Laboratory of Heme-Containing Sensor Proteins

"We are looking for cooperation in the fields of hemoprotein's related research focused mainly on heme enzymes or heme-containing sensors."

Offer

We offer our expertise, as well as consultancy or collaboration within a diverse range of biochemical or clinical biochemistry related topics, particularly in the fields of:

- hemoproteins (heme enzymes and heme-containing sensor proteins)
- diatomic gas molecules (NO, CO and O2) and their interaction with heme in hemoproteins
- enzymology
- post-translation modifications of hemoproteins
- protein stability and structure-function relationship
- oxidative stress in cells
- heavy metal ions including their complexes (such as free heme) and their effect on cells
- ionizing radiation and its effect on cells

Know-how & Technologies

- Identification of new hemoproteins and description of their properties
- Various hemoproteins production and/or isolation, their characterization including protein engineering
- Development of new antibacterial strategies based on the research focused on heme enzymes and heme sensors
- Development of new anticancer strategies based on the research focused on heme-containing sensor proteins that are unique for pathological bacteria
- Detection of diatomic gas molecules (NO, CO and O2) based on their specific interaction with heme-containing gas sensor proteins
- Molecular modeling of hemoproteins

Content of Research

Heme-containing Sensor Proteins

- structure-function relationships
- involvement in carcinogenesis - anticancer therapy
- involvement in bacterial pathogenesis - antibacterial therapy

Heme Enzymes

- structure-function relationships
- involvement in carcinogenesis – anticancer therapy

Mechanism of Signal Transduction in Eukaryotic and Prokaryotic Cells

- Role of heme in regulatory pathways (for example in regulation of protein expression)

Main Capabilities

Protein production, protein isolation, protein characterization, protein engineering, enzymology, protein-ligand interaction studies, immunochemical methods, electrochemical methods, chromatography and spectrophotometry

Key Research Equipment

Absorption spectroscopy, equipment for various chromatography approaches, mass spectrometry, standard equipment for molecular biology and protein engineering

Partnerships & Collaborations

Academic Partners

- Ecole Polytechnique, Palaiseau, France (Marten Vos and Ursula Liebl – ultrafast spectroscopy)
- Université Montpellier, France (Reinhard Lange – spectroscopy under high pressure)
- Cyprus University of Technology, Limessol and University of Cypru, Nicosia, Cyprus (Constantinos Varotsis and Eftychia Pinakoulaki – FTIR and Raman spectroscopy)
- Laboratory of Pediatric Infect. Diseases, Nijmegen, Netherlands (Marien de Jonge – microbiology)
- Tohoku University, Sendai, Japan (Kazuhiko Igarashi – eukaryotic heme sensor proteins)
- Institute of Microbiology, Prague, Czech Republic (Miroslav Šulc – mass spectrometry)
- BIOCEV, Vestec, Czech Republic (Petr Man and Petr Pompach – mass spectrometry; Jan Dohnálek – X-ray)

Private and Public Sector

- IPSEN Pharma, os. (France, 2014–2015)
- BEDO (Thailand, 2015–2016)
. National Radiation Protection Institute (Czech Republic, 2019–)

Main Projects

- 2012–2017: Modern technologies for identification and optimization of anti-tumor drugs of the new generation. Participation in the project granted to Assoc. Prof. RNDr. Miroslav Šulc, PhD. UNCE 204025/2012
- 2014–2015: Comparison of the adsorption capacity and trapping effectiveness of diosmectite and charcoal on the compounds causing the 10 most frequent intoxications in acute medicine. External sponsored study by IPSEN Pharma, os.
- 2015–2017: Molecular mechanisms of intraprotein/interdomain signal transduction in model heme sensor proteins. GAČR, 15-19883S

Achievements

- Stranava M, Man P, Skálová T, Kolenko P, Blaha J, Fojtikova V, Martínek V, Dohnálek J, Lengalova A, Rosůlek M, Shimizu T, Martinkova M (2017) *Coordination and redox state-dependent structural changes of the heme-based oxygen sensor AfGcHK associated with intraprotein signal transduction*, J Biol Chem, 292: 20921–20935
- Miná́riková M, Fojtikova V, Vyskočilová E, Sedláček J, Šikut M. Borek-Dohalska L, Stiborová M, Martinkova M (2017) *The capacity and effectiveness of diosmectite and charcoal in trapping the compounds causing the most frequent intoxications in acute medicine: a comparative study*, Environ Toxicol Phar 52: 214–220
- Stranava M, Martinek V, Man P, Fojtikova V, Kavan D, Vaněk O, Shimizu T, Martinkova M (2016) *Structural Characterization of the Heme-based Oxygen Sensor, AfGcHK, its Interactions with the Cognate Response Regulator, and their Combined Mechanism of Action in a Bacterial Two-component Signaling System*. Proteins, 84: 1375–89
- Kuipers K, Gallay C, Martínek V, Rohde M, Martínková M, van der Beek SL, Jong WS, Venselaar H, Zomer A, Bootsma H, Veening JW, de Jonge MI (2016) *Highly conserved nucleotide phosphatase essential for membrane lipid homeostasis in Streptococcus pneumoniae.* Mol Microbiol 101: 12–26
- Lambry J-Ch, Stranava M, Lobato L, Martinkova M, Shimizu T, Liebl U, Vos MH (2016) *Ultrafast Spectroscopy Evidence for Picosecond Ligand Exchange at the Binding Site of a Heme Protein: Heme-based Sensor YddV*. J Phys Chem Lett 7: 69–74
- Fojtikova V, Stranava M, Vos M H, Liebl U, Hraníček J, Kitanishi K, Shimizu T, Martinkova M (2015) *Kinetic Analysis of a Globin-coupled Histidine Kinase, AfGcHK: Effects of the Heme Iron Complex, Response Regulator and Metal Cations on Autophosphorylation Activity.* Biochemistry 54: 5017–5029
- Shimizu T, Yan F, Huang D, Stráňava M, Bartošová M, Fojtíková V, Martínková M (2015) *Molecular Characteristics of Heme- based Gas (O2, NO and CO) Sensors.* Chem Rev 115: 6491?6533

Are you interested in this expertisa?

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Experts and their department

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