Laboratory of Metabolism and Bioenergetics

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Welcome to the Laboratory of Metabolism and Bioenergetics!

Our laboratory focuses on **mitochondrial function, cancer biology, and cardiovascular research.**

Mitochondrial Research:
- **Iron metabolism**
- **Oxidative stress**
- **Transport of substances** across the mitochondrial membran**e**
- **Effects of drugs and environmental factors** on mitochondrial funct**ion**

Cancer Biology:
- Cultivation of organoids and 2D cell cultures from primary samples obtained **from patients with pancreatic adenocarcinoma**
- **Personalized genotyping, metabotyping, and pharmacotyping** of pancreatic tumors from patient biopsies
- Investigation of tumor cell communication at the cellular level
- Research on chemotherapeutic resistance

Cardiovascular Research:
- Pathophysiology of **atrial fibrillation**
- Investigation of the **molecular effects** of new **catheterization methods** in arrhythmology
- **Gene transfection of cardiomyocytes**

Laboratory Activities
- Cell and tissue cultures (organoids)
- Confocal and fluorescence microscopy
- Analysis of cellular respiration and metabolism
- Flow cytometry
- Protein and gene expression analyses
- Electroporation of cell membranes
- Fluoro/spectro/luminescence analyses
- Statistical analyses in accordance with the principles of open science (Open Science), including sharing experimental data and analytical scripts with a preference for Bayesian inference methods (R-Studio, Matlab)

Our team:
The head of the lab:

prof. MUDr. Jan Trnka, Ph.D., M.Phil., M.Scjan.trnka@lf3.cuni.cz ORCID WebofScience

· a **graduate** of general medicine at the **3rd Faculty of Medicine, Charles University**, with postgraduate studies in biochemistry and the history and philosophy of science at the **University of Cambridge**, and medical education at **Karolinska Institutet in Stockholm**
· **head of the Laboratory of Metabolism and Bioenergetics** since **2010** and the **Institute of Biochemistry, Cell, and Molecular Biology** since **2017**
· specializes in **mitochondrial function and dysfunction, mitochondria-targeted drugs, tumor tissue metabolism, and Bayesian modeling**

Assistant Professors:
Ing. Stanislava Martínková, Ph.D.Podnadpis
Text

· **a graduate** of the doctoral program in Molecular and Cell Biology and Genetics at the Faculty of Science, University of South Bohemia in České Budějovice

· **specializes in** research on pancreatic ductal adenocarcinoma

· **focuses on** improving targeted therapy and studying chemotherapeutic resistance in pancreatic tumors

· **works with** primary 2D and 3D cell cultures, cell lines, performs gene transfection, cloning, confocal and fluorescence microscopy, and measures metabolism, cellular respiration, and protein expression

· Has experience in molecular and cell biology, biochemistry, including developmental and cancer biology

Mgr. Ivana Fišerová, Ph.D.Podnadpis
Text

· **a graduate of** Animal and Human Physiology at the Faculty of Science, Charles University, and a postgraduate degree in Human Pathophysiology at the 3rd Faculty of Medicine, Charles University

· **specializes in** the pathophysiology of cardiovascular diseases

· **focuses on** enhancing the safety and effectiveness of cardiac ablation for arrhythmogenic myocardial disorders

· **works with** cell cultures, performs irreversible electroporation and electrotransfection, operates fluorescence microscopy, measures metabolism and protein expression, and analyzes and visualizes data using Matlab

Researchers:
Bc. Jana VorelPodnadpis
Text

· **a graduate of** the bachelor's program in Biochemistry and Biotechnology at the Faculty of Food and Biochemical Technology, University of Chemistry and Technology, currently pursuing a master's degree in Biochemistry

· **specializes in** tumor biology metabolism

· **focuses on** the influence of the cell cycle on cellular response to chemotherapeutic agents

· **works with** cell cultures, pharmacotyping of cell lines and primary cultures, operates fluorescence microscopy and flow cytometry, and measures metabolism and protein expression

Postgraduate students:
Mgr. Lucie Josefa LamačováPodnadpis
Text

· **a graduate of** the Organic Chemistry program at the Faculty of Science, Charles University

· **specializes in** mitochondria-targeted compounds and iron metabolism

· **focuses on** studying deferiprone derivatives targeted to mitochondria and their impact on iron metabolism in cancer cells

· **works with** cell cultures, fluorescence microscopy, measures metabolism and protein expression, HPLC, LC-MS, analyzes and visualizes data using R, conducts Bayesian modeling, and engages in science communication

Mgr. Michal ZuzčákPodnadpis
Text

· **a graduate** of Molecular Biology at the Faculty of Science, Comenius University in Bratislava

· **specializes in** the metabolism of pancreatic tumors

· **focuses on** the regulatory mechanism of the lactate transporter MCT1 and the influence of nutrients on its function in pancreatic tumors

· **works with** cell cultures, operates fluorescence microscopy and flow cytometry, and measures metabolism and protein expression

MUDr. Mário BoďoPodnadpis
Text

· **a graduate of** general medicine from the 3rd Faculty of Medicine, Charles University, and a physician at the Internal Clinic of the FNKV and the 3rd Faculty of Medicine, Charles University.

· **specializes in** the pathophysiology of pancreatic ductal adenocarcinoma.

· **focuses on** researching the mechanisms of chemotherapeutic resistance in pancreatic ductal adenocarcinoma, particularly on the development of resistance at low concentrations of cytotoxic drugs.

· **works with** cell cultures, operates fluorescence microscopy, measures metabolism, cellular respiration, and protein expression.

Undergraduate Students:
Alice Kapáková
David Kvapil
Kateřina Šmejkalová
Tomáš Wolf

Alumni:
Mgr. Anežka Kafková, Ph.D.
Mgr. Zdeňka Syrová, Ph.D.
Mgr. Jana Tůmová (Patková), Ph.D. (2009-2016)
Moustafa Elkalaf, MBBCh, Ph.D. (2009-2019)

Current Projects:
- Pharmacotyping, metabotyping, genotyping, and research on chemotherapeutic resistance in pancreatic ductal adenocarcinoma
- **3/2024-12/2028** - Public competition of the ZEMĚ II Program – Ministry of Agriculture - QL24010123 - Reproductive disorders in pigs - exposure of farms to harmful substances. Co-investigator: Stanislava Martínková
- **2024/2026** - GAUK 108624 - Mechanisms of chemoresistance development in pancreatic adenocarcinoma at low concentrations of cytostatics. Principal Investigator: Mário Boďo
- **UNCE 24/MED/015** - Research on the influence of pathophysiological mechanisms in modern cardiovascular disease treatment

- Biophysical and safety aspects of pulsed field ablation (irreversible electroporation) of cardiomyocytes and surrounding tissue in vitro

Unique Instruments:

- Seahorse XFp and XF24 – real-time analysis of cellular respiration and anaerobic glycolysis
- TONAGENA electroporation system for electroporation and electrotransfection of adherent cell cultures

Collaborations:

- MRC Mitochondrial Biology Unit, University of Cambridge
- Internal Clinic of the 3rd Faculty of Medicine, Charles University, University Hospital Královské Vinohrady
- Cardiology Clinic of the 3rd Faculty of Medicine, Charles University, University Hospital Královské Vinohrady
- Internal Clinic of the 3rd Faculty of Medicine, Charles University, Bulovka Hospital
- Institute of Histology and Embryology, Faculty of Medicine, Masaryk University

- Faculty of Biomedical Engineering, Czech Technical University in Prague
- Vera Vávrová's Laboratory, Pediatric Clinic of the 2nd Faculty of Medicine, Charles University, and FN Motol
- Institute of Animal Production, Department of Reproductive Biology – Regulation of Mammalian Oocyte Maturation
- Institute of Animal Physiology and Genetics, Czech Academy of Sciences, Laboratory of Biochemistry and Molecular Biology of Germ Cells
- Tonagena Ltd.

Recent Publications:

Zloh, Miloslav, Patrik Kutilek, Jan Hejda, **Ivana Fiserova**, Jan Kubovciak, Masaaki Murakami, and Andrea Stofkova. 2024. “Visual Stimulation and Brain-Derived Neurotrophic Factor (BDNF) Have Protective Effects in Experimental Autoimmune Uveoretinitis.” Life Sciences 355 (October). https://doi.org/10.1016/j.lfs.2024.122996

Acimovic I, Gabrielová V, **Martínková S**, Eid M, Vlažný J, Moravčík P, Hlavsa J, Moráň L, Cakmakci RC, Staňo P, Procházka V, Kala Z, **Trnka J**, Vaňhara P. (2024). Ex-vivo 3D cellular models of pancreatic ductal adenocarcinoma: from embryonic development to precision oncology. Pancreas. 2024 Jul 30. doi: 10.1097/MPA.0000000000002393. Epub ahead of print. PMID: 39074056.

Fiserova, Ivana, Ondrej Fiser, Marek Novak, **Jan Trnka, Antonia Gibalova, David Kvapil**, Barbora Bacova, Marek Hozman, Dalibor Herman, Klara Benesova, and Pavel Osmancik. 2024. “Significant Hemolysis Is Present during Irreversible Electroporation of Cardiomyocytes in Vitro.” Heart Rhythm. doi: 10.1016/j.hrthm.2024.08.019.

Osmancik, Pavel, Barbora Bacova, Dalibor Herman, Marek Hozman, **Ivana Fiserova**, Sabri Hassouna, Vaclav Melenovsky, Jakub Karch, Jana Vesela, Klara Benesova, and Vivek Y. Reddy. 2024. “Periprocedural Intravascular Hemolysis During Atrial Fibrillation Ablation: A Comparison of Pulsed Field With Radiofrequency Ablation.” JACC: Clinical Electrophysiology 10(7):1660–71. doi: 10.1016/j.jacep.2024.05.001.

Lucie J. Lamačová, and **Jan Trnka**. 2024. “Chelating Mitochondrial Iron and Copper: Recipes, Pitfalls and Promise.” Mitochondrion. Elsevier B.V. https://doi.org/10.1016/j.mito.2024.101903 .

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Anežka Kafková, Lisa Tilokani, Filip Trčka, Veronika Šrámková, Marie Vancová, Tomáš Bílý, Jana Nebesářová, Julien Prudent, and **Jan Trnka**. 2023. “Selective and Reversible Disruption of Mitochondrial Inner Membrane Protein Complexes by Lipophilic Cations.” Mitochondrion 68 (January):60–71. https://doi.org/10.1016/j.mito.2022.11.006 .

Fiserova I, Trinh MD, Elkalaf M, Vacek L, Heide M, **Martinkova S**, Bechynska K, Kosek V, Hajslova J, Fiser O, Tousek P, Polak J. (2022). Isoprenaline modified the lipidomic profile and reduced ?-oxidation in HL-1 cardiomyocytes: In vitro model of takotsubo syndrome. Front Cardiovasc Med. Aug 22;9:917989. doi: 10.3389/fcvm.2022.917989. PMID: 36072861; PMCID: PMC9441769.

Michal Šíma, **Stanislava Martínková, Anežka Kafková**, Jan Pala, and **Jan Trnka**. 2022. “Cell-Tak Coating Interferes With DNA-Based Normalization of Metabolic Flux Data.” Physiological Research 71 (4): 517–26. https://doi.org/10.33549/physiolres.934855 .

Michal Zuzčák, and **Jan Trnka**. 2022. “Cellular Metabolism in Pancreatic Cancer as a Tool for Prognosis and Treatment (Review).” International Journal of Oncology. Spandidos Publications. https://doi.org/10.3892/IJO.2022.5383.

J. Fontana, S. Martínková, J. Petr, T. Žalmanová, **J. Trnka**. Metabolic cooperation in the ovarian follicle. Physiol. Res. 69: 33-48, 2020; doi: 10.33549/physiolres.934233

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