

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Biofilmi
Course title:	Biofilms

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Interdisciplinarni doktorski študijski program BIOZNANOSTI 3. stopnja	Agroživilska mikrobiologija	1,2	1,2,3,4
Interdisciplinary Doctoral Study Programme in BIOSCIENCES 3rd cycle	Agrifood microbiology	1,2	1,2,3,4

Vrsta predmeta / Course type

teoretični predmet / theoretical course

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
10	20	/	/	/	95 ur	5

Nosilec predmeta / Lecturer:

Nosilec: Prof. dr. David Stopar

Jeziki / Languages:

Predavanja / Lectures:	slovenski / angleški Slovene / English
Vaje / Tutorial:	slovenski / angleški Slovene / English

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

Splošni pogoji za vpis na doktorski študij.

Prerequisites:

Enrolment to the PhD program.

Vsebina:**Content (Syllabus outline):**

- Sestava biofilmov (biološka, kemijska)
- Struktura, dinamika in razvoj biofilmov
- Transport in medcelične komunikacije v biofilmih
- Koristni in škodljivi biofilmi ter njihova perzistentnost v agroživilstvu
- Napredne tehnike za določanje sestave, strukture in dinamike biofilmov

- Composition of biofilms (biological, chemical)
- Structure, dynamics and development of biofilms.
- Transport and cell to cell communications in biofilms
- Good and bad biofilms in agro-food industry
- Advanced techniques for evaluation of a biofilm composition, structure and dynamics.

Temeljni literatura in viri / Readings:

- Fundamentals of Biofilm Research, Zbigniew Lewandowski, Haluk Beyenal, Second Edition, 2013, CRC Press,
- SIMÕES, Manuel (ur.), MERGULHÃO, Filipe (ur.). *Biofilms in bioengineering*, (Microbiology research advances). New York: Nova Science Publishers, 2013, str. 311-332.
- revijalni članki s področja

Cilji in kompetence:

Biofilm je najbolj kompleksna pojavna oblika mikrobne skupnosti v okolju. Cilj predmeta je, da študent skozi učni proces spozna razliko med rastjo mikroorganizmov v biofilmu in v suspendirani kulturi; spozna in razume vpliv biotskih/abiotičnih dejavnikov okolja na razvoj biofilmov. Študent spozna kdaj in zakaj so biofilmi lahko problematične in zakaj so biofilmi koristne strukture v agroživilstvu.

Objectives and competences:

Biofilms are the most complex microbial structures in the environment. Upon successful completion of the course student will be able to appreciate the difference between planktonic and biofilm growth and will be familiar with various biotic and abiotic factors that influence biofilm development. The student will also understand when and why biofilms cause problems as well as why biofilms are essential in agro-food industry.

Predvideni študijski rezultati:

Študent pozna glavne biološke in kemijske komponente različnih biofilmov. Razume njihovo strukturno in dinamično obnašanje. Razume redosled dogodkov, ki pripeljejo do nastanka in propada biofilma. Pozna spremembe v celični fiziologiji, ki omogočajo nastanek biofilma. Razume transportne pojave v biofilmu, vpliv signaliziranja in pozna glavne tehnike za proučevanje biofilmov. Pozna škodljiv in koristen vpliv biofilmov ter načine za

Intended learning outcomes:

Student understands main biological and chemical components of different biofilms. Understands structure – dynamic relationship in biofilms. Understands steps in biofilm formation, dispersal and disintegration. Understands different physiology of biofilm cells compared to planktonic cells. Understands transport phenomena in biofilms and role of signalling, knows the main techniques used for studies of biofilms. Student knows how

preprečitev oziroma uporabo biofilmov v agroživilstvu.

to prevent or use biofilms in agro-food industry.

Metode poučevanja in učenja:

Predavanja po posameznih vsebinskih sklopih. Problemsko voden seminar prilagojen potrebam posameznega študenta. Seminar lahko študent v dogovoru z nosilcem opravi teoretično ali praktično v laboratoriju. V okviru predmeta je možna uporaba raziskovalnih orodij, ki smo jih razvili v laboratoriju za proučevanje biofilmov, za potrebe raziskovalnega dela doktorskega študenta.

Learning and teaching methods:

Lectures and seminar adjusted to student needs. In agreement with the lecture student may decide to do practical or theoretical seminar. Student may use research tools developed for the study of biofilms in our laboratory for his/her PhD project related to microbial biofilms.

Načini ocenjevanja:

Ocenjuje se izvedba problemsko orientiranega dela.

Delež (v %) /
Weight (in %)

100 %

Assessment:

Assesment of problem oriented work.

Reference nosilca / izvajalcev / Lecturer's references:

Prof. Dr. David Stopar

1. DOGŠA, Iztok, TOMŠIČ, Matija, OREHEK, Janez, BENIGAR, Elizabeta, JAMNIK, Andrej, STOPAR, David. Amorphous supramolecular structure of carboxymethyl cellulose in aqueous solution at different pH values as determined by rheology, small angle X-ray and light scattering. *Carbohydrate polymers*, ISSN 0144-8617. [Print ed.], 2014, vol. 111, str. 492-504, doi: [10.1016/j.carbpol.2014.04.020](https://doi.org/10.1016/j.carbpol.2014.04.020). [COBISS.SI-ID [4392568](#)].
2. DOGŠA, Iztok, BRLOŽNIK, Mojca, STOPAR, David, MANDIČ-MULEC, Ines. Exopolymer diversity and the role of levan in *Bacillus subtilis* biofilms. *PloS one*, ISSN 1932-6203, 2013, vol. 8, iss. 4, str. 1-10, e62044, doi: [10.1371/journal.pone.0062044](https://doi.org/10.1371/journal.pone.0062044). [COBISS.SI-ID [4242040](#)], [JCR, SNIP, WoS do 16. 9. 2013: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0, Scopus do 30. 10. 2013: št. citatov (TC): 1, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 0].
3. OREHEK, Janez, DOGŠA, Iztok, TOMŠIČ, Matija, JAMNIK, Andrej, KOČAR, Drago, STOPAR, David. Structural investigation of carboxymethyl cellulose biodeterioration by *Bacillus subtilis* subsp. *subtilis* NCIB 3610. *International biodeterioration & biodegradation*, ISSN 0964-8305. [Print ed.], 2013, vol. 77, no. 1, str. 10-17, doi: [10.1016/j.ibiod.2012.10.007](https://doi.org/10.1016/j.ibiod.2012.10.007). [COBISS.SI-ID [36573957](#)].

4. OREHEK, Janez, PETEK, Klemen, DOGŠA, Iztok, STOPAR, David. New carboxymethyl cellulose tosylate with low biodeterioration. *Carbohydrate polymers*, ISSN 0144-8617. [Print ed.], 2014, vol. 113, str. 16-21, doi: [10.1016/j.carbpol.2014.06.016](https://doi.org/10.1016/j.carbpol.2014.06.016). [COBISS.SI-ID [4397688](#)].
5. BORIC, Maja, DANEVČIČ, Tjaša, STOPAR, David. Viscosity dictates metabolic activity of *Vibrio ruber*. *Frontiers in microbiology*, ISSN 1664-302X, July 2012, vol. 3, no. article 255, str. 1-12. doi: [10.3389/fmicb.2012.00255](https://doi.org/10.3389/fmicb.2012.00255). [COBISS.SI-ID [4146552](#)].
6. BENIGAR, Elizabeta, DOGŠA, Iztok, STOPAR, David, JAMNIK, Andrej, KRALJ CIGIĆ, Irena, TOMŠIČ, Matija. Structure and dynamics of a polysaccharide matrix : aqueous solutions of bacterial levan. *Langmuir*, ISSN 0743-7463, 2014, vol. 30, issue 14, str. 4172-4182, doi: [10.1021/la500830j](https://doi.org/10.1021/la500830j). [COBISS.SI-ID [4381304](#)]

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Dinamika mikrobnih genomov v agroživilskih sistemih
Course title:	Dynamics of microbial genomes in agro-food systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Interdisciplinarni doktorski študijski program BIOZNANOSTI 3. stopnja	Agroživilska mikrobiologija	1, 2	1, 2, 3, 4
Interdisciplinary Doctoral Study Programme in BIOSCIENCES 3rd cycle	Agrifood microbiology	1, 2	1, 2, 3, 4

Vrsta predmeta / Course type teoretični predmet / theoretical course

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
10	20	/	/	/	95	5

Nosilec predmeta / Lecturer: Nosilec: prof. dr. Marjanca Starčič Erjavec

Jeziki / Languages:	Predavanja / Lectures:	slovenski / angleški Slovene / English
	Vaje / Tutorial:	slovenski / angleški Slovene / English

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

Splošni pogoji za vpis na doktorski študij.	General criteria for enrollment in PhD studies.
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Vsebina: **Content (Syllabus outline):**

Hrana je vir in sredstvo prenosa patogenih mikroorganizmov, za katere je dinamika genoma pogosto odločilna v patogenezi. Postopki obdelave hrane sprožijo prerazporeditve in horizontalne prenose DNA ter evolucijo novih patogenov.

- Postopki obdelave hrane, mutageneza, rekombinacija in horizontalni prenosi DNA.
- Rastlinsko-mikrobna genomika.
- Struktura genomov, stalni in pogrešljivi deli genomov, pangenom.
- Genomski otoki, otoki patogenosti, metagenomski otoki.
- Mobilni genetski elementi in mehanizmi horizontalnih prenosov DNA (transpozoni, plazmidi, integrativni konjugativni elementi, virusi).
- Obramba pred tujo DNA.

Food as a source and means of dissemination of microbial pathogens, whose dynamic genomes play a key role in pathogenesis. Food treatment procedures induce DNA rearrangements along with horizontal DNA transfer and evolution of novel pathogens.

- Food treatment procedures, mutagenesis, recombination and horizontal DNA transfer.
- Plant-microbial genomics.
- Genome structure, core and dispensable genome, pangenome.
- Genomic islands, pathogenicity islands, metagenomic islands.
- Mobile genetic elements and mechanisms of horizontal DNA transfer (transposons, plasmids, integrative conjugative elements, viruses).
- Defense mechanisms protecting against foreign DNA.

Temeljni literatura in viri / Readings:

Revijalni članki s področja, tekoča periodika, druga učna gradiva bodo dostopna preko ŠIS.

Cilji in kompetence:

Cilj predmeta je povezati razumevanje strukture genomov in genetskih elementov z mehanizmi, ki omogočajo dinamiko mikrobne genoma ter dejavniki okolja kot so postopki pridelave in obdelave živil, ki vplivajo na to dinamiko. Vsebine predmeta so nadgradnja celično-bioloških, biokemijskih in genetskih predmetov na 1. in 2. stopnji. Pridobljena znanja dajejo študentom osnovo za poglobljeno razumevanje dinamike mikrobne genoma, potrebno za njegovo doktorsko disertacijo. Poudarek na postopkih agro-živilstva, ki vplivajo na omenjeno dinamiko in porajanje novih mikrobne lastnosti.

Objectives and competences:

The goal of the course is for students to understand the connection of the structure of genomes and genetic elements with the mechanism that conduct the dynamics of the microbial genomes and environmental factors such as food producing and treatment procedures that affect the dynamics of genomes. The course content is an upgrading of first and second level courses dealing with cell biology, biochemistry and genetics. The obtained knowledge will provide the student an in depth understanding of the dynamics of microbial genomes that is required for his/her PhD thesis. Emphasis on procedures employed in the food industry that affect microbial genome dynamics and evolution of novel pathogens.

Predvideni študijski rezultati:

Znanje in razumevanje:
 Študent bo pridobil znanje in razumevanje o strukturi genomov, genetskih elementih in mehanizmih horizontalnega genskega prenosa, njihovi uravnavi ter dejavnikih okolja v agroživilski mikrobiologiji, ki vplivajo na dinamiko mikrobnih genomov.

Intended learning outcomes:

Knowledge and understanding:
 Students will acquire the knowledge and understanding of genome structure, genetic elements and mechanism of horizontal gene transfer, the regulation and the environmental factors in agro-food microbiology that shape the dynamics of microbial genomes.

Metode poučevanja in učenja:

Pouk je organiziran s predavanji, konzultacijami; seminarsko delo.

Learning and teaching methods:

Lectures, consultations, seminar.

Načini ocenjevanja:

Izpit
 Seminar

Delež (v %) /
 Weight (in %)

50 %
 50 %

Assessment:

Exam
 Seminar

Reference nosilca / izvajalcev / Lecturer's references:**prof. dr. Marjanca Starčič Erjavec**

1. PAŠIČ, Lejla, AMBROŽIČ, Jerneja, **STARČIČ ERJAVEC, Marjanca**, HERZOG-VELIKONJA, Blagajana, PODLESEK, Zdravko, ŽGUR-BERTOK, Darja. Two tales of prokaryotic genomic diversity : *Escherichia coli* and halophiles. Food technology and biotechnology, ISSN 1330-9862, 2014, vol. 52, no. 2, str. 158-169.
2. FAJS, Luka, JELEN, Mateja, BORIĆ, Maja, ĐAPA, Tanja, ŽGUR-BERTOK, Darja, **STARČIČ ERJAVEC, Marjanca**. The discriminative power in determining genetic diversity of *Escherichia coli* isolates : comparing ERIC-PCR with AFLP. African journal of microbiology research, ISSN 1996-0808, 2013, no. 20, vol. 7, str. 2416-2419.
3. PETKOVŠEK, Živa, ŽGUR-BERTOK, Darja, **STARČIČ ERJAVEC, Marjanca**. Colicin insensitivity correlates with a higher prevalence of extraintestinal virulence factors among *Escherichia coli* isolates from skin and soft-tissue infections. Journal of medical microbiology, ISSN 0022-2615, 2012, vol. 61, no. Pt 6, str. 762-765.
4. **STARČIČ ERJAVEC, Marjanca**, JESENKO, Blaž, PETKOVŠEK, Živa, ŽGUR-BERTOK,

Darja. Prevalence and associations of tcpC, a gene encoding a Toll/Interleukin-1 receptor domain-containing protein, among *Escherichia coli* urinary tract infection, skin and soft tissue infection, and commensal isolates. *Journal of clinical microbiology*, ISSN 0095-1137, 2010, vol. 48, no. 3, str. 966-968.

5. REISSBRODT, Rolf, HAMMES, Walter P., DAL BELLO, Fabio, PRAGER, Rita, FRUTH, Angelika, HANTKE, Klaus, RAKIN, Alexander, **STARČIČ ERJAVEC, Marjanca**, WILLIAMS, P. H. Inhibition of growth of Shiga toxin-producing *Escherichia coli* by nonpathogenic *Escherichia coli*. *FEMS microbiology letters*, ISSN 0378-1097. 2009, vol. 290, no. 1, str. 62-69.
6. PETKOVŠEK, Živa, ELERŠIČ, Kristina, GUBINA, Marija, ŽGUR-BERTOK, Darja, **STARČIČ ERJAVEC, Marjanca**. Virulence potential of *Escherichia coli* isolates from skin and soft tissue infections. *Journal of clinical microbiology*, ISSN 0095-1137, 2009, issue 6, vol. 47, str. 1811-1817.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Sociomikrobiologija
Course title: Sociomicrobiology

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Interdisciplinarni doktorski študijski program BIOZNANOSTI 3. stopnja	Agroživilska mikrobiologija	1,2	1,2,3,4
Interdisciplinary Doctoral Study Programme in BIOSCIENCES 3rd cycle	Agrifood microbiology	1,2	1,2,3,4

Vrsta predmeta / Course type

individualno raziskovalni predmet /
individual research course

Univerzitetna koda predmeta / University course code:

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Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
/	20	20	/	10	200	10

Nosilec predmeta / Lecturer:

Nosilec: prof. dr. Ines Mandić Mulec

Jeziki / Languages:

Predavanja / Lectures:
Vaje / Tutorial:

slovenski / angleški
 Slovene / English
 slovenski / angleški
 Slovene / English

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

Prerequisites:

Splošni pogoji za vpis na doktorski študij

Enrolment to the PhD program.

Vsebina:

Sociomikrobiologija je novo hitro se razvijajoče področje mikrobiologije, ki preučuje različne skupinske odzive mikroorganizmov.

Glavni vsebinski sklopi:

- Kooperacija mikroorganizmov
- Sorodstvena in skupinska selekcija
- Sorodstveno prepoznavanje/diskriminacija
- Goljufi in mehanizmi, ki stabilizirajo kooperacijo
- Seks pri bakterijah in adaptacije
- Agresija in antibiotiki kot signali
- Socialne interakcije v strukturiranih agroživilskih okoljih
- Ekologija socialnih interakcij v agroživilskih okoljih
- Biokontrola: mikrob in rastlina

Content (Syllabus outline):

Sociomicrobiology is a new and rapidly developing field of microbiology which addresses various aspects of microbial group behaviour.

Content:

- Kooperativity of microorganisms
- Kin and group selection
- Kin recognition/discrimination
- Cheating and mechanisms that stabilize cooperation
- Spite and antibiotics as signals
- Bacterial sex and adaptation
- Social interactions in structured agro-food environments
- Ecology of social interactions in agro-food environments
- Biocontrol: plant / microb

Temeljni literatura in viri / Readings:

Predmet je zasnovan na novejših revijalnih (Nature Review Microbiology, Current Biology, Trend in Microbiology, ISME journal) in tekočih eksperimentalnih člankih s področja.

Cilji in kompetence:

Študent se skozi problemsko zasnovan seminar in eksperimentalno delo seznanja s koncepti in naborom metod, ki se uporabljajo v sociomikrobiologiji in so predstavljene v okviru vsebine predmeta. Omogoči se mu izvedba in nudi pomoč pri reševanju eksperimentalne problematike vezane na področje sociomikrobiologije in prirejene

Objectives and competences:

Student learns through seminar work fundamental methods and concepts (described above) which are used in sociomicrobiology. Student is also provided with an opportunity to work in the lecturer's laboratory and is supervised in solving the

individualnim potrebam študenta ter so lahko del doktorata vpisanega študenta.

experimental problems in sociomicrobiology. These could also be part of student's thesis project.

Predvideni študijski rezultati:

Študent spozna in razume osnovne koncepte in teorijo v sociomikrobiologiji in uporabo teh konceptov v medicini, biotehnologiji in ekologiji. Študent se nauči zasnovati in izvesti eksperiment s področja sociomikrobiologije.

Študent ima možnost izvajati del eksperimentov vezanih na doktorsko tezo v laboratoriju nosilke predmeta (v dogovoru z mentorjem). Pri tem lahko uporabi razpoložljivo opremo in modelne sisteme, ki jih rutinsko uporabljamo v laboratoriju.

- Zasnova eksperimenta v sociomikrobiologiji
- Modelni mikrobní sistemi
- Priprava rekombinantnih sevov
- Fluorescenčne mikroskopije
- Fluorometrija
- Reometrija
- Metagenomski pristopi

Intended learning outcomes:

Student gains an insight and understands the basic concepts in sociomicrobiology and application of this knowledge in medicine, biotechnology and ecology.

Student learns how to design and execute an experiment in the field of sociomicrobiology. Student can perform part of the thesis project in the lecturer's laboratory (in agreement with the student's thesis supervisor). He may use model systems and laboratory equipment that are routinely applied in the laboratory.

- Design of an experiment in sociomicrobiology
- Modelni mikrobní sistemi
- Preparation of recombinant strains
- Fluorescent microscopy
- Fluorometry
- Rheometry
- Metagenomic approaches

Metode poučevanja in učenja:

Konzultacije, pomoč pri zasnovi in izvedbi eksperimentalnega projekta. V okviru predmeta je možna uporaba raziskovalnih orodij, ki smo jih razvili v laboratoriju za proučevanje sociomikrobiologije, za potrebe raziskovalnega dela doktorskega študenta iz področja sociomikrobiologije.

Learning and teaching methods:

Consultations and experimental project in the laboratory of the lecturer. Student may use research tools developed for the study of sociomicrobiology in our laboratories for his/her PhD project related to sociomicrobiology or subjects related under the content of the

	course.
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Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Seminar- pisni Eksperimentalni del in pisno poročilo	20 % 80 %	Seminar Eksperimental project and the written report)

Reference nosilca / Lecturer's references:

Prof. dr. Ines Mandic Mulec

1. OSLIZLO, Anna, ŠTEFANIČ, Polonca, DOGŠA, Iztok, **MANDIĆ-MULEC, Ines**. Private link between signal and response in *Bacillus subtilis* quorum sensing. Proceedings of the National Academy of Sciences of the United States of America, ISSN 0027-8424, 2014, vol. 111, no. 4, str. 1586-1591, ilustr., doi: 10.1073/pnas.1316283111. [COBISS.SI-ID 4358008].
2. ŠTEFANIČ, Polonca, DECOROSI, Francesca, VITI, Carlo, PETITO, Janine, COHAN, Frederick, **MANDIĆ-MULEC, Ines**. The quorum sensing diversity within and between ecotypes of *Bacillus subtilis*. Environmental microbiology, ISSN 1462-2912. [Print ed.], 2012, vol. 14, no. 6, str. 1378-1389, doi: 10.1111/j.1462-2920.2012.02717.X. [COBISS.SI-ID 4044408].
3. ŠTEFANIČ, Polonca, **MANDIĆ-MULEC, Ines**. Social interactions and distribution of *Bacillus subtilis* phenotypes at microscale. Journal of bacteriology, ISSN 0021-9193, 2009, no. 6, vol. 191, str. 1756-1764, doi: 10.1128/JB.01290-08. [COBISS.SI-ID 3565432].
4. DOGŠA, Iztok, OSLIZLO, Anna, ŠTEFANIČ, Polonca, **MANDIĆ-MULEC, Ines**. Social interactions and biofilm formation in *Bacillus subtilis*. Food technology and biotechnology, ISSN 1330-9862, 2014, vol. 52, no. 2, str. 149-157. [COBISS.SI-ID 4381816].
5. DURRETT, Russell, MIRAS, Mathieu, MIROUZE, Nicolas, NARECHANIA, Apurva, **MANDIĆ-MULEC, Ines**, DUBNAU, David A. Genome sequence of the *Bacillus subtilis* biofilm-forming transformable strain PS216. Genome announcements, ISSN 2169-8287, 2013, vol. 1, no. 3, str. 1-2, e00288-13.
6. LEVIČNIK HOEFFERLE, Špela, NICOL, Graeme, AUSEC, Luka, **MANDIĆ-MULEC, Ines**, PROSSER, James Ivor. Stimulation of thaumarchaeal ammonia oxidation by ammonia derived from organic nitrogen but not added inorganic nitrogen. FEMS microbiology, ecology, 2012, vol. 80, issue 1, str. 114-123.
7. **MANDIĆ-MULEC, Ines**, GORENC, Katja, GAMS PETRIŠIČ, Marinka, FAGANELI, Jadran, OGRINC, Nives. Methanogenesis pathways in a stratified eutrophic alpine lake (Lake Bled, Slovenia). Limnology and oceanography, 2012, vol. 57, no. 3, str. 868-880. 9. KRAIGHER, Barbara, **MANDIĆ-MULEC, Ines**.
8. AUSEC, Luka, ELSAS, Jan D., **MANDIĆ-MULEC, Ines**. Two- and three-domain bacterial laccase-like genes are present in drained peat soils. Soil biology & biochemistry, 2011, vol. 43, issue 5, str. 975-983.
9. **MANDIĆ-MULEC, Ines**, PROSSER, James Ivor. Diversity of endospore - forming bacteria in soil : characterization and driving mechanisms. V: LOGAN, Niall A. (ur.), DE VOS, Paul (ur.). Endospore : forming soil bacteria, (Soil biology, ISSN 1613-3382, 27). 1st ed. Berlin;

Heidelberg: Springer, 2011, str. 31-59. [COBISS.SI-ID 3897720].

10. JACQUIOD, Samuel, DEMANECHÉ, Sandrine, AUSEC, Luka, XU, Zhuofei, DELMONT, Tom O., DUNON, Vincent, CAGNON, Christine, **MANDIĆ-MULEC, Ines**, VOGEL, Timothy M., SIMONET, Pascal, FRANQUEVILLE, Laure. Characterization of new bacterial catabolic genes and mobile genetic elements by high throughput genetic screening of a soil metagenomic library. *Journal of biotechnology*, ISSN 0168-1656. [Print ed.], 2014, str. [1-12, v tisku], doi: 10.1016/j.jbiotec.2014.03.036. [COBISS.SI-ID 4379512].

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Mikrobiologija hrane
Course title:	Microbiology of food

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Interdisciplinarni doktorski študijski program BIOZNANOSTI 3. stopnja	Agroživilska mikrobiologija	1,2	1,2,3,4
Interdisciplinary Doctoral Study Programme in BIOSCIENCES 3rd cycle	Agrifood microbiology	1,2	1,2,3,4

Vrsta predmeta / Course type teoretični predmet / theoretical course

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
10	20	/	/	10	85	5

Nosilec predmeta / Lecturer: Nosilec: Prof. dr. Sonja Smole Možina

Jeziki / Languages:	Predavanja / Lectures:	slovenski / angleški Slovene / English
	Vaje / Tutorial:	slovenski / angleški Slovene / English

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

Splošni pogoji za vpis na doktorski študij.

General conditions for enrolment in doctoral studies.

Vsebina: **Content (Syllabus outline):**

Glavni vsebinski sklopi predmeta so naslednji:

- izbrana poglavja iz mikrobne ekologije hrane in živilskih procesov oz. konzerviranja hrane
- aktualni epidemiološki podatki o mikrobno povzročeni težavi vzdolž proizvodno-oskrbovalne prehranske verige (nacionalni, EU-EFSA/ECDC, Med-Vet-Net, PulseNet in druge podatkovne baze, specifične za posamezne patogene)
- novi mikroorganizmi prenosljivi s hrano oz. vzdolž proizvodno-oskrbovalno prehranske verige in njihovo obvladovanje
- alimentarne intoksikacije z bakterijskimi in glivnimi (miko)toksini
- novejša metoda za zagotavljanje sledljivosti mikroorganizmov in/ali njihovih toksinov v hrani.
- rezistenca na protimikrobna sredstva pri patogenih mikroorganizmih, povzročiteljih kvarjenja ali indikatorskih mikroorganizmih v primarni in sekundarni proizvodnji hrane.

The main points in the contents of the subject are as follows:

- Selected topics form microbial ecology of foods, food processing and preservation.
- current epidemiological data (national, EU-EFSA/ECDC, Med-Vet-Net, PulseNet and others, specific for some foodborne pathogens) - emerging microorganisms: viruses, bacteria and eucaryotic causative agents (fungi, protozoa) along food production-supply chain
- alimentary intoxications with bacterial and fungal (myco)toxins
- new methods for ensuring traceability of microorganisms
- resistance to antimicrobial agents of food-related pathogenic microorganisms, food spoilage or indicator microorganisms.

Temeljni literatura in viri / Readings:

Microorganisms in Foods (izbrana poglavja). International Commission on Microbiological Specifications for Foods (ICMSF) and Springer, New York, 2011, 400 str.

Bhunia, A.K. 2008. Foodborne Microbial pathogens. Mechanisms and Pathogenesis. Food Science Text series, Springer, 276 str. (izbrana poglavja)

Smole Možina S., Klančnik, A., Raspor, P. Mechanisms of microbial resistance in biofilms. V:

Smole Možina, S. Živilska mikrobiologija = Food microbiology. V: Avguštin, G.(ur.), *Mikrobiologija za znanje in napredek : 20 let univerzitetnega študija mikrobiologije*, (Pomen biotehnologije in mikrobiologije za prihodnost, 11). Ljubljana: Biotehniška fakulteta, Oddelek za živilstvo, Katedra za biotehnologijo, mikrobiologijo in varnost živil, 2013, str. 253-266, in citirana literatura

Rupnik M, Songer JG (2010) *Clostridium difficile*: its potential as a source of food borne disease, In Taylor SL (Ed.) *Advances in Food and Nutrition Research*, vol. 60, Burlington, Academic Press, 2010, pp. 53-66.

HALBERG LARSEN, M. s sod., Persistence of foodborne pathogens and their control in primary and secondary food production chains. **Food control**, ISSN 0956-7135. 2014, vol. 44, str. 92-109
Drugi pregledni članki s področja in tekoča periodika.

Cilji in kompetence:

- Poglobitev znanja slušatelja o živilih kot kompleksnih sistemih, ki so lahko vzrok alimentarnim infekcijam in intoksikacijam,
- Razumevanje epidemioloških in ekoloških parametrov ter (bio)kemijskih sprememb živil na praktičnih primerih in na poglobljenem raziskovalnem nivoju;
- Uporaba pridobljenega znanja za uspešno preprečevanje neželenih okužb in kvarjenja hrane.

Objectives and competences:

- The basic aim is deepening the student's knowledge of foods as complex systems which can cause alimentary infections and intoxications;
- Understanding epidemiological and ecological parameters and (bio)chemical changes in foods on practical examples and on research level for successful prevention of undesirable infections and food spoilage.

Predvideni študijski rezultati:

Predviden študijski rezultat je kandidata usposobiti za izvedbo nalog in opravljanje raziskav, katerih rezultati bodo predstavljali pomembne prispevke temeljni ali aplikativni znanosti na področju ekologije in epidemiologije mikroorganizmov hrane

Intended learning outcomes:

The intended learning outcome is to qualify the candidate for carrying out the mentioned tasks and performing research, the results of which will make an important contribution to basic and applicative science in the field of ecology and epidemiology of food microorganisms.

Metode poučevanja in učenja:

Predavanja, samostojna priprava seminarjev oz. projektov in njihova (javna) predstavitev.

Learning and teaching methods:

Lectures, seminar and project work of the students in a written form and joined with oral presentation in the group.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Ocena seminarskega dela	50	Assessment of the seminar work
Ocena izpita	50	Written examination

Reference nosilca / izvajalcev / Lecturer's references:**Sonja Smole Možina**

1. KOVAČ, Jasna, ČADEŽ, Neža, LUŠICKY, Marija, MØLLER NIELSEN, Eva, OCEPEK, Matjaž, RASPOR, Peter, **SMOLE MOŽINA, Sonja**. The evidence for clonal spreading of quinolone resistance with a particular clonal complex of *Campylobacter jejuni*. ***Epidemiology and Infection***, ISSN 0950-2688, 2014, 1-9, doi: [10.1017/S0950268813003245](https://doi.org/10.1017/S0950268813003245). [COBISS.SI-ID [4335992](#)]
2. KLANČNIK, Anja, VUČKOVIĆ, Darinka, PLANKL, Mojca, ABRAM, Maja, **SMOLE MOŽINA, Sonja**. *In vivo* modulation of *Campylobacter jejuni* virulence in response to environmental stress. ***Foodborne pathogens and disease***, ISSN 1535-3141, 2013, vol. 10, issue 6, str. 566-572, doi: [10.1089/fpd.2012.1298](https://doi.org/10.1089/fpd.2012.1298). [COBISS.SI-ID [4242296](#)]
3. KLANČNIK, Anja, PISKERNIK, Saša, BUCAR, Franz, VUČKOVIĆ, Darinka, **SMOLE MOŽINA, Sonja**, JERŠEK, Barbara. Reduction of microbiological risk in minced meat by a combination of natural antimicrobials. *Journal of the Science of Food and Agriculture*, ISSN 0022-5142, 2014, vol. 94, str. 2758-2765, doi: [10.1002/jsfa.6621](https://doi.org/10.1002/jsfa.6621). [COBISS.SI-ID [4334968](#)];
4. KLANČNIK, Anja, **SMOLE MOŽINA, Sonja**, ZHANG, Qijing. Anti-Campylobacter activities and resistance mechanisms of natural phenolic compounds in Campylobacter. ***PloS one***, ISSN 1932-6203, 2012, vol. 7, no. 12, str. 1-10, doi: [10.1371/journal.pone.0051800](https://doi.org/10.1371/journal.pone.0051800). [COBISS.SI-ID [4160120](#)]
5. PISKERNIK, Saša, KLANČNIK, Anja, TANDRUP RIEDEL, Charlotte, BRØNDSTED, Lone, **SMOLE MOŽINA, Sonja**. Reduction of *Campylobacter jejuni* by natural antimicrobials in chicken meat-related conditions. ***Food control***, ISSN 0956-7135. [Print ed.], 2011, vol. 22, issue 5, str.

718-724, doi: [10.1016/j.foodcont.2010.11.002](https://doi.org/10.1016/j.foodcont.2010.11.002). [COBISS.SI-ID [3836280](#)]

6. GENERALIĆ MEKINIĆ, Ivana, SKROZA, Danijela, LJUBENKOV, Ivica, ŠIMAT, Vida, **SMOLE MOŽINA, Sonja**, KATALINIĆ, Višnja. In vitro antioxidant and antibacterial activity of Lamiaceae phenolic extracts : a correlation study. *Food technology and biotechnology*, ISSN 1330-9862, 2014, vol. 52, no. 1, str. 119-127.

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: **Mikrobni produkti in energija iz agroživilskih odpadkov**
 Course title: **Microbial products and energy from agro-food waste**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Interdisciplinarni doktorski študijski program BIOZNANOSTI 3. stopnja	Agroživilska mikrobiologija	1,2	1,2,3,4
Interdisciplinary Doctoral Study Programme in BIOSCIENCES 3rd cycle	Agrifood microbiology	1,2	1,2,3,4

Vrsta predmeta / Course type

teoretični predmet / theoretical course

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
20	60	/	/	/	170	10

Nosilec predmeta / Lecturer:

Nosilec: prof. dr. Romana Marinšek Logar

Jeziki / Languages:
Predavanja / Lectures:
Vaje / Tutorial:

 slovenski / angleški
 Slovene / English

 slovenski / angleški
 Slovene / English

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

Splošni pogoji za vpis na doktorski študij.

Prerequisites:

General requirements for the enrolment in PhD program.

Vsebina:
Content (Syllabus outline):

- Anaerobne bioplinske tehnologije (predelava bioplina v toplotno oz. električno energijo).
- Biotehnologije za proizvodnjo vodika iz agroživilskih odpadkov.
- Rastlinske čistilne naprave za odstranjevanje za predelavo agroživilskih odplak.
- Odstranjevanje viškov dušika iz agroživilskih odplak.
- Uporaba agroživilskih odpadkov za pridelavo mineralnih gnojil.
- Bioremediacijske tehnologije (biostimulacija, bioaugmentacija, landfarming, kompostiranje).
- Novejši trendi v anaerobni mikrobni presnovi organskih odpadkov (C1-C6 spojine kot direktni substrati za proizvodnjo zdravil).
- Novejše biotehnoške rešitve za proizvodnjo bioetanol in biobutanola iz agroživilskih odpadkov.

- Anaerobic biogas technologies (production of heat and electricity from biogas).
- Biotechnologies for production of hydrogen from agro-food waste.
- Constructed wetlands for agro-food waste degradation.
- Surplus nitrogen removal from agro-food slurries and sewage.
- Production of mineral fertilizers from agro-food waste.
- Bioremediation technologies (biostimulation, bioaugmentation, Landfarming, composting).
- Modern trends in anaerobic microbial degradation of organic waste (C1-C6 compounds as direct substrates for production of pharmaceuticals).
- Modern biotechnological solutions for production of bioethanol and biobutanol from agro-food waste.

Temeljni literatura in viri / Readings:

Revijalni in eksperimentalni članki s področja, tekoča periodika, druga učna gradiva bodo dostopna na ŠIS.

Izbrana poglavja iz knjig:

1. Deublein D., Steinhauser, A. 2008. Biogas from Waste and Renewable Resources: An Introduction. Weinheim, DE, Wiley-VCH Verlag GmbH & co, KGaA, , ISBN 978-3-527-31841-4, 429 pp.
2. Korres N., O'Kiely P., Benzie J., West J. 2013. Bioenergy Production by Anaerobic Digestion Using Agricultural Biomass and Organic Wastes, Earthscan, Routledge, ISBN: 9780415698405, 472 pp.
3. Pinheiro Lima, M.A., Policastro Natalense, A. P. Bioethanol. 2012. New York, InTech, ISBN 978-953-51-0008-9, 302 pp.

Cilji in kompetence:

Predmet je namenjen pridobivanju poglobljenega znanja o vrstah, lastnostih in energetskih potencialih odpadnih biomas v kmetijstvu, živilski industriji in na komunalnem področju. Slušatelje poglobljeno seznaniti z biotehnoškimi postopki, ki so primerni za pridobivanje obnovljive energije iz odpadnih

Objectives and competences:

The course is designed to obtain in-depth knowledge about the types, characteristics and energy potential of waste biomass in agriculture, food industry and municipal sector. Students have thorough knowledge of biotechnological processes, which are suitable for the production of renewable energy and C1-C6 compounds

biomas in C1-C6 spojin z visiko dodano vrednostjo ter so hkrati usmerjene (same ali v sklopih) v varovanje in remediacijo okolja. Pridobljeno znanje v kombinaciji z drugimi znanji doktorskega programa omogoča relevantno presojanje ravnanja z odpadki iz agroživilskega področja, načrtovanje ustreznih biotehnoloških postopkov in strategij in operativno vodenje biotehnoloških postopkov za presnovo in stabilizacijo odpadnih organskih biomas v smislu koncepta »zero waste«.

with high added value from biomass and waste and are at the same time oriented (alone or in clusters) in the protection and remediation of the environment. Lessons learned in combination with other skills of doctoral program allows assessment of the relevant waste from the agro-food areas, the design of appropriate biotechnological processes and strategies and operational management of biotechnological processes for the degradation and stabilization of waste organic biomass in »zero-waste« concept.

Predvideni študijski rezultati:

Znanje in razumevanje:

1. Razume aerobne in anaerobne postopke razgradnje organske biomase
2. Zna izbrati ustrezen biotehnološki postopek za presnovo/obdelavo izbrane odpadne biomase
3. Zna oceniti potencialne za pridobivanje obnovljive energije iz različnih organskih substratov iz agroživilske industrije
4. Zna oceniti potencialne za pridobivanje surovin z visoko dodano vrednostjo iz različnih virov agroživilske odpadne biomase.
5. Razume biorafinerijske principe na področju presnove odpadnih biomas iz agroživilske industrije
6. Biotehnološke postopke za razgradnjo odpadnih organskih biomas zna ustrezno ekonomično dizajnirati

Intended learning outcomes:

Knowledge and understanding:

1. The student understands aerobic and anaerobic decomposition processes of organic biomass
2. The student can select the appropriate biotechnological process for the degradation / processing of selected waste biomass
3. The student knows how to assess the energy potential of a selected organic substrate agro-food industry.
4. The student knows how to assess the potential for the production of raw materials with high added value from different sources agro-food waste biomass.
5. The student understands the biorafinery principles in the field of waste biomass degradation from agro-food industry
6. The student knows how to design economically the biotechnological processes for the decomposition of organic waste biomass .

Metode poučevanja in učenja:

Learning and teaching methods:

Pouk je organiziran v obliki predavanj, konzultacij; seminarskega dela.

Lectures, consultations, seminar.

Načini ocenjevanja:

Delež (v %) /

Weight (in %) /

Assessment:

Izpit, seminar

50 %
izpit/exam

Exam, seminar.

50 % seminar

Reference nosilca / Lecturer's references:

Prof. dr. Romana Marinšek Logar

1. GUŠTIN, Simon, **MARINŠEK-LOGAR, Romana**. Effect of pH, temperature and air flow rate on the continuous ammonia stripping of the anaerobic digestion effluent. *Process safety and environmental protection*, ISSN 0957-5820, 2011, vol. 89, issue 1, str. 61-66.
2. SEŽUN, Mija, GRILC, Viktor, ZUPANČIČ, Gregor Drago, **MARINŠEK-LOGAR, Romana**. Anaerobic digestion of brewery spent grain in a semi-continuous bioreactor : inhibition by phenolic degradation products. *Acta chimica slovenica*, 2011, vol. 58, no. 1, str. 158-166
3. NOVAK, Domen, STRES, Blaž, OSOJNIK ČRNIVEC, Ilja Gasan, ŠKRJANEC, Igor, **MARINŠEK-LOGAR, Romana**. General microbial community flexibility in biochemical methane potential assay is highly correlated to initial biogas production rates. *Acta chimica slovenica*, ISSN 1318-0207, 2011, vol. 58, no. 1, str. 171-175
4. NOVAK, Domen, FRANKE-WHITTLE, Ingrid H., TRATAR-PIRC, Elizabeta, JERMAN, Vesna, INSAM, Heribert, STRES, Blaž , **MARINŠEK-LOGAR, Romana**. Biotic and abiotic processes contribute to successful anaerobic degradation of cyanide by UASB reactor biomass treating brewery waste water. *Water research*, 2013, vol. 47, issue 11, str. 3644-3653.
5. ČATER, Maša, FANEDL, Lijana, **MARINŠEK-LOGAR, Romana**. Microbial community analyses in biogas reactors by molecular methods. *Acta chimica slovenica*, ISSN 1318-0207, 2013, vol. 60, no. 2, str. 243-255.
6. ZUPANČIČ, Gregor Drago, KLEMENČIČ, Miran, OSET, Matej, **MARINŠEK-LOGAR, Romana**, ROŠ, Milenko. *Postopek za predelavo pivovarniške kvasine v bioplin : patent : SI 24095 A, 2013-12-31*. Ljubljana: Urad RS za intelektualno lastnino, 2013. 20 str., ilustr.
7. RAJAPAKSE, Katarina, DROBNE, Damjana, KASTELEC, Damijana, **MARINŠEK-LOGAR, Romana**. Experimental evidence of false positive Comet test results due to TiO₂ particle - assay interactions. *Nanotoxicology*, ISSN 1743-5390, 2013, vol. 7, no. 5, str. 1043-105
8. ČATER, Maša, ZOREC, Maša, **MARINŠEK-LOGAR, Romana**. Methods for improving anaerobic lignocellulosic substrates degradation for enhanced biogas production. *Springer science reviews*, ISSN 2213-7793, 2014, in press.
9. ZUPANČIČ, Gregor Drago, ROŠ, Milenko, KLEMENČIČ, Miran, OSET, Matej, **MARINŠEK-LOGAR, Romana**. Excess brewery yeast co-digestion in a full-scale EGSB reactor : Elektronski vir. V: 13th World Congress on Anaerobic Digestion, 25th-28th June 2013, Santiago de Compostela. *Recovering (bio) resources for the world*. [S.l.: s.n.], 2013, iWA-11041. [COBISS.SI-ID [3253384](#)]
10. GRILLI, Diego J., KOPEČNÝ, Jan, MRÁZEK, Jakub, **MARINŠEK-LOGAR, Romana**,

PAEZ LAMA, Sebastián, SOSA ESCUDERO, Miguel, ARENAS, Graciela N. Identification of GH10 xylanases in strains 2 and Mz5 of *Pseudobutyribrio xylanivorans*. *Folia microbiologica*, ISSN 0015-5632, 2014, vol. 59, issue 6, str. 507-514.