1. Raziskovalna organizacija:

Univerza v Ljubljani, Biotehniška fakulteta

2. Ime in priimek mentorja:

Katarina Vogel-Mikuš

3. Področje znanosti iz šifranta ARRS:

1.03 Biologija

4. Kontaktni e-naslov mentorja:

katarina.vogelmikus@bf.uni-lj.si

5. Kratek opis programa usposabljanja:

Vpliv selena na privzem in speciacijo kadmija in živega srebra v rastlinah in prenos po prehranjevalnih verigah

Selen lahko s kovinami kot so Hg in Cd tvori netopne komplekse (HgSe in CdSe) ter tako zmanjša biorazpoložljivost in strupenost kovin v okolju. Interakcije Hg in Cd s selenom pri rastlinah so le slabo raziskane prav tako pa ni podatkov, kako biofortifikacija rastlin s selenom vpliva na prenos Hg in Cd po prehranjevalni verigi in njune nadaljnje (negativne) učinke na živalski organizem.
Kandidat(ka) bo opravljal(a) raziskave na področju akumulacije, lokalizacije in vezavnih oblik živega srebra in kadmija (Hg in Cd) pri izbranih modelnih rastlinah biofortificiranih s selenom s pomočjo modernih fizikalnih metod, kot so sinhrotronska rentgensko absorpcijska spektroskopija, sinhrotronska rentgensko fluorescenčna spektroskopija, protonsko inducirana emisija rentgenskih žarkov in pa masna spektroskopija (MeV SIMS in LA-ICPMS).
Izbrane rastline (solata, rani mošnjak,..) bo gojil(a) v naravno in umetno onesnaženih zemljinah v rastnih komorah in jih listno škropil(a) s selenovimi raztopinami (selenat, selenit). Določal(a) bo stopnjo privzema kovin in selena v rastlinske organe (korenine, poganjke) z ICP-MS in XRF ter porazdelitev in vezavne oblike (speciacijo) le teh na tkivnem in celičnem nivoju. Stopnjo stresa bo ocenil(a) s spremljanjem fotokemične učinkovitosti fotosistema II in nekaterih biokemijskih parametrov (vsebnost klorofilov, karotenoidov, polifenolov, lipidna peroksidacija, elementni profili, organski profili).
Eden od ciljev bo tudi preučiti vplive biofortifikacije rastlin s selenom na prenos kovin iz rastlin naprej po prehranjevalni verigi ter potencialno zaščitno vlogo selena pri stresu zaradi povečanih vsebnosti kovin pri živalih. Kot modelne živali bo kandidat(ka) uporabil(a) polže (lazar *Arion* spp.), ki jih bo hranil(a) z različno tretiranim rastlinskim materialom. Modelni organizem je bil izbran, ker so polži indikatorski organizmi za onesnaženje okolja s kovinami, saj kopičijo kovine v hepatopankreasu, poleg tega pa za tovrstne raziskave ni etičnih zadržkov. Kandidatk(a) bo ugotavljal(a) stopnjo akumulacije in vezavne oblike naštetih kovin v hepatopankreasu testnih živali ter stopnjo stresa preko aktivnosti izbranih encimov ter ugotavljanja prisotnosti biomarkerjev.
Dobljeni rezultati bodo pomembno prispevali k poznavanju interakcij Hg in Cd s selenom v rastlinskih in živalskih tkivih kot osnova za razvoj tehnologij za zmanjšanje biodostopnosti in strupenosti Hg in Cd v prehrani.
Delo bo potekalo v sodelovanju z Inštitutom Jožef Stefan, Kemijskim inštitutom v Ljubljani, sinhrotronom Elettra v Trstu in sinhrotronom ESRF v Grenoblu.

Effects of selenium on the uptake and speciation of cadmium and mercury in plants and futher in the food chains

Selenium can form insoluble complexes with metals such as Hg and Cd (HgSe and CdSe), thereby reducing their bioavailability and toxicity in the environment. Interactions of Hg and Cd with selenium in plants are just poorly known and there is lack of data on how plant biofortification with selenium affects the transfer of Hg and Cd into the food chains and further (negatively) affect the animal

organism.
The candidate will perform studies in the field of accumulation, localization and speciation of mercury and cadmium (Cd and Hg) in selected model plants (lettuce, pennycress,..) biofortified with selenium by employing modern physical methods such as synchrotron X-ray absorption spectroscopy, synchrotron X-ray fluorescence spectroscopy, proton induced X-ray emission, and mass spectroscopy (SIMS MeV and LA-ICPMS).
Selected plants (lettuce, pennycress) will be cultivated in natural and artificially contaminated soils in growth chambers and foliarly treated with selenium solutions (selenate, selenite). The rate of uptake of metals and selenium in plant organs (roots, stems) by ICP-MS and XRF, and the distribution and speciation of these elements at the tissue and cellular level will be determined. The level of stress will be assessed by monitoring of photochemical efficiency of photosystem II and some biochemical parameters (the content of chlorophylls, carotenoids, polyphenols, the level of lipid peroxidation, elemental and organic fingerprints). One of the objectives will be also to study the impact of biofortification of the plants with selenium on the transfer of metals from the plants further to the food chain and to estimate the potential protective role of selenium against metal stress in animals. A slug snail (*Arion* spp.) will be used as model animal. The snail was chosen as a model animal since the snails are good indicators for metal pollution and there are no ethical objections for experiments with these kinds of animals. The metals accumulate in digestive gland (hepatopancreas) and strong correlations were found between metal concentrations in hepatopancreas and soil. The snails will be fed with material of differentially treated plants. The rate of accumulation and speciation of the listed elements in hepatopancreas will be determined. In addition the degree of stress will be estimated by measuring the activities of selected enzymes and detection of biomarkers.
The results will importantly contribute to the understanding of interactions between Hg or Cd and selenium in plant and animal organism as a basis for development of technologies aiming to reduce the bioavailability and toxicity of Hg and Cd in the diet.
Work will be done in cooperation with the Jozef Stefan Institute, National Institute of Chemistry in Ljubljana, Synchrotron Trieste Elettra and ESRF, Grenoble.