Polyhydroxyacids of psychrophilic polar region bacteria: role in bacterial adaptation to stress conditions and biotechnological potential

Microorganisms inhabit almost all available environments on Earth. They owe their successful colonizing skills partially to the ability of energy and nutrient providing substance storage. One such substance are the macromolecular polymers called polyhydroxyacids (PHAs), that help survive periodic carbon deficits but also enable to cope with several types of environmental stresses. Those polymers have recently gained much attention as an environmentally friendly (biodegradable) alternative for oil-based plastics.

The main objective of this project is to examine the role of bacterial storage materials that are PHAs in adaptation of polar region bacteria to stress conditions but also to evaluate biotechnological potential of those microbes and the PHAs they produce.

Bacterial strains from the Arctic and Antarctic Psychrophile ("cold-lovers") Collection (part of the Central Collection of Strains of the Institute of Biochemistry and Biophysics, Polish Academy of Sciences) will be screened for PHA production. This collection holds almost 3000 isolates derived from various materials gathered during six expeditions to Arctic and Antarctica. Strains will be examined for PHA granule storage and presence of key PHA synthesis enzyme encoding genes. Genetic and genomic research will allow to determine the structure of the whole genetic apparatus encoding the PHA synthesis ability in a given strain. Those gene clusters will be introduced into a model microorganism (*Escherichia coli*) to further examine PHA influence on bacterial physiology. PHA-positive native and recombinant strains as well as their PHA-negative mutant equivalents will be subjected to a range of cell damaging physical and chemical conditions to determine PHA involvement in their survival. Insights into the chemical structure of the polar region bacteria-produced PHAs and its biosynthesis from waste product materials, like glycerol, will allow to evaluate their biotechnological potential.

The reasons for tackling this specific subject are both scientific (ecologic) and economic. Polar region bacteria experience a multiple of life-challenging factors in combinations not seen in other environments. This causes an evolutionary emergence of mechanisms enabling growth in such harsh circumstances, like the ability to store and utilize PHAs. Therefore Arctic and Antarctic ecosystems may host a plenitude of diverse, stress resistant PHA producers, able to utilize new low temperature biosynthesis pathways using unusual carbon sources. The search and comprehensive analyses of such strains can prove extremely valuable when seeking to lower bioplastic production costs and raising their popularity among consumers.