DESCRIPTION FOR THE GENERAL PUBLIC

Persistent organic pollutants (POP) are emitted to the environment due to human activities, such as: fossil fuels combustion and industrial by-products and rubbish incineration. To these chemicals can be included dioxins and other compounds containing in their molecules multiple chlorine atoms, organic compounds in which hydrogen atoms are substituted by fluorine (perfluorinated), and chemicals containing multiple mutually condensed benzene rings (polycyclic aromatic hydrocarbons, PAH) [1]. POP have limited volatility and water solubility; therefore, in the environment they accumulate in soils and sediments [2]. Due to their structure POP are very resistant to biodegradation; moreover, they can adversely affect decomposer communities, that is soil bacteria and other microorganisms breaking down the dead organic matter. POP exhibit high affinity toward lipids; therefore, they can easily penetrate cellular membranes of the decomposer cells and accumulate therein changing their structure and function [3]. Moreover, POP molecules present in the biomembrane disturb the action of the enzymes belonging to the phospholipase group. Phospholipases are a diverse group of enzymes acting on phospholipids that is the main class of membrane lipid components [4]. They are responsible for the control of the proper phospholipid composition of the membrane. Moreover, due to their action messenger molecules can be formed, the appearance of which can cause the domino effects, that is trigger the so-called metabolic cascades, which can finally lead to the death of the cell [5]. In our project we intend to investigate the effect of the incorporation of different POP to biomembranes on their structure and on the activity of phospholipases. In our studies we will apply simplified models of decomposer biomembranes, as this will enable the investigation of the interactions between specific phospholipid molecules and selected POP, and between specific phospholipid molecules and a selected phospholipase. The models of biomembranes which we intend to apply in our research are Langmuir monolayers, that is films of one-molecule thickness, which are formed when the solution of a phospholipid in a volatile organic solvent (chloroform) is spread at the surface of water [6]. The solution is dropped on the water surface from an analytic syringe, after which the organic solvent evaporates and the film-forming molecules remain at the water surface. Langmuir monolayers are normally formed at the surface of an instrument called Langmuir trough, that is on a Teflon trough filled with water at the surface of which two barriers move enabling the monolayer compression. The compression of the monolayer changes the surface pressure which is measured with the application of a tensiometer. In our studies via mixing specific phospholipids we will form model membranes with their composition mimicking the bacterial, fungal, plant and animal biomembranes. At the beginning we intend to characterize these membranes, which will be followed with the incorporation of POP therein and the investigation how it affects the structure and physical properties of such membranes. Via the injection of the phospholipase solution below the monolayer we will introduce the enzyme into the system. This will be followed with the studies of its adsorption to the monolayer and the monitoring of the digestion of the monolayer material by the enzyme. The comparative studies of the monolayers with incorporated POP molecules and without them will enable to asses to which extent the POP molecules affect the activity of phospholipases. The structure of the monolayers will be visualized with the application of Brewster angle microscopy, which is dedicated to the research of thin organic films on liquid surfaces. The exact packing of the molecules in the monolayer will be investigated with the application of X-ray radiation (a synchrotrone method, GIXD), and the progress of the enzymatic reaction will be studied with the application of infrared radiation (spectroscopic method, PM-IRRAS). The completion of the planned studies will broaden the understanding of the influence of POP on decomposer organisms. The gathered knowledge can help in the more efficient elimination of POP from the environment, which can be achieved by the introduction into the soils of selected microorganism species resistant to POP and able to degrade them.

Literature

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