

# RASTLINSKA BIOKEMIJA

## UČNI NAČRT PREDMETA/COURSE SYLLABUS

<b>Predmet:</b>	Rastlinska biokemija
<b>Course title:</b>	Plant Biochemistry
<b>Članica nosilka/UL Member:</b>	UL FKKT

<b>Študijski programi in stopnja</b>	<b>Študijska smer</b>	<b>Letnik</b>	<b>Semestri</b>	<b>Izbirnost</b>
Biokemija, prva stopnja, univerzitetni (od študijskega leta 2023/2024 dalje)	Ni členitve (študijski program)	3. letnik		izbirni

<b>Univerzitetna koda predmeta/University course code:</b>	0088101
<b>Koda učne enote na članici/UL Member course code:</b>	BKSI3

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 LV			75	5

**Nosilec predmeta/Lecturer:** prof. dr. Kristina Gruden

**Vrsta predmeta/Course type:** izbirni strokovni/elective professional

<b>Jeziki/Languages:</b>	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	Angleščina, Slovenščina

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

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.

### Prerequisites:

The course has to be assigned to the student.

### Vsebina:

Uvod (Rastlinski sistem, morfologija rastlin, rast. celica).  
Posebnosti rastlinskega metabolizma: Glioksilatni ciklus, glukoneogeneza. Na cianid rezistentna dihalna veriga. Fotosinteza  
Ogljikovi hidrati. Monosaharidi, sladkorni alkoholi, kisline, polisaharidi (heteroglikani, homoglikani): škrob, komponente in zgradba celične stene.  
Prehranski vidiki rastlinskih OH: vlaknine (pektini, inulin, celuloza), rezistentni škrob. Zdravilne rastline s sluzmi. Tehnološko pomembni OH iz rastlin (agar, alginska kislina, celuloza)  
Lipidi, derivati maščobnih kislin (trigliceridi, fosfolipidi, voski, suberin), kemizem, fiziologija, metabolizem, biokemija, esencielne maščobne kisline, prehranski viri lipidov, vrste lipidov v rastlinah. Vpliv

### Content (Syllabus outline):

Introduction (Plant systematics, plant morphology, plant cell).  
Special features of plant metabolism: Glioksilatn cycle, gluconeogenesis. cyanide resistant respiratory chain. Photosynthesis  
Carbon hydrates. Monosaccharides, sugar alcohols, acids, polysaccharides (heteroglikans, homoglikans): starch, components and structure of cell wall.  
Nutritional aspects of vegetable carbon hydrates: fibers (pectin, inulin, cellulose), resistant starch.  
Lipids, fatty acid derivatives (triglycerides, phospholipids, waxes, suberin), physiology, metabolism, biochemistry, essential fatty acid, nutritional sources of lipids, types of lipids in plants.  
Influence of lipids (with saturated, mono unsaturated, poly unsaturated, omega-3, omega-6) on health.

<p>lipidov (z nasičenimi, enkrat nenasičenimi, večkrat nenasičenimi, omega-3, omega-6) na zdravje</p> <p>Fenoli: fenilpropanoidi, lignani, lignin, flavonoidi: biosintezne poti (šikimatna pot), glavne skupine, biološka aktivnost</p> <p>tanini, poliketidi (antrakinoni, benzodiantroni),</p> <p>Spojine z žveplom: česen, hren</p> <p>Terpeni: eterična olja, steroidi, saponini; biosintezne poti (mevalonatna in Rohmerjeva biosintezna pot), glavne skupine, biološka aktivnost</p> <p>Spojine z dušikom, alkaloidi: biosintezne poti, glavne skupine, biološka aktivnost.</p> <p>Prehrabeni vidiki rastlin: metabolizem dušika, aminokislin in proteinov, ostale komponente prehrane bodo predstavljene v zadnjem sklopu</p> <p>Rastlinski hormoni in tkivne kulture: metabolizem rastlinskih hormonov, ki je ena od bistvenih drugačnosti rastlin glede na živali. Seznanili se bodo s tehnologijo rastlinskih tkivnih kultur, katere bistvo je poznavanje hormonalnega metabolizma rastlin in primeri uporabe v rastlinskih tkivnih kultur biotehnologiji.</p> <p>Interakcije med organizmi in odgovor rastline na stres: Rastline kot sesilni organizmi imajo razvite specifične mehanizme obrambe pred napadalci. Seznanili se bomo s simbiotskimi reakcijami, patogenimi interakcijami, inkompatibilnimi interakcijami in s pojavom aleopatije, vsa prepoznavanja na molekularno biokemijskem nivoju.</p> <p>Transgene rastline in njihova uporaba: Seznanili se bomo s tehnologijo priprave transgenih rastlin, možnimi načini uporabe tehnologije in diskutirali o prednostih in slabostih uporabe ter kako ocenimo varnost transgenih rastlin.</p>	<p>Phenols: phenilpropanoids, lignans, lignin, flavonoids: biosynthetic pathway (shikimatna pathway), main groups, biological activity</p> <p>tanins, poliketids (antracinons, bensodiantrons),</p> <p>Compounds with sulphur: garlic, horseradish</p> <p>Terpenes: essential oils, steroids, saponins; biosynthetic pathway (mevalonat and Rohmers biosynthetic pathway), main groups, biological activity</p> <p>Compounds with nitrogen, alkaloids: biosynthetic pathway, main groups, biological activity.</p> <p>Nutritional value of plants: metabolism of nitrogen, amino acids and proteins, the other nutritional aspects will be presented in last part of the course.</p> <p>Plant hormones and plant tissue cultures: Students will get acquainted with the metabolism of plant hormones, one of substantially different aspects of plant biochemistry compared to animal one. The technique of plant tissue cultures, which is closely connected with the knowledge of the metabolism of hormones, and different aspect of its application in biotechnology will be discussed.</p> <p>Interactions and defense response: Plants have developed specific mechanisms for communication with other organisms and environment. Symbiotic, pathological and incompatible interactions will be discussed from biochemical point of view as well as some examples of allelopathy.</p> <p>Transgenic plants: Technology of plant transformation and regeneration, example of transgenic plants approved for use on the market and the future use of the technology, pros and cons of technology, risk assessment of transgenic plant.</p>
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### Temeljna literatura in viri/Readings:

- J. Bruneton: Pharmacognosy, phytochemistry, medicinal plants, Lavoisier publishing 1999.
- Dodatna literatura:
- T.W.Goodwin, E.Mercer: Introduction to plant biochemistry, 2nd ed. Pergamon Press, Oxford, 1988
  - Jones,Ougham, Thomas, Waaland: The molecular life of plants, 2013
  - Chrispeels, Sadava: Plants, Genes and Crop Biotechnology 2003

### Cilji in kompetence:

Predmet razširja znanje splošne biokemije na procese izgradnje in metabolizma snovi, ki so specifične za rastline ter pojasnjuje vlogo teh snovi pri odzivu rastline na stresne dejavnike; nakazuje pa tudi možnosti uporabe tega znanja v farmaciji in moderni biotehnologiji.

Sposobnost uporabe znanj, zlasti sposobnost reševanja problemov; ter sposobnost analize gradiva in oblikovanje koncepta.

### Objectives and competences:

The course extends the previous knowledge of biochemistry to plant specific metabolic processes. Explains the role of plant secondary metabolites in interactions with other organisms. The applicability of this knowledge in pharmacy and biotechnology is presented.

The competencies of the students completing this course successfully would include understanding of basic concepts in plant biochemistry, application of knowledge in case studies, ability to study related literature and form basic conclusions.

### Predvideni študijski rezultati:

### Intended learning outcomes:

<p>Znanje in razumevanje  Poznavanje biosinteze rastlinskih metabolitov in njihove biološke funkcije, ter uporabnosti v farmaciji in biotehnologiji.  Uporaba  Reševanje praktičnih nalog.  Refleksija  Zahteva se razumevanje teorije in izkušenj v praksi, kritično ovrednotenje skladnosti med teoretičnimi načeli in praktičnim ravnanjem.  Prenosljive spretnosti  Prepoznavanje funkcionalnih skupin v formulah spojin. Samostojna uporaba literature in interneta za reševanje strokovnih nalog.</p>	<p>Knowledge and Comprehension  Understanding of plant metabolism with applications in pharmacy and biotechnology  Application  Solving practical problems  Analysis  Understanding of theory and praxis is required, together with critical thinking when solving practical problems  Skill-transference Ability  Ability to recognise functional groups in plant specific compounds. Independent problem oriented literature and web search</p>
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**Metode poučevanja in učenja:**

predavanja, vaje, vodene individualne naloge, sodelovalno učenje / poučevanje.

**Learning and teaching methods:**

lectures, lab practice, individual

**Načini ocenjevanja:**

Pisni izpit Ocene: pozitivno 6-10; negativno 1-5.

**Delež/Weight**

**Assessment:**

Written assessment Grades: positive 6-10, negative 1-5

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

TAVČAR BENKOVIĆ, Eva, ŽIGON, Dušan, FRIEDRICH, Miha, PLAVEC, Janez, **KREFT, Samo**. Isolation, analysis and structures of phototoxic fagopyrins from buckwheat. Food chemistry, vol. 143, 2014, str. 432-439

TAVČAR BENKOVIĆ, Eva, GROHAR, Tina, ŽIGON, Dušan, ŠVAJGER, Urban, JANEŠ, Damjan, **KREFT, Samo**, ŠTRUKELJ, Borut. Chemical composition of the silver fir (*Abies alba*) bark extract Abigenol and its antioxidant activity. Industrial crops and products, vol. 52, 2014, str. 23-28,

KOČEVAR GLAVAČ, Nina, **KREFT, Samo**. Excretion profile of glycyrrhizin metabolite in human urine. Food chemistry, 2012, vol. 131, str. 305-308.

BAEBLER, Špela, KREČIČ STRES, Hana, ROTTER, Ana, KOGOVŠEK, Polona, CANKAR, Katarina, KOK, Esther, **GRUDEN, Kristina**, KOVAČ, Maja, ŽEL, Jana, POMPE NOVAK, Maruša, RAVNIKAR, Maja. PVY[supra]NTN elicits a diverse gene expression response in different potato genotypes in the first 12 h after inoculation. Molecular plant pathology, ISSN 1464-6722, 2009, vol. 10, no. 2, str. 263-275.

BAEBLER, Špela, STARE, Katja, KOVAČ, Maja, BLEJEC, Andrej, PREZELJ, Nina, STARE, Tjaša, KOGOVŠEK, Polona, POMPE NOVAK, Maruša, ROSAHL, S., RAVNIKAR, Maja, **GRUDEN, Kristina**. Dynamics of responses in compatible potato - potato virus Y interaction are modulated by salicylic acid. PloS one, ISSN 1932-6203, 2011, vol. 6, issue 12, str. 1-12

MILJKOVIĆ, Dragana, STARE, Tjaša, MOZETIČ, Igor, PODPEČAN, Vid, PETEK, Marko, WITEK, Kamil, DERMASTIA, Marina, LAVRAČ, Nada, **GRUDEN, Kristina**. Signalling network construction for modelling plant defence response. PloS one, ISSN 1932-6203, 2012, vol. 7, no. 12, str. e51822-1e51822-18.