POPULAR SCIENCE DESCRIPTION OF THE PROJECT

In recent years the problem of untreatable bacterial infections became a serious threat for human health. Due to the overuse of known antibiotics, the number of multidrug resistant bacteria is still growing. This raises a need to act quickly and try to develop new strategy to fight harmful pathogens. Otherwise, the infections or even small injuries that were treatable for many years may turn out to be deadly. Most of the currently known antibiotic drugs acts specifically and affects certain biochemical processes within the cells. Unfortunately, the bacteria are quick learners and with time they develop the mechanisms that suppress drugs action. Many scientists believe that in order to solve this problem, an antimicrobial effect of the drug should be less specific. This can be done by choosing bacterial cell membrane as a target for antimicrobial action of new drugs. Cell membrane is a complex system responsible for many processes including transport of ions, water and nutrients between the surrounding environment and the interior of the cell. Thus the idea is to disturb membrane ability to function properly. In order to achieve such effect, there are several possible ways. One of the approaches is to disturb activity of proteins which are directly responsible for transmembrane transport such as ion channels embedded within the cell membrane. The question is how to realize this in practice. Again there are several ways, since the activity of the channels can be disturbed either directly or indirectly. The latter method will be explored within this project with use of artificial membranes with embedded mechanosensitive channels, which occur in bacterial membranes. Their role is to protect the cell from osmotic shock, so they work as security valves which release ions from inside the cell in response to membrane deformation, for example caused by large difference in concentration of solutes between surrounding environment and the cell interior. The main objective of this project is to verify whether the action of mechanosensitive channels can be affected by chemical or physical stimuli. In order to achieve this goal it is necessary to construct a model system mimicking natural cell membrane of bacteria. This can be done using artificial lipid bilayers deposited on solid surfaces like gold. Use of metal provides unique opportunity to look at the behavior of the bilayers in the presence of electric field which is comparable to that experienced by natural cell membranes. Important feature of these model systems is that they provide suitable environment to incorporate proteins such as ion channels. The model membranes with incorporated mechanosensitive channels will be exposed to chemical compounds that have ability to change the properties of the membrane and cause its deformation. Then we will look how it affects the channels structure. In order to get more detailed insight into the mechanism of channel opening, we will use numerous instrumental techniques, which enable conclusion about the changes in membrane permeability, elasticity, content of water and orientation of molecules within the assembly. Hopefully, state-of-the-art spectroscopic and microscopic techniques allow us to “see” how the channel opens.