

Viral infections constitute one of the major health issues worldwide and pose a serious risk to human life, including the human loss, long-term health effects as well as economic problems. The well-known representative of a human viruses, influenza virus, still constitutes an ongoing therapeutic challenge, with worldwide pandemics occurring quite frequently and claiming many deaths. Symptoms associated with influenza virus infection vary from a mild respiratory disease affecting mostly the upper respiratory tract accompanied by fever, headache, muscle pain and fatigue to more severe ones even leading to the lethal pneumonia. Additionally, influenza virus infection may also cause a wide range of other complications affecting the heart, central nervous system and other organs. On the other hand, the emergence of novel virus threats, such as severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), can develop especially dangerous pandemic diseases, as observed over the last several years. The existing medications seem not to be efficient enough to prevent the serious health issues caused by these viruses. Therefore, both scientists and medics have been focusing their attention to provide more successful and more efficient medicines to prevent a serious risk to human life and health caused by the viruses. It is obvious that novel approaches towards the prevention and treatment of the viral infections are necessary.

In this project, we propose to focus on the viral lipid envelope, which covers and protects both influenza and coronaviruses, as a potential new target for the antiviral agents. Therefore, the detailed understanding of the composition, structure and surface properties of the lipid envelopes from the chemical point of view is necessary at the beginning. The physicochemical description of the mechanisms of action of antiviral substances, both already being in use and novel, potentially effective medicines, on the lipid envelope will be useful for developing new strategies to prevent the spread of viral infections. The factors determining successful destabilization of the viral envelope leading to a decreased ability to replicate will be identified to provide new, important information in the field of the antiviral drug discovery. The investigated model systems will be characterized by a variety of combined, highly-specialized surface sensitive techniques including microscopy, spectroscopy and neutron and synchrotron-based methods. Such a unique combination of the experimental approaches, which has not been employed so far in the studies of viral lipid envelopes, will provide a very detailed, molecular-level description of the biophysical properties of such systems and mechanisms of interactions of antiviral agents with model viral envelopes. This type of information is crucial for increasing the efficiency of the treatment as well as for the introduction of novel drugs to fight viral infections.