BIOCHEMISTRY

The influence of ligands binding recognizing non-canonical structural motifs of nucleic acids
supervisor: doc. RNDr. Viktor Víglaský, PhD. (viktor.viglasky@upjs.sk)
study form: full time
Annotation: The occurrence and location of non-canonic structural motifs in nucleic acids, e.g. DNA hairpins, triplexes and G-quadruplexes, are non-random. These motifs, and not mutation in structural genes, are crucial control elements influencing various biological processes including a gene expression of regulating proteins. There are responsible for example for the loss of cell proliferation control, induction of neoplasms formation, inefficiency in DNA repair and recombination, unexpected cell differentiation and senescence. The main task will be to determine condition of non-canonic motifs formation and their stabilization by specific ligands and their influence to cell viability.

Development of tageted contrasting DNA- aptamer-nanoconjugates for dignostics
supervisor: doc. RNDr. Viktor Víglaský, PhD. (viktor.viglasky@upjs.sk)
study form: full time
Annotation: Nanoparticles are commonly used for bioimaging and drug delivery in cancer diagnostics and treatment. Their use can be substantially improved when they are modified with DNA aptamers, artificial nucleic acid ligands, recognizing various molecular targets with high selectivity and sensitivity. Binding of the aptamer to its target “anchors” the aptamer nanoparticle conjugate at its site of action. The goal of investigation will be focused on development of targeted nanoparticle-aptamer bioconjugates. The main goal of research will be to find universal procedure for low cost production of conjugated receptor molecules which could be used for diagnostics of wide scale of molecular targets.

Design, synthesis, and biological activity of selected heterocyclic compounds
supervisor: doc. RNDr. Mária Kožurková, CSc. (maria.kozurkova@upjs.sk)
consultant: RNDr. Slávka Hamuľaková, PhD.
study form: full time
Annotation: Heterocyclic compounds represent one of the most valuable sources of compounds with significant biological activity. Heterocyclic structures provide the possibility of synthesizing new derivatives based on one main skeleton, which can be combined indefinitely, leading to the formation of new compounds with different physical, chemical, and biological properties.
Heterocyclic compounds are used in chemotherapy for the treatment of infectious, parasitic, or malignant diseases, but also the treatment of neurodegenerative diseases. They can affect the functioning of enzymes, the transmission of nerve impulses, or the action of hormones on receptors. The introduction of heterocyclic scaffolds into drugs can affect their physical properties such as absorption, metabolism, and toxicity, as well as the biological efficacy of the whole drug. The dissertation will aim to prepare new types of heterocyclic compounds as drugs with the perspective of application in medicine, to clarify details about the method of their binding with selected biomacromolecules, and to monitor the inhibitory effect of these substances on the activity of selected enzymes.

Purification and characterization of selected haloalkane dehalogenase mutants
supervisor: doc. RNDr. Erik Sedlák, DrSc. (erik.sedlak@upjs.sk)
consultant: RNDr. Rastislav Varhač, PhD.
study form: full time
Annotation: Haloalkane dehalogenases are microbial enzymes - hydrolases, which are able to cleave carbon-halogen bonds in halogenated compounds and convert them into less toxic alternatives – alcohols. Since most of the halogenated compounds used in practice also represent prominent environmental pollutants, the capability of dehalogenases to partially degrade these compounds has a significant value for environmental protection. The aim of the dissertation is to provide a detailed analysis and characterization of biophysical and biochemical properties of individual haloalkane dehalodenases mutants obtained by directed evolution with an emphasis on the study of enzyme kinetics.

Nanobodies as a platform for a interactions with biological molecules
supervisor: RNDr. Gabriel Žoldák, PhD. (gabriel.zoldak@upjs.sk)
consultant: prof. Ing. Marián Antalík, DrSc.
study form: full time
Annotation: Nanobodies are a group of proteins with a high potential for developing new therapeutic strategies in biomedicine. Nanobodies are a relatively small, monomeric antigen-binding proteins that are derived from the variable domain of the heavy chain of antibodies. Their main advantage over classical monoclonal antibodies is their high stability, solubility, and ease of preparation using standard techniques of biochemistry and molecular biology. This dissertation will focus on the purification of nanobodies in E. coli, understanding the relationship structure - function-stability, and on the development of experimental approaches for the identification of suitable candidates, which bind selected target molecules.

Novel protein discovery by phage-display screening from metagenomic libraries
supervisor: RNDr. Gabriel Žoldák, PhD. (gabriel.zoldak@upjs.sk)
consultants: prof. Ing. Marián Antalík, DrSc., Dr. Susana Garcia Sanchez
study form: full time
Annotation: Naturally occurring peptides and proteins with promising biotechnological applications are produced by different biological taxa under extreme environmental conditions, including biotic or abiotic challenges. The aim of this project is to explore -and exploit- the molecular diversity of Slovakian phytomicrobiome communities by using phage-display technology. Metagenomic libraries will be constructed to allow the expression of a vast number of protein variants and select functional products.