Enzymes of the Future – New Life for Protein Waste

In the era of sustainable development and circular economy, waste does not have to be a problem – it can become a resource. This project focuses on one of the most underestimated side-streams of the food industry: animal protein waste, such as poultry feathers, keratin-rich tissue residues and soft tissues such as viscera. The aim of the project is to develop enzymatic tools – modern biocatalysts – that will enable efficient and selective conversion of these difficult substrates into valuable components of functional foods, feed and other bioactive products.

The starting point is the search for proteolytic enzymes (peptidases), including keratinases, originating from microorganisms from various environmental niches as well as from industrially used organisms. The project uses modern bioinformatic techniques (including InterProScan, Pfam, MEROPS, BLASTp, HMMER) and whole-genome sequencing to identify genes encoding these different proteases. Then, the most interesting sequences will be synthesized and transferred to *Yarrowia lipolytica* yeast – a host optimized for efficient protein secretion. Thanks to the use of modern cloning technologies (Golden Gate) and precise gene integration (including CRISPR/Cas9), yeast strains are being created that produce enzymes in an extremely efficient, stable and controlled manner.

Recombinant enzymes will be purified and thoroughly studied – their activity towards model and natural substrates, pH and temperature profile, resistance to environmental factors, kinetics and susceptibility to inhibitors will be analyzed. Each of these parameters plays a key role in the context of further use of enzymes in the development of protein waste processing technologies. Particular emphasis was placed on obtaining hydrolysates without a bitter taste, which is crucial for their use in functional food and high-quality feed.

The project not only responds to the real needs of the industry, but also opens up new possibilities for the use of microorganisms in biomass conversion processes. By combining elements of industrial biotechnology, genetic engineering and food technology, it makes a significant contribution to the development of green, innovative bioeconomy – in which even the most difficult waste is given a second life.