

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Sledljivost in pristnost živil
<b>Course title:</b>	Food Traceability and Authenticity

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Ekotehnologije, 3. stopnja		1	1
Ecotechnologies, 3 <sup>rd</sup> cycle		1	1

**Vrsta predmeta / Course type**

Izbirni / Elective

**Univerzitetna koda predmeta / University course code:**

EKO3-705

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	30			30	210	10

*\*Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transferred to individual work.*

**Nosilec predmeta / Lecturer:**

Prof. dr. Nives Ogrinc  
Prof. dr. Janez Plavec  
Prof. dr. Barbara Koroušič Seljak

**Jeziki /  
Languages:**

**Predavanja / Lectures:**

slovenščina, angleščina  
Slovenian, English

**Vaje / Tutorial:**

slovenščina, angleščina  
Slovenian, English

**Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:**

Zaključen študij druge stopnje ustrezne (naravoslovne ali tehniške) smeri ali zaključen študij drugih smeri z dokazanim poznavanjem osnov področja predmeta (pisna dokazila, pogovor). Potrebna so tudi osnovna znanja iz računalništva in statistike.

**Prerequisites:**

Completed second level studies in natural sciences or engineering or completed second level studies in other fields with proven knowledge of fundamentals in the field of this course (certificates, interview). The basic knowledge in computer science and statistics is needed.

**Vsebina:**

Podiplomskim študentom zagotoviti znanje na področju sistema zagotavljanja pristnosti in sledljivosti živil. Sistemi sledljivosti nam podaja informacije o pristnosti in izvoru proizvoda v verigi preskrbe s hrano. Prav na področju sledljivosti živil so se pojavile zahteve po bolj sofisticiranih instrumentih in primernih analitskih metodah, ki omogočajo boljše kvalitativne in kvantitativne rezultate. Tako

**Content (Syllabus outline):**

The course is open to graduate students who wish to understand better systems and concepts relating to food authenticity and traceability. Traceability systems provide information on the history, authenticity and the origin of a product in the supply food chain. Improvements in this field are increasing rapidly as is the demand for robust analytical methods and strategies that can deliver better qualitative and quantitative results. This is

raziskovalci vključeni v sodobno znanost o živilih potrebujejo ustrezno znanje za delo na naprednih analitskih orodjih, da se lahko soočijo s kompleksnostjo samega problema in ustvarjajo rezultate na racionalen način.

V okviru predmeta bomo predstavili različne pristope in metode, ki se uporabljajo pri sledljivosti na področju živilstva:

- Podane bodo teoretične osnove ter regulative, norme, certificiranje in standardi, ki vključujejo sledljivost.
- Predstavljene bodo vrste potvorb, ki se pojavljajo v živilih, in načini reševanja problemov z naprednimi analitskimi metodami, ki se navezujejo na kakovost in varnost živil.
- Predstavili bomo principe in aplikacije uporabe stabilnih izotopov lahkih elementov (H, C, N, O in S), težjih elementov (Sr) in elementov v sledovih, ki se uporabljajo pri določanju pristnosti in sledljivosti živil.
- Podane bodo osnove in principi delovanja masne spektrometrije in NMR ter meroslovni principi, ki zagotavljajo sledljive in primerljive rezultate meritev.
- Sledila bo predstavitev ovrednotenja, dokumentiranja in analize pridobljenih podatkov na področju pristnosti in sledljivosti.
- Uporaba naprednih statističnih metod kot so linearna diskriminantna analiza, analiza glavnih osi.
- Uporaba prostorskega modeliranja vključno z uporabo geografskega informacijskega sistema (GIS) in izdelavo »isoscapes« na lokalnem, regionalnem in svetovnem nivoju. Principi prostorskega modeliranja bodo predstavljeni na osnovnem, teoretično-metodološkem nivoju.
- V okviru predmeta bodo predstavljeni tudi drugi načini sledljivosti, ki se uporabljajo na področju živilstva, kot so npr. črtne kode, radiofrekvenčna identifikacija (RFID).

Predstavitev primerov iz prakse in industrije.

the reality for many working in modern food science, so it is essential to have sufficient knowledge to make the most of what these technologies have to offer.

The Postgraduate Course will explore all aspects of food traceability including the following:

- Theoretical background and overview on legislation, norms, certification and standards involving traceability.
- The different types of fraud and the opportunities to identify fraud using advanced analytical methods and the link between food quality and safety.
- The principles and use of stable isotopes of light elements (H, C, N, O and S), non-traditional isotopes (Sr) and trace elements in determining authenticity.
- Principles of mass spectrometry and NMR techniques. Validation of analytical methods; Traceability and comparability of the results.
- How to evaluate, document and analyse food authenticity and traceability data.
- The use of advanced statistical methods such as principal component analysis and linear discrimination analysis.
- The use of spatial modelling including the geographical information system (GIS) approach and "isoscapes" on the local, regional and global scale. It will also provide students with an understanding of the principles of spatial modelling at the basic, theoretical and methodological level.
- The course will also cover other ways of tracing food that are used in the food industry, such as barcodes, radio frequency identification (RFID).

Case studies including industrial aspect.

#### **Temeljni literatura in viri / Readings:**

- Food Authenticity and Traceability, volume in Woodhead Publishing Series in Food Science, Technology and Nutrition; Edited by M. Lees, ISBN: 978-1-85573-526-2
- Food Chain Integrity: A Holistic Approach to Food Traceability, Safety, Quality and Authenticity (Woodhead Publishing Series in Food Science, Technology and Nutrition); Edited by J. Hoorfar, K. Jordan, F. Butler, R. Prugger, ISBN: 978-0857090683

- Milan Hladnik, Verjetnost in statistika. Založba FE in FRI, 2002
- David S. Moore, Statistika: znanost o podatkih. Purdue University, prevod v slovenščino 2010; dostopno na [http://studentski.net/gradivo/ulj\\_fri\\_ri3\\_ovs\\_sno\\_statistika\\_znanost\\_o\\_podatkih\\_01\\_knjiga?r=1](http://studentski.net/gradivo/ulj_fri_ri3_ovs_sno_statistika_znanost_o_podatkih_01_knjiga?r=1) (september 2016)
- Katarin Košmelj, Uporabna statistika, 2. dop. Izdaja. Biotehniška fakulteta, Univerza v Ljubljani, 2007; dostopno na [http://www.bf.uni-lj.si/fileadmin/groups/2721/Uporabna\\_statistika\\_okt\\_2007/Uporabna\\_statistika\\_01.pdf](http://www.bf.uni-lj.si/fileadmin/groups/2721/Uporabna_statistika_okt_2007/Uporabna_statistika_01.pdf) (september 2016)
- Pregledni članki iz: Food Chemistry, Journal of Agricultural and Food Chemistry, Journal of Food Composition and Analysis, Journal of Food Science, Comprehensive Reviews in Food Science and Food Safety etc. tekoča periodika, druga učna gradiva...

### Cilji in kompetence:

Izobraževalni cilji:

Študenti bodo poglobili znanje o uporabi različnih metod in pristopov pri določanju pristnosti in sledljivosti živil:

- uporaba naprednih analitskih metod, ki vključujejo stabilne izotope (IRMS, NMR tehnike), hitre metode (FTIR, UV-VIS) in določanje elementne sestave (ICP-MS, XRF);
- modeliranje in geoinformatika.

Študijski rezultati: Vse to naj bi študentom omogočilo napredno in interdisciplinarno razumevanje področja kontrole, varnosti in kakovosti ter porekla živil in njihovo sledljivost v dobavni verigi.

### Objectives and competences:

The curriculum is designed to provide students with an understanding of the latest principles, practices regarding food authenticity and traceability systems including:

- a comprehensive understanding of advanced analytical methods including stable isotopes (IRMS, NMR techniques), fast methods (FTIR, UV-VIS), determination of elemental composition (ICP-MS, XRF)
- modelling and geoinformatics in relation to food authenticity and traceability.

This course prepares students with an advanced and interdisciplinary understanding of control, safety, quality and provenance of food products and their traceability along the supply chain.

### Predvideni študijski rezultati:

#### Znanje in razumevanje:

- osnovo znanje o definiciji pojmov, ki so povezani s sledljivostjo in pristnostjo živil;
- identifikacijo možnih potvorb in z njimi povezanih nevarnosti;
- razumeti principe osnov uporabe stabilnih izotopov lahkih elementov in elementne sestave pri določanju pristnosti in sledljivosti živil;
- obdelava in dokumentacija rezultatov z naprednimi statističnimi metodami in modeliranjem;
- uporaba pridobljenih znanj pri reševanju praktičnih problemov povezanih s pristnostjo in sledljivostjo živil.

#### Splošne kompetence:

- obvladanje raziskovalnih metod na področju pristnosti in sledljivosti živil v povezavi s kakovostjo in varnostjo;
- sposobnost uporabe pridobljenega znanja in spretnosti pri izvedbi analiz in obdelavi

### Intended learning outcomes:

#### Knowledge and Understanding

- gain a knowledge of the definitions of concepts related to food authenticity and traceability;
- identify the common types of food frauds and the associated hazards
- understand the basic principles of using stable isotopes of light elements and elemental composition for determining food authenticity and traceability;
- document and evaluate data using advanced statistical methods and modeling;
- select and carry out appropriate techniques to solve analytical problems associated with food authenticity and traceability.

#### General Competences:

- the student will master research methods in the field of traceability for food safety and quality control;
- ability to use the knowledge and skills acquired to analyze and interpret experimental data

podatkov v praksi;

- izboljšati način analitičnega in kritičnega razmišljanja, uporabnega tudi v vsakodnevnem življenju ter komunikacijske sposobnosti;
- kooperativnost, delo v skupini (in v mednarodnem okolju).

obtained from different instrumental measurements;

- demonstrate analytical and critical thinking as well as life-long learning and communication skills,
- ability to work on an interdisciplinary team (in international environment).

#### Metode poučevanja in učenja:

Predavanja, priprava seminarjev - timsko delo in debate. Poudarek je predvsem na reševanju realnih problemov, ki so povezani z raziskovalnim delom kandidata.

#### Learning and teaching methods:

Lectures, seminars – team work and discussions. The focus is on solving real problems that are related to the research work of the student.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Seminarska naloga.	30 %	Seminar.
Ustni zagovor seminarske naloge.	30 %	Oral defence of seminar work.
Študenti bodo morali razviti študijo v povezavi z njihovo kariero.	40 %	Students will be required to develop an enquiry linked to their specialist pathway.

#### Reference nosilca / Lecturer's references:

- BAT, Karmen, MOZETIČ VODOPIVEC, Branka, ELER, Klemen, OGRINC, Nives, MULIČ, Ines, MASUERO, Domenico, VRHOVŠEK, Urška. Primary and secondary metabolites as a tool for differentiation of apple juice according to cultivar and geographical origin. *Lebensmittel-Wissenschaft + Technologie*, ISSN 0023-6438, 2018, vol. 90, str. 238-245, doi: [10.1016/j.lwt.2017.12.026](https://doi.org/10.1016/j.lwt.2017.12.026).
- BAT, Karmen, ELER, Klemen, MAZEJ, Darja, MOZETIČ VODOPIVEC, Branka, MULIČ, Ines, KUMP, Peter, OGRINC, Nives. Isotopic and elemental characterisation of Slovenian apple juice according to geographical origin: preliminary results. *Food Chemistry*, ISSN 0308-8146, 2016, vol. 203, str. 86-94, ilustr., doi: 10.1016/j.foodchem.2016.02.039.
- Vojč Kocman and Janez Plavec, Tetrahelical structural family adopted by AGCGA-rich regulatory DNA regions, *Nat. Commun.* 2017, 8, article number: 15355.
- Martin Gajarský, Martina Lenarčič Živković, Petr Stadlbauer, Bruno Pagano, Radovan Fiala, Jussara Amato, L'ubomír Tomáška, Jiří Šponer, Janez Plavec and Lukáš Trantírek, Structure of a Stable G-Hairpin, *J. Am. Chem. Soc.* 2017, 139, 3591-3594.
- EFTIMOV, Tome, KOROŠEC, Peter, KOROUŠIĆ-SELJAK, Barbara. StandFood : standardization of foods using a semi-automatic system for classifying and describing foods according to FoodEx2. *Nutrients*, ISSN 2072-6643, 2017, vol. 9, no. 6, str. 542-1-541-16.