develop a new, safe, and environmentally friendly method for producing rhamnolipids without using pathogenic organisms or hazardous chemicals. We will use biocatalysis – enzymatic reactions that act like natural, eco-friendly catalysts. Enzymes derived from yeasts and fungi will catalyse the reaction between rhamnose sugar and biodegradable fatty compounds obtained from non-pathogenic bacteria.

In addition, we plan to introduce structural modifications to potentially enhance the anticancer properties of rhamnolipids. New molecular variants will be synthesized and thoroughly tested for their physical, chemical, and biological properties – including micelle formation and selective toxicity against cancer and healthy cells.

This project addresses a key challenge in modern biotechnology: how to produce advanced bioactive compounds sustainably, safely, and in an environmentally conscious manner. The expected outcomes include a universal, enzyme-based platform for biosurfactant synthesis and a new class of compounds with therapeutic potential. The results may be relevant not only for science but also for the pharmaceutical and cosmetics industries.