DESCRIPTION FOR THE GENERAL PUBLIC

In human environment there are more and more metal compounds, that may cause serious health issues. Effect of metal compounds poisoning such as Ni, Cr, Pt or Pd is risk of irreversible DNA damage, which may lead to cancer initiation. Among those metals, chromium (Cr) is particularly hazardous element due to the fact that its influence was only superficially examined.

Up to now it was shown that while hexavalent chromium (Cr^{VI}) compound passes lipid membrane, it rapidly reduces to Cr^{III} and only in this form Cr is present in cell interior [1,2]. It was also shown that transport may occur through ion channels. Moreover, using EPR technique it was proven that lipid bilayer become significantly much more fluid when exposed to Cr^{VI} compounds and that unstable radical Cr^{V}/Cr^{IV} metastates were generated [3]. It was direct evidence of lipid membrane damage. However, currently there is neither any consistent explanation of Cr^{VI} permeation mechanism through lipid bilayer nor a damage model to membranes due to exposure to Cr^{VI} compounds.

Main goal of proposed project is to study mechanisms governing process of Cr^{VI} permeation throughout model lipid membrane in which there is no ionic channels. The main goal is to proof existence and study a mechanism of Cr^{VI} permeation through phospholipid membrane with absence of ionic channels. Study will focus on interactions which lead to permeation process as well as on intermediate and final products. Attention will be given also to high oxidation stress due to Cr^{V}/CrI^{V} free radical generation during whole process [4]. Project will utilize X-Ray spectroscopic methods: synchrotron radiation RXES - Resonant X-Ray Emission Spectroscopy and time resolved synchrotron radiation XES - X-Ray Emission Spectroscopy as well as supplementary methods: PIXE – Proton Induced X-Ray Emission and EPR – Electron Paramagnetic Resonance. Due to their high selectivity and specificity RXES and XES methods will be focused on electronic structure and structural changes around Cr atoms during permeation process. EPR spin trapping method, which is based on fixation of unstable radicals, will allow to investigate short living species generated during process. PIXE experiments will quantitatively evaluate process of permeation of Cr compounds throughout lipid membrane. The study will be conducted on properly prepared liposomes treated with potassium dichromate (VI) and chromium (III) chloride solutions in different final pH and concentrations. RXES and XES experiment analysis will be supported by advanced theoretical calculations in FeFF 9.6 software.

Proposed research project will allow to identify and understand key aspects leading to chromium poisoning on cellular level and may help to develop techniques of curing such intoxications. What is more, it will be the first time when RXES method is used to lipid membrane system.

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