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Proučevanje izbranih invazivnih rastlinskih vrst iz rodu *Fallopia* kot zanesljivih virov bioaktivnih spojin

Investigation of selected invasive plant species from genus *Fallopia* as reliable sources of bioactive compounds

Vodja projekta / Project leader

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1. VSEBINSKI OPIS RAZISKOVALNEGA PROJEKTA / DESCRIPTION OF THE RESEARCH PROJECT

Zaradi hitrega razširjanja in velike biomase predstavljajo invazivne tujerodne rastlinske vrste velik ekološki (vpliv na biodiverzitetu) in ekonomski problem (škoda na infrastrukturi, poslopih, itd.). Pet rastlinskih vrst iz rodu *Fallopia* (japonski (*F. japonica*), sahalinski (*F. sachalinensis*) in češki dresnik (*F. × bohémica*) ter grmasti (*F. baldschuanica*) in gomoljasti slakovec (*F. multiflora*)) spada v svetovnem merilu med bolj problematične invazivne tujerodne vrste. Ker teh rastlinskih vrst trenutno nismo sposobni učinkovito izkoreniniti, jih lahko vsaj koristno uporabimo. Dosedanje raziskave kažejo, da so te rastlinske vrste iz rodu *Fallopia* bogat vir bioaktivnih sekundarnih metabolitov. V okviru projekta bomo proučevali rastlinski material, ki ga bomo nabrali na več lokalitetah v Sloveniji. Razvili bomo analize metode na osnovi tankoplastne kromatografije visoke ločljivosti (HPTLC), tekočinske kromatografije visoke ločljivosti in plinske kromatografije, pri čemer bomo uporabili različne načine detekcije (npr. UV-Vis, masna spektrometrija (MS)). Za odkrivanje bioaktivnih spojin v proučevanih rastlinah bomo kot najhitrejši in najbolj ekonomičen pristop uporabili ne-ciljano analizo usmerjeno z biomonitoringom v kombinaciji s kromatografskimi tehnikami. Bioaktivnost (npr. antioksidativna aktivnost) izoliranih spojin / frakcij bomo določili z *in vitro* testi. Na osnovi spektroskopskih metod (npr. MS ali NMR) bomo predlagali in/ali določili kemijske strukture izoliranih bioaktivnih spojin. Izbrane predhodno identificirane bioaktivne spojine, frakcije in ekstrakte bomo kapsulirali in jih s tem stabilizirali s primernimi tehnikami in materiali. Izvedli bomo tudi mikrobnó biotehnološko razgradnjo. Z rezultati naših raziskav bomo prispevali v svetovno zakladnico znanj, ki bo služila kot baza za razvoj novih izdelkov (funkcionalna živila, prehranska dopolnila, itd.). Nadalje bo primerjava kemijskih profilov proučevanih petih invazivnih vrst rodu *Fallopia* pripomogla k razumevanju različne stopnje invazivnosti teh vrst ne le v Sloveniji, ampak tudi drugod po svetu, kar je osnova za razvoj tehnik za preprečevanje invazije proučevanih rastlin in možnosti njihovega obvladovanja.

Due to rapid spreading and large biomass, invasive alien plant species represent major ecological problems (impact on biodiversity) and also economic problems (destruction of infrastructure, buildings, etc.). This project studies five globally very problematic invasive alien plant species from genus *Fallopia*: Japanese knotweed (*F. japonica*), giant knotweed (*F. sachalinensis*), Bohemian knotweed (*F. × bohémica*), Russian vine (*F. baldschuanica*) and Chinese knotweed (*F. multiflora*). Since efficient eradication of these invasive plant species has not been discovered, we can at least search for ways to usefully exploit them. Previous research has shown that the proposed plant species of the genus *Fallopia* are a rich source of bioactive secondary metabolites. In the frame of the project we will investigate plant material collected at several localities in Slovenia. Analytical methods based on high-performance thin-layer chromatography (HPTLC), high-performance liquid chromatography and gas chromatography using different detection modes (e.g. UV-Vis, mass spectrometry (MS), etc.) will be developed. A non-targeted effect-directed analysis in combination with chromatographic techniques as the quickest and the most cost-effective approach to discover bioactive compounds in the plants studied. Bioactivity (e.g. antioxidant activity) of the isolated compounds/fractions will be determined by *in vitro* assays. The chemical structure of the isolated bioactive compounds will be proposed and/or determined based on spectroscopic methods (e.g. MS or NMR). Selected pre-identified bioactive compounds, fractions and extracts will be encapsulated by suitable techniques and materials. Microbiotechnological biodegradation will also be performed. The results of our research will contribute to the global body of knowledge that will serve as a base for the development of new products (functional foods, food supplements, etc.). Further, comparison of the chemical profiles of the five invasive plants from genus *Fallopia* could aid the understanding of invasiveness and facilitate the development of new techniques for prevention and control of their invasion, not only in Slovenia, but globally.

2. OSNOVNI PODATKI GLEDE FINANCIRANJA / BASIC DATA ABOUT FINANCING

Projekt financira:

- Javna agencija za znanstvenoraziskovalno in inovacijsko dejavnost Republike Slovenije (ARIS) - v okviru cenovne kategorije C za obdobje treh let v obsegu 2017 ur letno.

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- The Slovenian Research and Innovation Agency (ARIS) – within price category C for the period of three years with 2017 hours per year.

Funding period: 1. 10. 2023 – 30. 9. 2026.

3. SODELUJOČE ORGANIZACIJE / PARTICIPATING RESEARCH ORGANISATIONS

- Kemijski inštitut
- Biotehniška fakulteta (Univerza v Ljubljani)
- Institut Jožef Stefan
- Plant Protection Institute, Centre for Agricultural Research (Madžarska)

- National Institute of Chemistry (Slovenia)
- Biotechnical Faculty (University of Ljubljana, Slovenia)
- Jožef Stefan Institute (Slovenia)
- Plant Protection Institute, Centre for Agricultural Research (Hungary)

4. SESTAVA PROJEKTNE SKUPINE S POVEZAVAMI NA SICRIS (LE ZA SLOVENSKO SKUPINO) / PROJECT TEAM MEMBERS WITH LINKS TO THE SICRIS DATABASE (FOR SLOVENIAN TEAM)

Ime in priimek / Name and surname	Raziskovalna organizacija / Research organisation
Irena Vovk Vesna Glavnik Katerina Naumoska Živa Vipotnik	Kemijski inštitut / National Institute of Chemistry (Slovenia)
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Aleš Lapanje Tomaž Rijavec	Institut Jožef Stefan / Jožef Stefan Institute (Slovenia)
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5. FAZE PROJEKTA IN NJIHOVA REALIZACIJA / PROJECT PHASES AND REALIZATION

DS1: Vzorčenje in določevanje rastlinskega materiala
DS2: Ekstrakcije, kemijske analize, izolacije in karakterizacije bioaktivnih spojin
DS3: Testiranje bioloških aktivnosti
DS4: Kapsulacija izbranih bioaktivnih spojin, frakcij in ekstraktov
DS5: Mikrobiotehnološka biorazgradnja

WP1: Collection and determination of plant material
WP2: Extraction, chemical analyses, isolation and characterization of bioactive compounds
WP3: Bioactivity testing
WP4: Encapsulation of selected bioactive compounds, fractions and extracts
WP5: Microbiotechnological biodegradation

6. BIBLIOGRAFSKE REFERENCE, KI IZHAJAJO NEPOSREDNO IZ IZVAJANJA RAZISKOVALNEGA PROJEKTA / BIBLIOGRAPHIC REFERENCES ARISING DIRECTLY FROM THE IMPLEMENTATION OF THE RESEARCH PROJECT

Objavljeni povzetek znanstvenega prispevka na konferenci (vabljeni predavanjski prispevek) / Published scientific conference contribution abstract (invited lecture)

1. VOVK, Irena, GLAVNIK, Vesna, BENSA, Maja, MÓRICZ, Ágnes M., OTT, Péter G., ŠEN, Nisa Beril, GUZELMERIC, Etil, VIPOTNIK, Živa, SIMONOVSKA, Breda. Utilising the full potential of HPTLC in analyses of bioactive compounds. V: *Abstract book : HPTLC 2024 : 26th International Symposium for High-Performance Thin-Layer Chromatography : 9–11 September 2024, Budapest, Hungary*. Budapest: Akadémiai Kiadó, cop. 2024. Str. 16. ISBN 978-963-664-061-3. <https://static.akcongress.com/downloads/hptlc/hptlc2024-abstract-book.pdf>. [COBISS.SI-ID [216776451](#)]
2. VOVK, Irena, GLAVNIK, Vesna, BENSA, Maja, GUZELMERIC, Etil, ŠEN, Nisa Beril, OTT, Péter G., VIPOTNIK, Živa, SIMONOVSKA, Breda, STRGULC KRAJŠEK, Simona, MÓRICZ, Ágnes M. Challenges in chromatographic analyses of bioactives in plant extracts and food. V: *ISSS2024 : 28th International Symposium on Separation Sciences : book of abstracts : September 22-25, 2024, Messina, Italy*. Messina: Campus University, 2024. Str. [9]. https://www.sepscisoc.com/images/documents/Book_Abstract_ISSS-2024.pdf. [COBISS.SI-ID [216689923](#)]
3. VOVK, Irena, GLAVNIK, Vesna, BENSA, Maja, SIMONOVSKA, Breda, VIPOTNIK, Živa. Chromatography and mass spectrometry in analyses of phytonutrients in food samples. V: *UNIFood2024 conference : The 3rd international UNIFood conference : book of abstracts : Belgrade, June 28-29, 2024*. [Belgrade: University of Belgrade-Faculty of Agriculture], 2024. Str. 8. [COBISS.SI-ID [202415107](#)]

Objavljeni povzetek znanstvenega prispevka na konferenci / Published scientific conference contribution abstract

1. GLAVNIK, Vesna, VOVK, Irena. HPTLC analyses of Japanese knotweed and Bohemian knotweed leaves extracts obtained by supercritical fluid extraction. V: *ISSS2024 : 28th International Symposium on Separation Sciences : book of abstracts : September 22-25, 2024, Messina, Italy*. Messina: Campus University, 2024. Str. [139]. https://www.sepscisoc.com/images/documents/Book_Abstract_ISSS-2024.pdf. [COBISS.SI-ID [216760067](#)]