PLANT PHYSIOLOGY

Chemical composition of coffee from different bioms.
supervisor: prof. RNDr. Martin Bačkor, DrSc. (martin.backor@upjs.sk)
consultant: RNDr. Dajana Ručová, PhD.
study form: full time
Annotation: The coffee contains mature seeds of Coffea arabica Linn., belonging to the family Rubiaceae. Seeds of the botanical genus Coffea may be raw, roasted, whole or ground. Coffee prepared through such coffee seeds is also called coffee. Of the 70 types of coffee, only three are grown. 75% of the world's coffee production is provided by Coffea arabica, about 25% by Coffea canephora and less than 1% by Coffea liberica. Coffee has gone through steps to achieve its ultimate goal: human consumption. All these steps - seed ripening, post-harvest processing, storage and transport on land and ship, roasting, home preparation or industrial extraction and intermediate processing - have an impact on the chemical composition of the coffee. The subject of the presented dissertation will be the study of the main components of coffee: caffeine, carbohydrates, chlorogenic acids, lipids, polyphenols, other nitrogen compounds and their changes in concentration in the process of roasting and processing of coffee. Caffeine is a nitrogenous compound that is not affected by the central process in coffee-roasting chemistry. The aim of the work will be the use of appropriate analytical methods (spectroscopy, NMR, chromatography-HPLC, TLC) for proper identification, separation, optimization and determination of substances present in coffee, as well as comparison of the composition of selected chemical compounds in different varieties of coffee.

Study of antioxidant activity mechanisms of secondary metabolites isolated from the lichens.
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consultant: RNDr. Michal Goga, PhD.
study form: full time
Annotation: Lichens represent a symbiotic association of at least two organisms (fungi and green algae or cyanobacteria). They are also part of the ecosystems that are affected by the environment. Lichens are characterized by the production of secondary metabolites that are unique in terms of origin and presence. Three biosynthetic pathways are known in the production of secondary metabolites in lichens. The most interesting from the point of origin is the acetyl-malonate pathway, which produce metabolites belonging to the class of depsides and depsidones. The biological activity of lichen secondary metabolites are known from several studies. One of them is the antioxidant activity. Many studies are focused on the antioxidant activity of secondary metabolites, but in most cases it is the so-called screening of lichen extracts. The aim of the dissertation is study the mechanisms of antioxidant activity of lichen secondary metabolites, which would be combined and based on the isolation, identification and subsequent testing of chemically pure substances in comparison with the extracts from which they are origin. The result of the work will be also to find out which metabolites are the most effective in terms of antioxidant activity. It is assumed, that synergisms could be a significant bases of the lichen secondary metabolite activities.

Significance of isoflavonoids synthesized in the genus Lotus under conditions of abiotic stress.
supervisor: doc. RNDr. Peter Paľove-Balang, PhD. (peter.palove-balang@upjs.sk)
study form: full time
Annotation: Isoflavonoids are typical substances present in the Fabaceae family because of the presence of isoflavone synthase that typically occur in this family. Isoflavans are the main isoflavonoids formed in the genus Lotus, which accumulate in biotic stress, but also in some types of abiotic stress. Compared to other groups of isoflavonoids, isoflavans have been less studied so far. The work will focus on understanding the regulation and production of these substances and their defensive role in conditions of abiotic stress (e.g. drought, nitrogen deficiency, UV). The expression of key genes of this biosynthetic pathway will be evaluated. The possibility of using LORE-1 insertion mutants of MYB transcription factors will be tested if a clear phenotype will be identified. We also focus on the identification of new substances by LC-MS or NMR methods, and on the possible effects of isoflavonoids on other organisms. The model plant Lotus japonicus and selected forage varieties of L. corniculatus will be utilized as the experimental material.

Phytochemical diversity in the genus *Sorbus* in Central Europe and ecophysiologically modulated variability in the content of selected phytochemicals.
supervisor: doc. RNDr. Peter Paľove-Balang, PhD. (peter.palove-balang@upjs.sk)
consultant: Mgr. Vladislav Kolarčik, PhD.
study form: full time
Annotation: Genus *Sorbus* L. s.l. (rowan, family Rosaceae) includes about 250 species of trees and shrubs occurring mainly in the northern hemisphere. Many species of the genus *Sorbus* are valued for their content of ethnopharmacologically important natural chemical compounds with positive effects on respiratory and gastrointestinal diseases, rheumatism, as well as on cancer and diabetic diseases. Fruits of some species are used as a suitable functional foods valued for their high amounts of antioxidants. Traditionally distinguished subgenus *Sorbus* subg. *Aria* (Pers.) Host is known for the occurrence of polyploid facultatively apomictic species, often of hybrid origin, and proven ongoing speciation at the microevolutionary level. Many hybrid types, to this day without proper description and taxonomic evaluation, represent a highly valued and weakly investigated source of natural phytochemicals with high pharmacological potential. The aims of the thesis are to use an integrated approach (separation techniques, HPLC, substance identification, NMR, cytogenetics) to characterize the phytochemical profile of a selected group of taxa and especially: 1. Identify and determine the amount of phytochemicals in selected organs (leaves, fruits). 2. Clarify the variability in the content of phytochemicals depending on the degree of development of organs and depending on ecophysiological conditions. 3. To estimate the potential of microevolutionary processes (hybridization and polyploidization) in an effort to achieve a qualitatively suitable combination of phytochemicals.

The role of endopolyploidization in the plant development.
supervisor: doc. RNDr. Peter Paľove-Balang, PhD. (peter.palove-balang@upjs.sk)
consultant: Mgr. Vladislav Kolarčik, PhD.
study form: full time
Annotation: Endopolyploidization, the multiplication of the cell's nuclear genome, is one of the mechanisms for changing the ploidy level at the cellular level. It leads to the

formation of polyploid cells and occurs during differentiation in various plant organs. The abundance of polyploid cells in tissues is closely related to their physiological function. Increased endopolyploidy levels are typical for physiologically active tissue cells as well as cells whose differentiation requires accelerated cell growth. Endopolyploidy occurs scattered in individual evolutionary lines of plants, it is common in mosses and some families of flowering plants, among others in economically important families Brassicaceae, Fabaceae, Solanaceae or Orchidaceae. Endopolyploidy level is the result of the interaction of several factors such as the systematic position of the plant species, the ploidy level, the genome size and the stage of plant development, the type of tissues and organs and the environmental conditions. The aim of the study is: 1. To clarify the relationship between the level of endopolyploidy and growth parameters during the development of organs in a selected group of plants. 2. To determine what an effect the genome size (or polyploidy) has on the role of endopolyploidy in the developmental processes of closely related phenotypes of a selected plant species with low and high basal levels of endopolyploidy.