DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

Discovery and use of antibiotics to destroy selectively microorganisms represent one of the most significant progresses made in medicine, resulting in the treatment and sometimes complete eradication of earlier incurable diseases. At the beginning of twenty first century it was expected that bacteria related diseases will be reduced to the level that would no longer had a serious impact on human health. However, bacteria have developed resistance mechanisms against antimicrobial drugs being previously highly effective. Additionally, bacteria can form difficult to eradicate biofilms, which, according to the National Institute of Health are responsible for about 80% of human infections. Due to these facts, the search for novel methods effective in eradication of microorganisms seems to be necessary. Antimicrobial photodynamic therapy (aPDT) represents promising, new method to eliminate microbial cells.

Photodynamic therapy involves the simultaneous action of three component: oxygen, photosensitizer (PS) and light source of an appropriate wavelength that matches the absorption band of the dye. The interaction of oxygen with electronically excited, due to the absorption of light, molecules of photosensitizer results in generation of singlet oxygen and other reactive oxygen species (ROS). These reactive oxygen molecules can oxidize and damage nearly all types of biomolecules (proteins, lipids and nucleic acid) and kill cells. Advantage of aPDT as a potential new antimicrobial therapy is that aPDT works equally well towards the bacteria which are sensitive or resistant to antibiotics and that it is able to damage bacterial biofilms. This anti-biofilm activity has found a particular application in treatment of dental infections.

Photosensitizer plays a crucial role in aPDT. Optimal PS for aPDT should be non-toxic in dark, especially towards host healthy cells, should be characterized by high quantum yields of generation of singlet oxygen and ROS and high molar absorption coefficient in the visible-light spectral range. PS should also show selectivity for microbial cells over host cells particularly at short incubation times and should have cationic charge ideally provided by quaternary nitrogen atoms or basic amino groups.

Our research will be focused on the synthesis of series of novel low molecular weight cationic derivatives of boron hexaiodosubphthalocyanine and its conjugates with selected polymers (chitosan, polyethylenimine). Subphthalocyanines (SubPcs) are lower homologs of phthalocyanines, containing 14 delocalized π electron. Chlorine atom attached to the boron atom of the subphthalocyanine, can be easily displaced by-nucleophiles which allows to obtain monosubstituent derivatives. The presence of many iodine atoms in molecule should provide high population of excited triplet state, which will lead to high quantum yield of singlet oxygen and different ROS formation.

The aim of this project is to design novel, inexpensive and easy to synthesize photosensitizers, effective in aPDT for broad-spectrum of microorganisms. The aPDT effectiveness of low molecular weight photosensitizers and polymeric ones will be compared.