Eukaryotic mikrobiology and protistology

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The research is focused on unicellular eukaryotes (protists) and covers three main directions: research on parasitic and free?living protists, research on phototrophic organisms, and research on yeast colonies.

The first topic includes the study of organisms at the level of diversity, evolution and ekology of obligate anaerobic protists. Studied include both free?living organisms occurring in freshwater and marine anoxic sediments, symbionts as well as parasites of different groups of invertebrates and vertebrates, including humans, who inhabit mainly gastrointestinal or genitourinary tract. Attention is also paid to various types of symbiosis between anaerobic ciliates and prokaryotic organisms. Research of aerobic protists is mainly focused on free?living and parasitic protists of Euglenozoa group. For free?living protists, emphasis is given to evolution of secondary plastids in the group Euglenida. Studies of parasitic protists of Kinetoplastida group are focused on leishmania, serious pathogens of humans and domestic animals, and their development in vectors. We have defined the current view of interspecies differences in Leishmania?vector relationship, demonstrated sexual multiplication of Leishmania in vectors, and introduced a unique method for determining the risk of infection using antibodies against the saliva of vectors. In addition to laboratory experiments, we carry out field investigations in endemic areas of leishmaniasis. At the subcellular level, we study evolution and function of semiautonomic organelles (mitochondria, plastids), particularly specific adaptations of these organelles in relation to the evolution of parasitism and adaptation to anaerobic environments. Emphasis is given to investigations of the role of reductive evolution and lateral gene transfer in transition of classical mitochondria to their anaerobic forms: hydrogenosomes and mitosomes. The main findings include the discovery of complete loss of mitochondria in a specific lineage within Preaxostyla group. At the molecular level, we studied complete genomes of selected organisms, changes in transcriptomes under various environmental conditions, and proteomes of isolated subcellular structures.

The second direction is concentrated on research of phylogenetic diversity of phototrophic unicellular eukaryotes. Using techniques of molecular phylogenetics, microscopy and metabolomics, the research deals with the mechanisms that generate and maintain diversity and structure of micro?algae communities in nature. Part of this activity is the study of the molecular diversity of micro?algae habitats (sub?aeric biofilms, microbentos). Parallel direction is also studying precipitation of inorganic crystals and colloidal nanostructures in algal cells. The main model groups include flagellates of Stramenopiles , diatoms and unicellular green algae.

The most important result in the third direction of research is the finding that yeast colonies behave as primitive multicellular organisms in which the cells differentiate and form specialized cell populations, which mutually cooperate or compete. One of the studied subpopulations, which is long?lived and resistant to metabolic stress, is markedly similar to cells of mammalian tumors. Specialized subpopulations of biofilm colonies are important for protection against external influences.

Selected outputs

- Makki A., Rada P, Žárský V., Kereiche S., Kovacik L., Novotny M., Jores T., Rapaport D., Tachezy J. (2019): Triplet-pore structure of a highly divergent TOM complex of hydrogenosomes in Trichomonas vaginalis. PLoS Biology. 17(1):e3000098. doi: 10.1371/journal.pbio.3000098
- Karnkowska A, Vacek V, Zubáčová Z, Treitli SC, Petrželková R, Eme L, Novák L, Žárský V, Barlow LD, Herman EK, Soukal P, Hroudová M, Doležal P, Stairs CW, Roger AJ, Eliáš M, Dacks JB, Vlček Č, Hampl V. (2016): A Eukaryote without a mitochondrial organelle. Curr Biol. 2016 May 23;26(10):1274-84. doi: 10.1016/j.cub.2016.03.053
- Nguyen PV, Hlaváček O, Maršíková J, Váchová L, Palková Z. (2018) Cyc8p and Tup1p transcription regulators antagonistically regulate Flo11p expression and complexity of yeast colony biofilms. PLoS Genet. 14(7):e1007495
- Sumova P, Sima M, Spitzova T, Osman ME, Guimaraes-Costa AB, Oliveira F, Elnaiem DA, Hailu A, Warburg A, Valenzuela JG, Volf P. (2018) Human antibody reaction against recombinant salivary proteins of Phlebotomus orientalis in Eastern Africa. PLoS Negl Trop Dis. 2018 Dec 4;12(12):e0006981