

Summer Research Internship Project Proposal

Project Topic	Isolation of secondary metabolites form plant material		
Name	Karel Šmejkal	Field	Pharmacognosy, Phytochemistry
Department	Department of Natural Drugs	Keywords	Secondary metabolites, extraction, chromatography, TLC, HPLC

Description of the Project (overview, expected outcomes, reason for research, proposed outcomes for student(s))

Plants represent sources of valuable natural products that have been used for treatment or prevention of different diseases in many countries and cultures. Use of screening-, identification- and isolation strategies such as “high-throughput screening and in vitro bioassay-guided fractionation” enabled identification of many novel active plant-derived “lead” compounds in recent years, and their subsequent industrial application or clinical use. Indeed, a recent survey of the 113 first-in-class drugs that were approved by FDA from 1999 to 2013, revealed that 28% of all these drugs are either natural products or their derivatives. The significance of natural products in medicine has also been reaffirmed by the therapeutic use of the *Artemisia annua*-derived drug artemisinin. This compound is administrated to treat malaria and its discovery has been awarded with the 2015 Nobel Prize in Physiology or Medicine.

Besides medicinal plants, regular plant-derived food also contains numerous compounds with positive health effects. A prominent example for such compounds with a high dietary relevance and medicinal importance are the phenolics, representing diverse classes of plant metabolites. In the European diet, an average daily intake of plant-derived phenolic compounds is estimated to be higher than one gram. Health-benefits of the phenolics were re-affirmed in recent two meta-analyses of randomized clinical trials or observational studies that confirmed a strong positive correlation between intake of dietary phenolics and decreased levels of monitored markers of inflammation. Some of the phenolic compounds, such as trans-resveratrol, readily cross the blood-brain barrier, and there is growing evidence on their beneficial role, e.g., in the neurodegenerative diseases. In the gastrointestinal tract, phytochemicals act as antioxidants, protect the mucosa of the gut by controlling mucus secretion, affecting gut microbiota, and modulating cellular signalling in the epithelium.

Prenylated phenolic compounds (PPCs) are plant secondary metabolites representing a unique combination of aromatic skeleton with terpenoid elements. Based on the type of the prenyl chain (C5 isopentenyl, C10 geranyl, C15 farnesyl or C20 geranylgeranyl), PPCs can be assigned to various subclasses. Further classification is made according to the phenolic moiety allowing subdivision into e.g., prenylated phloroglucinols, coumarins, prenylated flavonoids, prenylated chalcones, and prenylated cinnamic acids [55, 56]. Medicinal plants containing PPCs exhibit a wide range of biological effects, and have been traditionally used in many countries. PPCs occur mainly in plant families such as Fabaceae, Moraceae, Cannabaceae, Clusiaceae, and Rutaceae, and their occurrence is chemotaxonomically extended also to several other species belonging to Euphorbiaceae, Asteraceae, Apiaceae, Boraginaceae and Piperaceae. For some plant, like

Cannabis or *Humulus* spp., they are taken as main active substances responsible, beside others, for anti-inflammatory effects.

The aim of the project is to isolate phenolic constituents from selected plant source, with antibacterial and antiphlogistic activity. The total extract will be divided among the immiscible solvents these will be separated by column chromatography and semi-preparative HPLC.

Identification of individual substances will be performed by spectral methods. HPLC and TLC analysis will be performed in order to isolate the substances responsible for possible biological activity.

The exact structure of the substances will be identified using spectral methods.

Student Requirements (prerequisites, experience, acceptable fields of study, etc.)

- Good knowledge of English
- Basic knowledge of work with scientific literature sources
- Basic laboratory skills
- Students of chemistry, pharmacy
- Knowledge of chromatographic techniques is advantageous (not necessary)

Proposed responsibilities of the student(s)

- To process selected plant material
- To process column chromatography
- To carry on thin layer chromatography, high performance liquid chromatography
- To process both analytical and semipreparative scale techniques for isolation of plant secondary metabolites

Additional important information (max. number of students, additional staff/faculty involved, etc.)

- Maximal number of students: 1
- Specific tasks will be guided by staff of the department