

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Kemijska varnost v prehrani – anorganska, organska onesnažila, nanodelci
Course title:	Food Chemical Safety – Inorganic, Organic Contaminants, Nanoparticles

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

Vrsta predmeta / Course type

Izbirni / Elective

Univerzitetna koda predmeta / University course code:

EKO3-605

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. Janez Ščančar
 Doc. dr. Tina Kosjek
 Prof. dr. Ester Heath
 Prof. dr. Radmila Milačič
 Doc. dr. Tea Zuliani
 Prof. dr. Milena Horvat

Jeziki /**Predavanja / Lectures:** slovenski, angleški / Slovene, English**Languages:****Vaje / Tutorial:** slovenski, angleški / Slovene, English**Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:**

Zaključen študij druge stopnje naravoslovne ali tehniške smeri ali zaključen študij drugih smeri z dokazanim poznavanjem osnov s področja kemije in biologije (pisna dokazila, pogovor).

Prerequisites:

Completed second level studies in natural sciences or engineering or completed second level studies in other fields with proven knowledge of chemistry and biology (certificates, interview).

Vsebina:

Študentje se bodo seznanili z različnimi skupinami organskih ter anorganskih onesnažil v živilih in vse večjo prisotnostjo nove skupine onesnažil, ki jo predstavljajo nanodelci. Podan jim bo pregled obstoječe mednarodne zakonodaje, povezane z vsebnostjo kemijskih onesnažil v hrani. V okviru predmeta bodo študentje spoznali analize metode ter meroslovne principe, ki zagotavljajo sledljive in primerljive rezultate analiznih metod.

Content (Syllabus outline):

The students will obtain the information in relation to different chemical types of pollutants in food, thus the course comprises of topics on inorganic and organic pollutants, and nanoparticles, which are a group of new emerging contaminants. They will be introduced to the relevant international legislation from the field of chemical contaminants in food. During the course students will also be introduced to analytical methods used to determine chemical contaminants in food and to the metrological principles, which ensure the traceable and

Anorganska onesnažila:

Uvod z osnovami kemijske varnosti v prehrani; Esencialni (kot so npr. Zn, Cu, Fe, Se) in strupeni elementi v sledovih (npr. Hg, Pb, Cd, As, Sn) v hrani, njihovo kroženje v naravi, celotne koncentracije in porazdelitev med posamezne kemijske zvrsti, naravni viri in kontaminacija hrane z anorganskimi onesnažili;

Vzorčenje in analiza vsebnosti anorganskih onesnažil v hrani;

Instrumentalne analize tehnike določitve celotnih koncentracij ter posameznih kemijskih zvrsti elementov v sledovih v vzorcih hrane (atomska optična in masna spektrometrija ter sklopljene tehnike), kontrola in zagotavljanje kakovosti meritev;

Moderni analitični pristopi v raziskavah kemijske varnosti hrane; izotopski sledilci;

Posamezni elementi v sledovih, njihov biološki pomen, vloga v prehrani, zdravju in boleznih.

Organska onesnažila:

Najpogostejše skupine organskih onesnažil v hrani in njihov izvor; Karakterizacija organskih onesnažil, ki izhajajo iz onesnažene prsti, vode ali zraka; Karakterizacija organskih onesnažil, ki jih vnesemo v hrano med njeno pridelavo, predelavo in pakiranjem; Obstojna in novejša organska onesnažila v hrani;

Vzorčenje; Analizne metode za detekcijo, identifikacijo in kvantitativno določanje organskih onesnažil; Validacija analitičnih metod; Sledljivost in primerljivost rezultatov analitičnih metod; Analizne metode, ki temeljijo na uporabi senzorjev: principi delovanja, prednosti in slabosti.

Nanodelci:

Viri kontaminacije hrane z nanodelci (proizvodnja prehranskih dodatkov in materialov, ki pridejo v stik s hrano, kot so kuhinjska posoda in ovojni materiali). Moderni pristopi v določitvi nanodelcev v vzorcih hrane s poudarkom na potrebi po uporabi različnih komplementarnih tehnik.

comparable results of measurements when different analytical methods are applied.

Inorganic pollutants:

Introduction with basis of food chemical safety; essential (for example Zn, Cu, Fe, Se) and toxic (like Hg, Pb, Cd, As, Sn) trace elements in food, total concentration versus chemical speciation, natural sources and contamination of food with inorganic contaminants

Food sampling and analysis of inorganic contaminants in food;

Instrumental analytical techniques for the determination of total concentration and chemical species of trace elements in food samples (atomic optical, mass spectrometric and hyphenated techniques), quality control and quality assurance of measurements

Modern analytical approaches in investigations of chemical food safety (like isotopic ratio measurements);

Element by element presentation: the biological role of a given trace element in food for health.

Organic pollutants:

Most common groups of organic pollutants in food and their origin; Characterization of organic pollutants originating from contaminated soil, water or air; Characterization of organic pollutants that enter the food during its production, processing and packaging; Persistent and emerging organic pollutants;

Sampling; Analytical methods for detection, identification and quantitation of organic pollutants; Validation analytical methods; Traceability and comparability of the results; Analytical methods based on the use of sensors: principles of operation, advantages and disadvantages.

Nanoparticles:

Sources of food contamination with nanoparticles (food additives and food-contact materials, like kitchen dishes and packing materials). Modern approaches in the determination of nanoparticles in various food samples with the emphasis on the need for the use of different complementary analytical techniques.

Temeljni literatura in viri / Readings:

D. Watson (2001), Food Chemical Safety, Woodhead Publishing Limited, Cambridge CB1 6AH, England, str. 1-12, 37-70, 148-168, 193-217, 263-278, 279-294.

Food Safety Management: A Practical Guide for the Food Industry, Edited by: Yasmine Motarjemi and Huub Lelieveld, Elsevier Inc. 2014. ISBN: 978-0-12-381504-0

Persistent Organic Pollutants and Toxic Metals in Foods, 1st Edition, Edited by Martin Rose and Alwyn Fernandes. Elsevier Woodhead Publishing, 2013.

pregledni članki s področja, tekoča periodika, spletna stran EU, druga učna gradiva... / review articles from the field, periodicals, EU website, other educational readings...

Cilji in kompetence:

Izobraževalni cilji: Študentje bodo pridobili znanje o kemijski varnosti v prehrani in poglobili znanje o modernih pristopih v analitiki, raziskavah in zagotavljanju kemijske varnosti prehrane. Poleg tega bodo študentje poglobili znanje o določanju in tveganju, ki ga organska onesnažila predstavljajo v hrani.

Študijski rezultati: Vsebine iz predmeta bodo študentom omogočile razumevanje kompleksnih procesov, povezanih z onesnažili v hrani, ki izvirajo iz pridelave in predelave hrane ter pakiranja.

Objectives and competences:

Educational outcomes: students will gain new knowledge on chemical food safety and deepen their knowledge on modern approaches in analysis, investigations and assurance of chemical food safety. In addition, they will gain knowledge in the determination and importance of organic pollutants in food.

Results: All the above will enable students to understand the complex processes of food contaminants deriving from food production, processing and packaging.

Predvideni študijski rezultati:

Znanje in razumevanje:
Slušatelji razumejo pomen kemijske varnosti hrane, spoznajo, da je v primeru onesnaženja hrane z anorganskimi in organskimi onesnažili ter nanodelci potrebno znanje, ki vključuje poznavanje kroženja elementov in porazdelitve organskih onesnažil ter nanodelcev v zemlji, vodi in zraku. Pridobijo razumevanje, da je za oceno usode, vloge in učinka elementov v sledovih na živo in neživo naravo bistveno poznati ne samo njihove celotne koncentracije, temveč tudi porazdelitev med njihove različne kemijske zvrsti (speciacijo). Prav tako pridobijo znanje o možnih pretvorbah organskih onesnažil med procesi pridelave, predelave, pakiranja in shranjevanja hrane. Študenti lahko predvidijo, kako uporabiti instrumentalne analize tehnike, ki omogočajo detekcijo, identifikacijo in kvantitativno določitev elementov v sledovih oz. njihovih posameznih kemijskih zvrsti ter organskih onesnažil in nanodelcev na zelo nizkih koncentracijskih nivojih v vzorcih hrane.

Intended learning outcomes:

Knowledge and understanding:
Students understand the importance of chemical food safety for quality of life. They learn that accurate estimation of the contamination of food involves also the use of knowledge on biogeochemical cycling of trace elements and distribution of organic pollutants and nanoparticles in soil, air and water, where for understanding their fate, role and effects on environment and living beings, it is necessary to know both, their total concentrations and distribution between their different chemical species (speciation). In addition, they receive knowledge on possible transformations of organic pollutants during processes of food production, preparation, packaging and storing. Students have been introduced to the frequently used instrumental analytical techniques for the detection, identification and quantitative determination of the total concentration and the speciation of trace elements, organic pollutants and nanoparticles on low concentration levels in food samples and also become aware of the importance

Na podlagi znanja o posameznih najpomembnejših onesnažilih lahko načrtujejo ukrepe za zmanjšanje onesnaženja. Razumejo pomen esencialnosti elementov v sledovih za normalno delovanje fizioloških procesov v živih organizmih in se seznanijo z najpogostejšimi neželenimi učinki oz. pojavom obolenj ali zastrupitev, do katerih privede njihovo neravnotežje (pomanjkanje ali presežek). Pridobijo znanje o potencialnih nevarnostih, ki jih lahko prinaša kontaminacija hrane z obstojnimi in novejšimi organskimi onesnažili, predvsem za najbolj občutljive skupine populacije. Seznanijo se s sistemi kakovosti na področju analitike hrane ter z aktualno zakonodajo, ki predpisuje še varne/dovoljene vnose onesnažil. Pridobljeno znanje o modernih pristopih v analitiki anorganskih in organskih onesnažil ter nanodelcev v hrani lahko inovativno uporabijo v interdisciplinarnih raziskavah zagotavljanja kemijske varnosti hrane.

of quality assurance and control in measurement process. Hence, at the end of the course they can critically estimate which technique is the optimal for its intended use in practice. Knowledge on the elements, organic pollutants and nanoparticles that are commonly found present as a contaminant of food can be used by participant when adequate measures to avoid contamination of food are planned and safe diet with optimal nutrition is proposed. Finally, knowing modern approaches of inorganic, organic and nanoparticles food contaminant analysis can help students to use them in innovative way when interdisciplinary investigation in the field of chemical food safety are carried out.

Metode poučevanja in učenja:

Predavanja, priprava seminarjev - timsko delo in diskusije.

Learning and teaching methods:

Lectures. Seminars – team work and discussions.

	Delež (v %) / Weight (in %)	Assessment:
Načini ocenjevanja:		
Seminar	50 %	Seminar
Ustni izpit	50 %	Oral examination

Reference nosilca / Lecturer's references:

- PEETERS, Kelly, ZULIANI, Tea, ŽIGON, Dušan, MILAČIČ, Radmila, ŠČANČAR, Janez. Nickel speciation in cocoa infusions using monolithic chromatography : post-column ID-ICP-MS and Q-TOF-MS. *Food Chemistry*. 2017, 230, 327-335.
- NOVAK, Petra, ZULIANI, Tea, MILAČIČ, Radmila, ŠČANČAR, Janez. Development of an analytical method for the determination of polybrominated diphenyl ethers in mussels and fish by gas chromatography: inductively coupled plasma mass spectrometry. *Journal of Chromatography A.*, 2017, 1524, 179-187.
- ČESEN, Marjeta; LAMBROPOULOU, Dimitra; LAIMOU-GERANIOU, Maria; KOSJEK, Tina; BLAZNIK, Urška; HEATH, David; HEATH, Ester: The determination of bisphenols and related compounds in honey and their migration from selected food contact materials. *Journal of Agricultural and Food Chemistry*, 2016, 64, 8866-8875.
- HEATH, Ester, ČESEN, Marjeta, ŠČANČAR, Janez, NOVAKOVIĆ, Srdjan, MISLEJ, Vesna, STRAŽAR, Marjeta, KOSJEK, Tina, et al. First inter-laboratory comparison exercise for the determination of anticancer drugs in aqueous samples. *Environmental Science and Pollution Research International*, 2016, 23, 14692-14704.
- ARCAGNI, Marina, JUNCOS, Romina, RIZZO, Andrea, PAVLIN, Majda, FAJON, Vesna, ARRIBÉRE, Maria, HORVAT, Milena, RIBEIRO GUEVARA, Sergio. Species- and habitat-specific bioaccumulation of total mercury and methylmercury in the food web of a deep oligotrophic lake. *Science of the Total Environment*, 2018, 612, 1311-1319.