ANIMAL PHYSIOLOGY

Chronophysiology of the dentine and bone tissue in ectotherms and endotherms

supervisor: doc. RNDr. Martin Kundrát, PhD.
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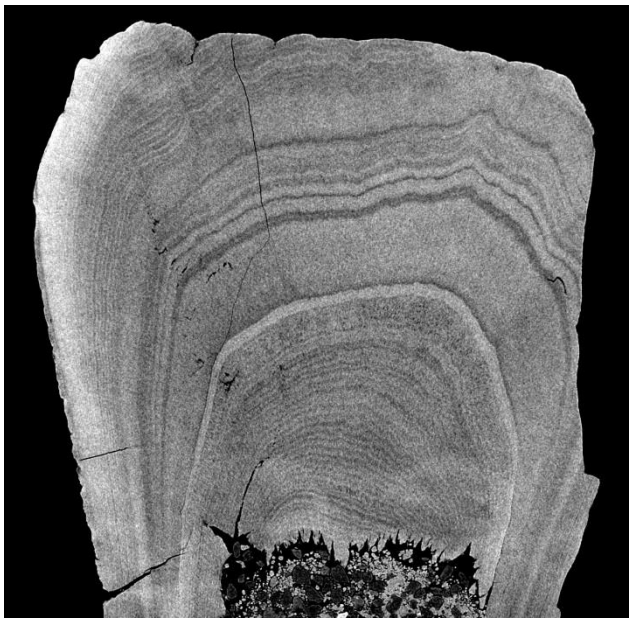
consultant: prof. RNDr. Beňadik Šmajda, CSc.
study form: full time

Annotation: Formation of skeletal tissues is known to show biological rhythms including seasonal rhythms, and is sensitive to different stressors and climatic events. Dentine increments are usually deposited with finer periodicity whereas bone compacta is usually interrupted by growth marks on a yearly base or lacking any cessations in growth. How these two different tissues develop under the same external conditions in cold-blooded and warm-blooded tetrapods remain unclear when it comes to quantification of micro-structure changes in three dimensions and over million years. The doctoral student is expected to investigate these microstructural specializations on different sets of extant and extinct animals. Particularly, this project has been centered on organismal types such as: (under)ground dwellers *versus* gliders/fliers, eastivating *versus* hibernating specialists, and miniature *versus* gigantic forms. The student will use both approaches: invasive physical sectioning and non-invasive micro-tomographic imaging (based on both conventional and synchrotron sources). The student will analyze the imaging outcomes by tools of geometric morphometry and biostatistics. The stable isotope spectroscopy datasets will be available for this study as well. Active participation in field work is required. We aim to find significant correlations between osteo-physiology and environmental stresses as well as behavioral specializations on a broad interdisciplinary platform. The project will be funded through the project APVV-18-0251 and several synchrotron-based grants.



Convergent osteo-physiological patterns in the evolution of the flapping flight: bats vs birds vs pterosaurs.

supervisor: doc. RNDr. Martin Kundrát, PhD.
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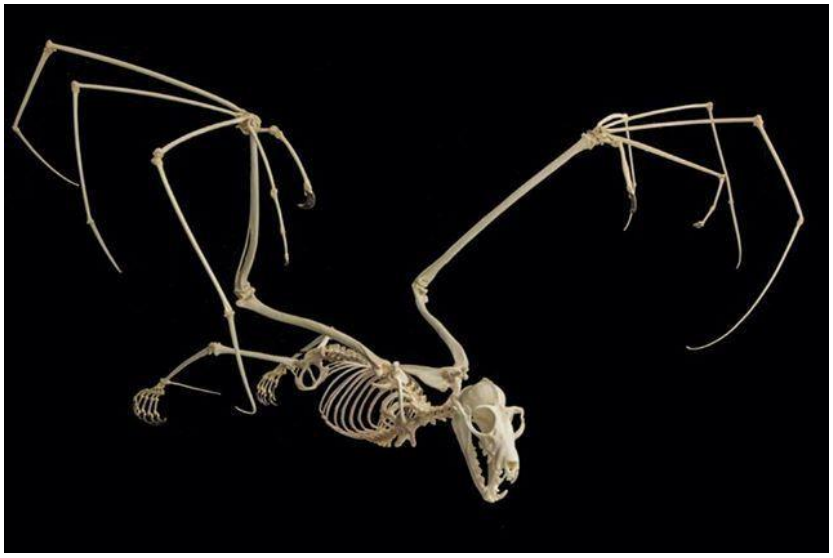
consultant: prof. RNDr. Beňadik Šmajda, CSc.
study form: full-time study

Annotation: There are three groups of vertebrates that colonized aerial environment: bats (Mammalia), avialan dinosaurs (Aves), and pterosaurs (Reptilia). Apart from distinct ancestry, bats, birds and pterosaurs are the well-known example of functional convergence of forelimb in the evolution of flapping flight. In contrast to birds, the wing airfoil is formed by skin membrane called patagium in bats and pterosaurs. Patagial wings consists of the same bone elements, however, their active involvement into flying mechanics was specially modified in each group, respectively. Furthermore, bats and pterosaurs exhibit ability to employ the patagial wing in quadrupedal locomotion.

This doctoral project is centered for evaluation of adaptive changes in development of the wing bones of bats, birds and pterosaurs. Microstructure of the bone tissue is considered here as a functional interface useful for correlation of osteonal bone patterns with growth dynamics, locomotion performance, metabolism and termoregulation. This project aims to shaed light on developmental convergence of osteophysiological characteristics in the actively flying vertebrates. We expect the applicant to be fluent in spoken and written English, to show high work engagement, to work along and in a team, in lab as well as in field, to handle correctly fixed biological material and fossils, and being interested in 3D imaging, phylogenetic and statistic methods.



The effect of selected secondary metabolites of lichens on neurobehavioral parameters inexperimental animals.

supervisor: RNDr. Terézia Kisková,PhD.
study form: full-time

Annotation: Secondary metabolites of lichens form a not well-studied group of natural substances with a number of potential biological effects. These substances serve the lichens predominantly as a protection against external environmental influences. In recent years, a number of studies with their potential antimicrobial, antibacterial, antifungal, antiproliferative or cytotoxic effects have been published. However, their effect on the brain and related behavioral changes has not been studied yet.

The aim of the PhD. study is to follow the influence of selected secondary metabolites of lichens on changes in the behavior of laboratory animals, both healthy and affected by various pathological conditions, such as depressive disorders or brain cancer, in various behavioral tests. Using molecular methods the brain structures associated with behavioral changes will be studied. In addition, monitoring of other organ structures that could be affected by lichen metabolites, such as liver or blood, will be performed. This work requires not only a stay at the home institution, but also at partner institutions at home and abroad.

Probiotics vs postbiotics-parabiotics: the new horizons in microbial biotherapy of chronic gut inflammatory diseases.

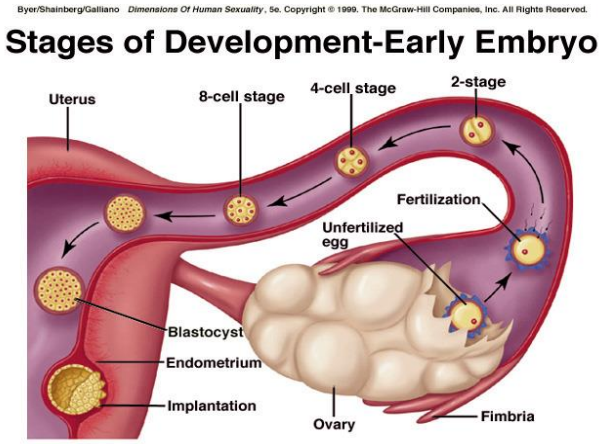
supervisor: prof. RNDr. Beňadik Šmajda, CSc. (benadik.smajda@upjs.sk)
consultants: RNDr. Jana Štofilová, PhD. Institute of Experimental Medicine, Medical Faculty, UPJŠ,
RNDr. Vlasta Demečková, PhD., Institute of Biology and Ecology, Faculty of Science, UPJŠ
study form: full-time

Annotation: Probiotics have several health benefits by modulating gut microbiome; however, techno-functional limitations such as viability controls have hampered their full potential applications in the food and pharmaceutical sectors. Therefore, the focus is gradually shifting from viable probiotic bacteria towards non-viable paraprobiotics and/or probiotics derived biomolecules, so-called postbiotics. The postbiotics are the complex mixture of metabolic products secreted by probiotics in cell-free supernatants such as enzymes, secreted proteins, short chain fatty acids, vitamins, secreted biosurfactants, amino acids, peptides, organic acids, etc. The paraprobiotics are the inactivated microbial cells of probiotics or crude cell extracts. The human gut microbiota comprises approximately 100 trillion
microbial cells and has a significant effect on many aspects of human physiology including metabolism, nutrient absorption and immune function. Disruption of this population has been implicated in many chronic and degenerative diseases, including intestinal inflammatory diseases, allergies, colorectal carcinoma, metabolic syndrome, diabetes and obesity. Idiopathic inflammatory bowel disease (IBD) refers to a group of chronic inflammatory diseases of the gastrointestinal tract with alternating relapses and remissions. Crohn's disease (CD) and ulcerative colitis (UC) are two major manifestations of IBD. These two forms of IBD differ mainly by localization of inflammatory deposits in the digestive tract and the extent of histopathological changes in the intestinal wall. High morbidity, serious early and late complications of the disease with potential disability, shortening the life of the patient with significant reduction of the quality of life are the reason for finding new options for prevention, rational diagnosis and treatment of IBD. The aim of this thesis will be to investigate the relationship between adherent and immunomodulatory properties of probiotic lactobacilli, their metabolites and their ability to modulate the function and microbial composition of the intestinal barrier in UC in vitro and in vivo conditions using rat chronic model of ulcerative colitis.

Molecular mechanisms participating in early embryo cell responses to the factors of environment.

supervisor: RNDr. Štefan Čikoš, DrSc. (cikos@saske.sk), Ústav fyziológie hospodárskych zvierat, Centrum biovied SAV
consultant: RNDr. Alexandra Špirková, PhD. (spirkova@saske.sk), Ústav fyziológie hospodárskych zvierat, Centrum biovied SAV
study form: full time

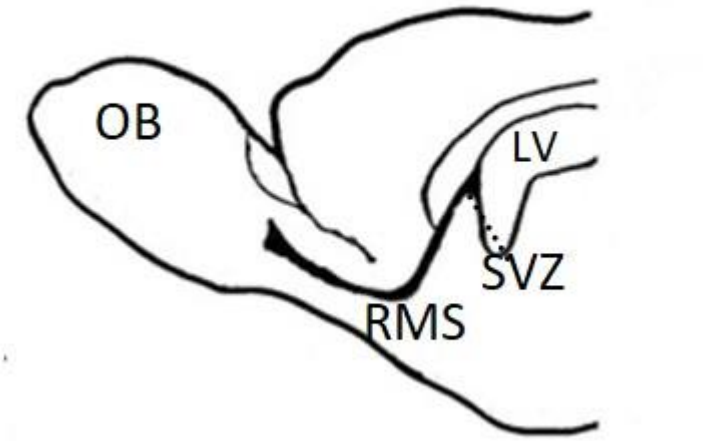
Annotation: The preimplantation embryo (i.e. the embryo in the period from oocyte fertilization to implantation of blastocyst into uterus) can finish its development to the blastocyst stage relatively autonomously. On the other hand, recent data indicate that maternal environment influences significantly developmental potential of oocytes, quality of preimplantation embryos, implantation success rate, and can also have long term consequences on the offspring health. Model of laboratory mouse (in vitro as well as in vivo approaches) will be used in experiments. Modern biochemical methods, molecular biology techniques as well as morphological methods will be used to analyze cell receptors, activated signaling pathways and physiological responses of early embryo cells.



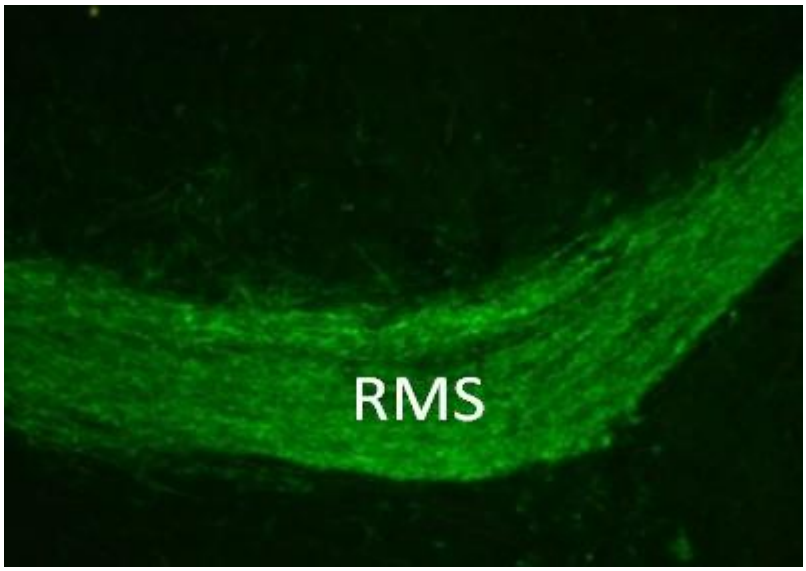
The use of organic forms of trace elements in nutrition and their effect on selected physiological processes of animals
supervisor: RNDr. Klaudia Čobanová, PhD. (boldik@saske.sk), Ústav fyziológie hospodárskych zvierat, Centrum biovied SAV
study form: full time
Annotation: Microelements are necessary for basic metabolic functions in the organism and play an important role in antioxidant defence system. Introduction of new organic compounds as source of microelements into the diets of farm animals represent one of a many current trends in the animal food production. Minerals bound to organic ligands are considered to be more bioavailable and absorbed better by the animals in comparison to the traditionally used inorganic sources. Thus, it would be possible to reduce the current needs for mineral additives in the diets. The dissertation thesis will be focused on the evaluation of the microelements bioavailability in farm animals (sheep, poultry) by determining their absorption and tissue deposition as well as the activity of specific metalloenzymes and metalloproteins levels in animal tissues will be measured too. The antioxidant response of animals to feed supplementation with various organic mineral sources (zinc, selenium) and the quality of foods of animal origin will be study as well.

Regulation of postnatal neurogenesis.
supervisor: RNDr. Marcela Martončíková, CSc. (martoncikova@saske.sk), Institute of Neurobiology, Biomedical Research center SAS, Košice
study form: full time
Annotation: Generation of new neurons from the stem cells in the brain of adult mammals (postnatal neurogenesis) is a phenomenon that attracts the attention of neurosciences because of perspective of their use in regenerative medicine. The

largest neurogenic area in the adult brain is the subventricular zone of the lateral ventricles. Its particularity is that the cells arising here migrate for a long distance by the rostral migratory stream to the olfactory bulb that represents their target structure. Under pathological condition, these cells are able to migrate out of the rostral migratory stream towards the affected brain area. To know the mechanisms regulating neurogenesis is essential for its potential therapeutic use. The aim of the thesis will be to examine the mechanisms regulating the migration of cells in the rostral migratory stream of the rat based on histological methods as well as *in vitro* methods.



Schematic drawing of the rat forebrain:
SVZ – subventricular zone, RMS – rostral migratory stream, OB – olfactory bulb, LV – lateral ventricle of the brain



Part of the RMS:
Migrating neural precursors are labeled immunofluorescently (green)

Study of the possibilities of functional recovery of injured neural pathways in laboratory rat.

supervisor: RNDr. Ján Gálik, CSc. (galik@saske.sk), Institute of Neurobiology, Biomedical Research center SAS, Košice

consultant: RNDr. Mária Bačová, PhD.
study form: full-time
Annotation: Traumatic spinal cord injury is one of the most serious pathological diseases of the nervous system, which results in partial or complete loss of motor, sensory and autonomic functions. Despite the intensive efforts of scientific community, there is still no clinically approved and effective form of therapy for the regeneration and functional regeneration of the spinal cord after injury. The scientific community focuses on the use of neuroprotective (minimizing the extent of damage) and neuroregenerative (inducing effective spinal cord regeneration) therapeutic strategies. The dissertation will focus on the study of mechanisms and models of traumatic spinal cord and peripheral nerve damage, and functional diagnosis of the condition of damaged nerve pathways. The aim of the work will be to explore the possibilities of regenerative therapy based on the application, or combination of methods of electrical stimulation, exercise and supportive pharmacological treatment.
More information in the paper by Bacova et. al,: http://nbusav.synology.me/galik

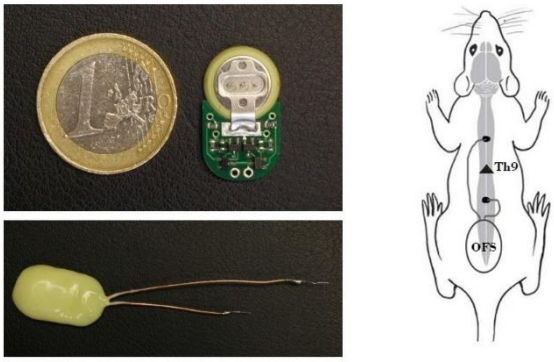
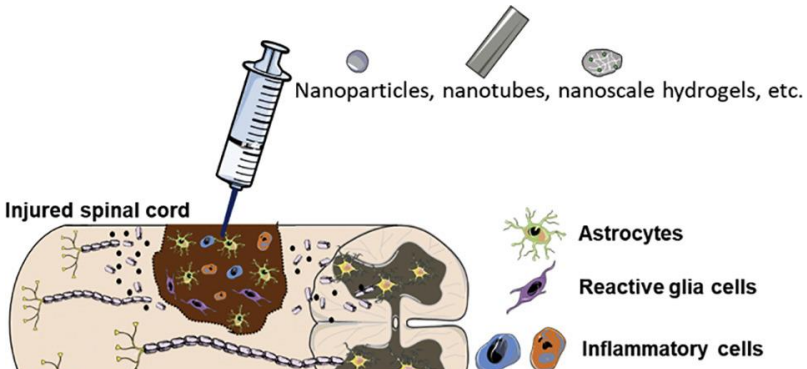
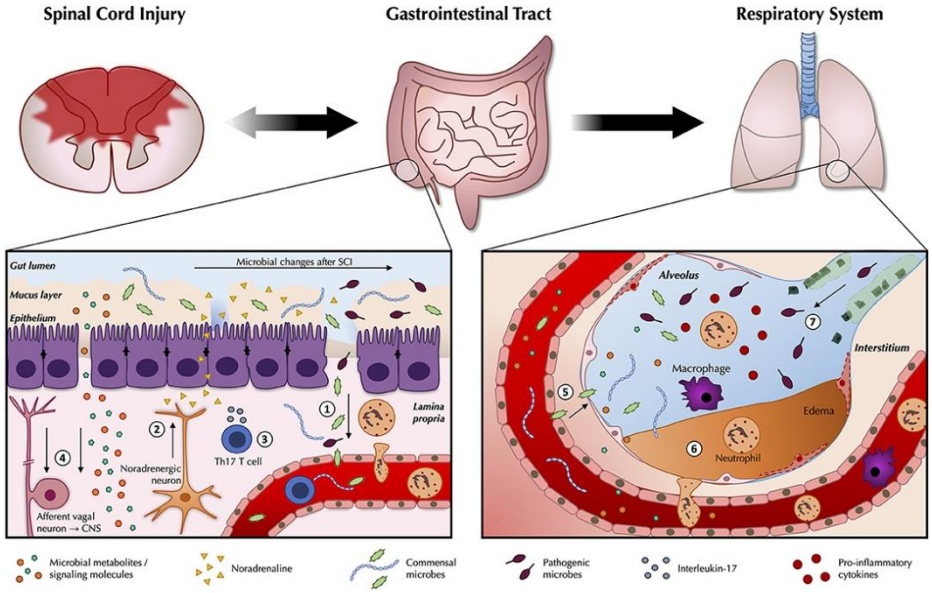


Image of a miniature electrical stimulator designed to implant and generate a weak electric field and schematic placement of electrodes across the site of spinal cord injury.

The development of translationally relevant regenerative and reparative strategies after spinal cord trauma.
supervisor: RNDr. Nadežda Lukáčová, DrSc. (lukacova@saske.sk),
Institute of Neurobiology, Biomedical Research center SAS, Košice
consultant: RNDr. Katarína Bimbová, PhD.
study form: full time
Annotation: The aim of PhD thesis is to investigate impact of anti-inflammatory drugs on the polarization of destructive *vs* beneficial M1/M2 macrophages, which play a key role in activation of pro-regenerative molecules after traumatic spinal cord injury and to design strategies that have the potential to improve functional recovery of experimental animals. We plan to examine the protein profile in spinal cord after compression and application of methylprednisolone, atorvastatin and VX-210 and evaluate their neuroprotective potential. An innovative approach will be tested that will allow local application of the most effective drug to the site of injury via magnetic nanoparticles.



Pharmacologically induced modulation of inflammatory reaction and oxidative stress in acute phase after traumatic spinal cord injury.
supervisor: RNDr. Nadežda Lukáčová, DrSc. (lukacova@saske.sk), Institute of Neurobiology, Biomedical Research center SAS, Košice
consultant: RNDr. Katarína Bimbová, PhD.
study form: full time
Annotation: Traumatic spinal cord injury elicits inflammatory response that comprises the activation of resident cells (microglia and astrocytes) and the influx of cells of the immune system from the bloodstream to the site of injury (macrophages, neutrophils). Activation of microglia by pro-inflammatory mediators can convert astrocytes to the neurotoxic A1 phenotype. Macrophages can differentiate into cells that exacerbate tissue injury or promote CNS repair (M1 or M2 phenotype). Recently, research has focused on the study of intestinal microflora and its impact on neurodegenerative diseases. For that reason the aim of Phd thesis is to find out, whether gut microbiome manipulation in the form of probiotics and siponimod is able to activate specific signalling pathways, M1/A2 activation and M1/M2 polarization and thus positively "direct" the process of spinal cord regeneration.



Activation of the endogenous mechanism in ischemic tolerance.
supervisor: RNDr. Petra Bonová, PhD. (bonova@saske.sk), Institute of Neurobiology, Biomedical Research center SAS, Košice
consultant: RNDr. Jana Jachová, PhD.
study form: full time

Annotation: Stroke represents a serious socio-economic problem with limited treatment options. Recently, the phenomenon of ischemic tolerance has become an attractive solution for the prevention and treatment of such conditions.
Objectives:
Study of mechanisms of ischemic tolerance
Defining the role of peripheral blood cells in inducing ischemic tolerance
Testing of in vivo and ex vivo conditioning methods
Testing of conditioning methods in animal models of ischemic-reperfusion injury of nerve tissue
For more information click on: http://nbusav.synology.me/Bonova