

## **ENTRANCE EXAMINATIONS FOR DOCTORAL STUDIES IN ACADEMIC YEAR 2022/2023**

The Faculty of Natural Sciences, University of Cyril and Methodius in Trnava, has launched the Entrance Examinations for the doctoral degree programme in

### **Applied Analytical and Bioanalytical Chemistry**

in the full-time and part-time forms of study. The graduates of Slovak or foreign higher education institutions may apply for admission to study providing that they have completed their master's or engineering studies.

### **APPLICATION FOR DOCTORAL STUDIES**

The applicants should submit a filled-in application form with annexes at the Student Affairs Office at the Faculty of Natural Sciences of UCM no later than **15 June 2022**.

**The applicants will register for the announced thesis topics.**

#### **Annexes to attach to the application form:**

- A verified copy of the higher education diploma in the same or related field of study and programme;
- The state leaving examination certificate;
- A short curriculum vitae with the list of published and unpublished works;
- A medical certificate;
- A certificate of the accomplished practice (not obligatory);
- A dissertation thesis proposal.

#### **Entrance examinations**

The entrance examination has the character of a selection procedure in the form of a dialogue. The applicant presents his or her motives and study skills, the dissertation thesis proposal, and the foreign language knowledge. The admission commission will also take into consideration the applicant's participation in the student research conferences and the results of previous master's or engineering studies. The applicant applying for the part-time study will submit a certificate of employment in the specific field.

**Contact address:** Faculty of Natural Sciences of UCM in Trnava, Nám. J. Herdu 2, 917 01 Trnava, Slovak Republic Tel. No.: 033/55 65 321, 033/55 65 316

e-mail: [dekan.fpv@ucm.sk](mailto:dekan.fpv@ucm.sk)

doc. Ing. Jozef Sokol, PhD.

Dean of the the Faculty of Natural Sciences  
UCM in Trnava

## **Proposal of topic of dissertations for Biotechnology study program in academic year 2022/2023**

**Topic:** The use of advanced biophotonics technologies to study the effect of environmental pollution on living organisms

**Supervisor:** prof. Mgr. Alžbeta Marček Chorvátová, Ph.D., DrSc.

**Workplace:** Department of Biophysics, Faculty of Natural Sciences, University of Ss. Cyril and Methodius in Trnava and International Laser Center SCSTI in Bratislava

**Annotation:** The aim of the Ph.D. thesis is to compare different biophotonic technologies in order to determine the responses of living organisms to environmental pollution by monitoring their endogenous fluorescence using microscopy methods in the spectral and time domains. Optical screening methods based on chlorophyll, flavin and/or carotenoid autofluorescence will be developed for analyzing mixtures of potentially toxic environmental species, including microplastics with/without additives. We will use methods of steady-state and time-resolved spectroscopy (measurement of spectra, quantum yield, fluorescence lifetime and anisotropy) at various temperatures under different physico-chemical conditions. Gathered knowledge will help to better understand pathophysiological changes of living organisms (algae, moss, small aquatic animals) under conditions of stress.

**Topic:** Application of magnetic and electric fields to control of processes for metal removal from the environment

**Supervisor:** prof. Jana Sedláková, Ph.D.

**Consultant:** Ing. Alena Luptáková, Ph.D.

**Workplace:** Department of Ecochemistry and Radioecology, Faculty of Natural Sciences, University of Ss. Cyril and Methodius in Trnava

**Annotation:** One of the main challenges slowing down the wider application of environmental biotechnology processes in practice is their longer duration in comparison with conventional methods. It seems that application of electric current or magnetic field has significant effect on microbial processes, including their growth and biomass production that can affect their further functions used in environmental cleaning up. The aim of the Ph.D. work is to verify if stimulation of bioleaching and bioaccumulation processes by magnetic or electric fields can be sufficient to speed up them so much that they would be more competitive among existing technologies. The work will concentrate on the study of electric waste bioleaching followed by metal ions bioaccumulation in the presence of magnetic or electric fields.

**Topic:** Plant *in vitro* systems for production of cell biomass and plant stem cells

**Supervisor:** prof. RNDr. Ján Kraic, Ph.D.

**Workplace:** Department of Biotechnology, Faculty of Natural Sciences, University of Ss. Cyril and Methodius in Trnava and National Agricultural and Food Center – Research Institute of Plant Production in Piešťany

**Annotation:** Plant *in vitro* culture systems can be suitable and efficient production systems for the production of cell biomass and plant stem cells. Depending on the plant species, organ, tissue, or specialized cells, suitable types are callus and cell suspension cultures. The use of plant cell cultures is broad-spectrum, from applications in research of physiological, biochemical and genetic processes to various practical applications in industry, medicine and cosmetics. The process of establishing, maintaining, and using various *in vitro* plant culture systems is associated with the so-called stem cells. The *in vitro* lines of plant stem cells are derived from explants containing meristem cells.

The aim of the dissertation will be problems of establishing *in vitro* cultures from primary plant explants containing meristem tissue cells, characterization of parameters of such established *in vitro* cultures, possibility of long-term *in vitro* cultivation, *in vitro* cultivation in liquid culture media, maintenance of plant stem cell lines *in vitro*, and plant stem cell production. Among the plant species, they will be, on the one hand, species with a known application in cosmetics and dermatology, but they will also be species not yet used for these purposes.

The experimental part of the doctoral student will take place in the laboratories of the Department of Biotechnology FPV UCM in Špačince and in the laboratories of the Research Institute of Plant Production in Piešťany.

**Topic:** Application of (1-3)(1-4)- $\beta$ -D-glucan for the development of an innovative functional food

**Supervisor:** Assoc. prof. RNDr. Michaela Havrlentová, Ph.D.

**Workplace:** Department of Biotechnologies, Faculty of Natural Sciences, University of Ss. Cyril and Methodius in Trnava and National Agricultural and Food Centre – Research Institute of Plant Production in Piešťany

**Annotation:** The trend today is to develop the so-called functional foods, foods enriched with a biologically active and / or functional substance. One such natural substance is  $\beta$ -D-glucan occurring in the cell walls of selected species of the genus *Poales*, which includes e.g. cereals. These substances, as components of soluble dietary fiber, have proven biological properties. Their functional properties in the food industry are aimed at increasing not only the nutritional quality of the food, but also the food stability, texture and the like. The aim of the doctoral thesis will be to analyze the factors influencing the content and properties of  $\beta$ -D-glucans in primary food sources and the attention will be paid e.g. on the process of germination and fermentation of grain, heat treatment of raw materials and their impact on the quality of the primary raw material.  $\beta$ -D-glucans will then be isolated and purified from suitable sources and their biological and functional properties will be analyzed. Isolates as well as suitable primary raw materials will then be applied to food products (e.g. bakery and biscuit products, beverages) in order to develop an innovative food with an increased content of this functional and biologically active molecule.

**Topic:** Application of bioaccumulation and biosorption processes in the biotechnological removal of metals by algal biomass

**Supervisor:** Assoc. prof. RNDr. Miroslav Horník, Ph.D.

**Workplace:** Department of Ecochemistry and Radioecology Faculty of Natural Sciences, University of Ss. Cyril and Methodius in Trnava

**Annotation:** Removal of (radio)toxic metals from wastewater to environmentally acceptable levels is a costly process, although a wide range of commercially available methods and technologies can be used in this area. For this reason, there is an enormous interest in various industrial sectors for less costly, efficient and environmentally acceptable alternative technologies for the removal of these contaminants. In this respect, the biotechnological application of bioaccumulation and biosorption processes for the removal of (radio)toxic metals, in particular *via* available or waste biomass, appears to be very advantageous and interesting. The main objective of this dissertation thesis will be to evaluate the potential of using living or non-living algal biomass or (bio)sorbents derived from this type of biomass in the removal of mono- ( $\text{Li}^+$ ,  $\text{K}^+$  or  $\text{Cs}^+$ ) and divalent metals ( $\text{Cd}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Co}^{2+}$  or  $\text{Sr}^{2+}$ ) from model single- and multicomponent solutions. In terms of this main objective, (bio)sorbents will also be prepared as physically or chemically modified (bio)sorbents with the aim their effective application under different operating conditions. In a first step, physico-chemical characterization and quantitative analysis of the specific accumulation/sorption capacities of the algal biomass or prepared (bio)sorbents to the studied metals will be carried out.

For these purposes, analytical methods including radioindication techniques using scintillation gamma-spectrometry, atomic absorption spectrometry or flame photometry will be used. At the same time, predictive modelling approaches for the portion of chemical forms of metals in solutions or the occurrence of functional groups on prepared or modified (bio)sorbents potentially playing a role in the binding of the metals, as well as non-linear regression methods for the prediction of specific sorption capacities will also be applied. Bioaccumulation or biosorption of the studied mono- and bivalent metals by algal biomass or algal-derived (bio)sorbents from model solutions will be evaluated under both batch and continuous column system conditions.

In Trnava 08.03.2022

approved by:

prof. RNDr. Ján Kraic, Ph.D  
Chair of Specialized Board of Doctoral Degree  
in Biotechnology

doc. Ing. Jozef Sokol, CSc. mim. profesor  
dean FPV UCM