Coordinator of infrastructural program
Prof.Dr. Dušan Turk
E-mail dusan.turk@ijs.si
Tel. +386 1 477 3957

Research institution
Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins
CIPKeBiP
Jamova cesta 39, Ljubljana (seat at Jožef Stefan Institute)

Title
ARIS Code IO-0048
Analysis and protein production and biologically active molecules of medical importance

Duration of the program
From 1. January 2013 to 31. December 2027

Abstract

In the second decade of postgenomic era, genome sequencing and the development of new technologies have completely changed the concept of research in the biological sciences. Today, we are witnessing the integration of approaches that, on the hand collect data and analyze processes in cells and organisms as a whole and, on the other hand, observe and analyze increasingly complex molecular processes „in vitro“, which are approaching the situations in cells. In this process of integrating knowledge and information, computational tools are becoming a crucial part of science and development. In order to follow contemporary trends in science and provide researchers from academa and industry with access to modern cutting-edge technologies, we have established a technological and scientific platform in the Centre of excellence for Integrated Approaches in Chemistry and Biology of Proteins (CIPKeBiP). The platform represents an essential infrastructure. It enables the identification of carriers of individual physiological and pathological processes, the characterization of their biochemical and biophysical properties and structure as well as the exploitation of the knowledge gained for commercial purposes.

The infrastructure created within the CIPKeBiP Centre of Excellence includes world-class state-of-the-art research and development equipment. Additional funding to support the proposed Infrastructure program will provide the opportunity to make this cutting-edge research infrastructure and expertise available to other Slovenian academic and industrial research groups. A number of academic and industrial projects can be supported by increasing their competitiveness at the same time. In particular, we would like to emphasize that the local availability of such infrastructural support for Slovenian industry (pharmaceutical and biotechnological companies) will enable them to carry out the necessary research and analysis in Slovenia instead of relocating it abroad.

To take advantage of this most advanced research infrastructure of the Centre of excellence, we propose the infrastructure program for „Analysis and protein production and biologically active molecules of medical importance“. It is a biomedically oriented program. The proposed infrastructure program has the potential to support the most advanced and challenging research and development projects. It will support the leading academic and industrial institutions in Slovenia in the development of new biological drugs and biologically active

organic compounds. The infrastructure is divided into five areas and an additional area for COVID-19:

1. Visualization of molecules and their interactions in cells alone or in tissues and organisms with high resolution light microscopy;

2. Analysis and identification of protein composition in complex samples and analysis and identification of individual biological molecules and their modifications by mass spectroscopy;

3. Analysis of interactions, structure and properties of biologically active molecules (proteins and small organic molecules);

4. Development of novel potential biological drugs and drugs on the basis of biologically active organic molecules (studies at the levels of function of organelles in cells, identification and characterization of molecules with clinical potential, and expression, purification and optimization of production processes of biologically active molecules);

5. Demanding computational analysis of complex biological and other experimental data in the sense of integration of knowledge as well as optimization of experimental approaches and technological processes.

Research into the mechanisms of viral infections to prevent the spread of COVID-19 disease

We are investigating the interactions between potential protein inhibitors and proteolytic enzymes of the SARS-CoV-2 virus. We will prepare viral proteases and use proteomic methods to determine their specificity for natural substrates from the lung epithelium and try to identify some potentially critical human substrates.

Theoretically, based on developed SVM models, the possibility of cleavage of the S protein of the SARS-CoV-2 virus (with which the virus enters the cell) by endosomal proteases will be investigated.

When investigating the function of SARS-CoV-2 virus proteins in the cell, the possibility of inhibiting virus replication is also being investigated. In this context, the role of autophagy and lipid droplets as well as the influence of potential drugs on the function of viral proteins are being investigated.

Key words
proteins; small organic molecules; visualisation of molecules; structural biology; protein production, mass spectroscopy; demanding computational analysis;