

**NASTAVNO-NAUČNOM VEĆU
TEHNOLOŠKO-METALURŠKOG FAKULTETA
UNIVERZITETA U BEOGRADU**

Na sednici Nastavno-naučnog veća Tehnološko-metalurškog fakulteta u Beogradu održanoj 25.06.2020.godine imenovani smo za članove Komisije za podnošenje izveštaja o ispunjenosti uslova za sticanje naučnoistraživačkog zvanja VIŠI NAUČNI SARADNIK dr Nevene Luković, dipl. inž. tehnologije u skladu sa Zakonom o naučnoistraživačkoj delatnosti i Pravilnikom o postupku i načinu vrednovanja, i kvantitativnom iskazivanju naučnoistraživačkog rezultata istraživača i saglasno statutu Tehnološko-metalurškog fakulteta Univerziteta u Beogradu. Posle pregledanog materijala koji je dostavljen komisiji i uvida u dosadašnji rad dr Nevene Lukovic, Komisija podnosi sledeći:

IZVEŠTAJ

1.1. BIOGRAFSKI PODACI

Nevena Luković (devojačko Ognjanović) rođena je u Beogradu gde je završila osnovnu školu Kralj Petar I i III beogradsku gimnaziju. Studije na Tehnološko-metalurškom fakultetu Univerziteta u Beogradu upisala je školske 1997/1998. godine. Diplomirala je na Tehnološko-metalurškom fakultetu na Katedri za biohemijsko inženjerstvo i biotehnologiju 05.10.2004. sa ocenom na diplomskom radu 10 (deset) i prosečnom ocenom u toku studija 8,53. Po završetku redovnih studija, upisala je magistarske studije na Katedri za biohemijsko inženjerstvo i biotehnologiju. Odlukom Nastavno-naučnog veća održanog 07.02.2008. godine prelazi sa magistarskih na doktorske studije Tehnološko-metalurškog fakulteta na Katedri za biohemijsko inženjerstvo i biotehnologiju. Položila je sve ispite predviđene planom i programom doktorskih studija sa prosečnom ocenom 10,00 uključujući i završni ispit. Doktorsku disertaciju pod nazivom: "Razvoj enzimskog postupka za sintezu metil estara masnih kiselina" je odbranila 26.02.2014. godine pod mentorstvom prof. dr Zorice Knežević-Jugović i time stekla zvanje Doktor nauka - tehnološko inženjerstvo – hemija i hemijska tehnologija.

Naučnoistraživači rad Nevene Luković je započeo 2005. god., kada je kao istraživač pripravnik bila angažovana na naučnoistraživačkom projektu Ministarstva za nauku i zaštitu životne sredine Republike Srbije na Tehnološko-metalurškom fakultetu. Od 2009. godine zaposlena je kao istraživač saradnik, da bi 25.3.2015. godine stekla zvanje naučni saradnik.

Od 2005.do 2007. godine Nevena Luković je kao istraživač pripravnik bila angažovana na naučnoistraživačkom projektu Ministarstva za nauku i zaštitu životne sredine Republike Srbije pod nazivom "*Razvoj tehnologije sinteze biodizela*" ev. broj TR6742 u okviru programa za tehnološki razvoj. Od aprila 2008. do 2011. godine bila je zaposlena na projektu tehnološkog

razvoja "Razvoj biotehnoloških postupaka za proizvodnju aditiva i novih formulacija za prehrambenu industriju" ev. broj TR20064, koji je finansiralo Ministarstvo za nauku i tehnološki razvoj Republike Srbije. U tekućem projektnom ciklusu angažovana je na projektu "Razvoj novih inkapsulacionih i enzimskih tehnologija za proizvodnju biokatalizatora i biološki aktivnih komponenata hrane u cilju povećanja njene konkurentnosti, kvaliteta i bezbednosti" ev. br. III 46010. Tokom 2014. godine bila je angažovana na realizaciji inovacionog projekta Ministarstva za nauku i tehnološki razvoj pod nazivom "Proizvodnja novih dijetetskih formulacija na bazi prorodnih proteina sa anitoksidativnim i antitumorskim dejstvom". Od 2013. do 2014. godine bila je angažovana na naučnoistraživačkom projektu bilateralne saradnje između Republike Srbije i Narodne Republike Kine, pod nazivom "Primena poljoprivrednog otpada za proizvodnju enzima". Trenutno je angažovana na strateškom međunarodnom projektu saradnje između Republike Srbije i Republike Kine pod nazivom "Razvoj novih bioloških postupaka za dobijanje proizvoda sa dodatom vrednošću na agroindustrijskom otpadu" (Science and technology development programme –joint funding of development and research projects of the republic of Serbia and the people's republic of China). Dr Nevena Luković je bila rukovodilac zadatka 1.1 (Otimizacija mikrobiološke proizvodnje enzima u šaržnom reaktoru sa mehaničkim mešanjem) u okviru podprojekta „Razvoj novih enzimskih tehnologija za proizvodnju biološki aktivnih komponenata hrane“ (projekat III46010).

Od školske 2005/2006. godine učestvuje u izvođenju vežbi iz predmeta "Industrijska mikrobiologija sa genetikom", "Laboratorijski praktikum", "Biotehnološki praktikum“, "Tehnologija ugljenih hidrata“ i "Enzimsko inženjerstvo“ na Katedri za biohemijsko inženjerstvo i biotehnologiju. Od školske 2015/2016. drži nastavu na Master studijima na Katedri za biohemijsko inženjerstvo i biotehnologiju na predmetu "Primena enzima u prehrambenoj industriji". Dr Nevena Luković je u svom dosadašnjem radu publikovala 48 bibliografskih jedinica uključujući i doktorsku disertaciju, samostalno ili u saradnji sa drugim kolegama, od kojih je jedno poglavlje u knjizi međunarodnog značaja (M14), 17 radova objavljeni u časopisima međunarodnog značaja (1 rad u međunarodnom časopisu izuzetnih vrednosti M21a, 6 radova u vrhunskim međunarodnim časopisima M21, 3 rada u istaknutim međunarodnim časopisima M22, 7 radova u međunarodnim časopisima M23), 1 rad u vodećem časopisu nacionalnog značaja, 26 saopštenja na skupovima međunarodnog i nacionalnog značaja (M30 i M60). Dr Nevena Luković ima prihvaćeno tehničko rešenje primenjeno na međunarodnom nivou (M81) i objavljen patent na nacionalnom nivou (M94).

Učestvovala je u izradi nekoliko završnih i diplomskih radova. Govori engleski i nemački jezik.

1.2. NAUČNOISTRAŽIVAČKI RAD

Nevena Luković je od 2005. do 2007. godine kao istraživač pripravnik bila angažovana na naučnoistraživačkom projektu Ministarstva za nauku i zaštitu životne sredine Republike Srbije pod nazivom "Razvoj tehnologije sinteze biodizela" ev. broj TR6742 u okviru programa za tehnološki razvoj. Od aprila 2008. do 2011. godine bila je zaposlena na projektu tehnološkog razvoja "Razvoj biotehnoloških postupaka za proizvodnju aditiva i novih formulacija za prehrambenu industriju" ev. broj TR20064 koji je finansiralo Ministarstvo za nauku i tehnološki razvoj Republike Srbije. U tekućem projektnom ciklusu angažovana je na projektu "Razvoj novih inkapsulacionih i enzimskih tehnologija za proizvodnju biokatalizatora i biološki aktivnih

komponentata hrane u cilju povećanja njene konkurentnosti, kvaliteta i bezbednosti" ev. br. III 46010. Tokom 2014.godine bila je na realizaciji inovacionog projekta Ministarstva za nauku i tehnološki razvoj pod nazivom "*Proizvodnja novih dijetetskih formulacija na bazi prorodnih proteina sa anitoksidativnim i antitumorskim dejstvom*". Od 2013.do 2014. godine bila je angažovana na zajedničkom naučnoistraživačkom projektu između Republike Srbije i Narodne Republike Kine, pod nazivom "*Primena poljoprivrednog otpada za proizvodnju enzima*". Od 2017. do 2019. bila je angažovana na međunarodnom projektu bilateralne saradnje između Republike Srbije i Republike Kine pod nazivom "*Razvoj novih bioloških postupaka za dobijanje proizvoda sa dodatom vrednošću na agroindustrijskom otpadu*".

Naučni rad dr Nevene Luković je vezan za oblast biohemijskog inženjerstva i biotehnologije. U periodu do i tokom izrade doktorske disertacije dr Nevena Luković se bavila proučavanjem enzimskih sinteza posebno metil estara masnih kiselina. Bavila se detaljnom analizom svih značajnih parametara koji utiču na enzimsku transesterifikaciju kao što su izbor sirovina, acil akceptora, rastvarača. Bavila se analizom reaktorskih sistema za primenu u sintezi estara sa posebnim osvrtom na sintezu biodizela. Osim toga, bavila se ispitivanjem različitih metoda imobilizacije, posebno kovalentne imobilizacije. U toku istraživačkog rada pokazala je individualnost i samostalnost u eksperimentalnom radu, kao i sposobnost kritičkog razmatranja rezultata i naučne literature. Rezultati koji su prikazani u okviru doktorske disertacije dali su značajan doprinos naučnoistraživačkim projektima u kojima je učestvovala, a time doprineli realizaciji i kvalitetu, i potvrdili istraživačku kompetentnost kandidata.

Nakon doktoriranja, sfera interesovanja se sa aspekta primene enzima prenela i na proizvodnju enzima, mikrobiološkom sintezom, pre svega metodama gajenja mikroorganizama na čvrstim nosačima. Najveći segment istraživanja je bio usmeren ka upotrebi poljoprivrednog otpada i njegova valorizacija kao supstrata za mikrobiološku proizvodnju enzima (proteaze, pektinaze, celulaze, amilaze i mananaze) putem fementacije na čvrstim nosačima (SSF - solid state fermentation). U cilju razvoja produktivnog procesa kandidatkinja se bavila selekcijom sojeva producenata enzima, zatim pripremom supstrata, izborom najefikasnijeg pretretmana supstrata, izborom i optimizacijom hranljive podloge i na kraju optimizacijom parametara fermentacionog procesa. U okviru ovih oblasti Dr Nevena Luković je bila rukovodilac zadatka 1.1 (Otimizacija mikrobiološke proizvodnje enzima u šaržnom reaktoru sa mehaničkim mešanjem) u okviru podprojekta „Razvoj novih enzimskih tehnologija za proizvodnju biološki aktivnih komponenata hrane“ (projekat III46010).

Dr Nevena Luković je razvijala i optimizovala postupke za fermentacionu proizvodnju i prečišćavanje dobijenih enzima. U svom radu kandidatkinja se bavila primenom inovativnih postupaka za pretretman supstrata i to pre svega primenom mikrotalasa i ultrazvuka. Primenu ultrazvuka je proširila i na postupak naknadne ekstrakcije proizvedenih enzima iz reakcione smeše. Takođe, kandidatkinja se bavila i evaluacijom uticaja proizvodnih mikroorganizama na nutritivni kvalitet fermentacione pogače.

Pored postupaka mikrobiološke proizvodnje enzima, dr Nevena Luković se poslednjih godina bavila i primenom različitih vrsta egzo- i endoproteaza u jednostepenim ili dvostepenim postupcima hidrolize proteina belanaca. Razvojem ovih postupaka ostvarila je proizvodnju hidrolizata koji, pored nutritivne, imaju i izražena biološka svojstva kao što su antioksidativna, antimikrobna i antiproliferativna aktivnost, i koji se kao takvi mogu inkorporirati kao dodaci funkcionalne hrane. Razvila je i postupak primene membranskog protočnog reaktora sa

separacionim modulom čime je omogućena proizvodnja frakcije peptida tačno definisanih bioloških svojstava u kontinualnom procesu.

Kandidat dr Nevena Luković je do sada objavila poglavlje u knjizi međunarodnog značaja (M14), jedan rad u međunarodnom časopisu izuzetnih vrednosti (M21a), 6 radova u vrhunskom međunarodnom časopisu (M21), tri rada u istaknutom međunarodnom časopisu (M22), 7 radova u međunarodnim časopisima (M23), 4 saopštenja na međunarodnim skupovima štampanim u celini (M33) i 10 saopštenja na međunarodnim skupovima štampanim u izvodu (M34), takođe dr Nevena Luković je publikovala jedan rad u vodećem nacionalnom časopisu (M51), 9 saopštenja štampana u celini na nacionalnim naučnim skupovima (M63) i tri saopštenja štampana u izvodu na nacionalnim naučnim skupovima (M64). Prihvaćeno je i jedno tehničko rešenje primenjeno na međunarodnom nivou (M81), kao i objavljen patent na nacionalnom nivou (M94).

2. NAUČNA KOMPETENTNOST

2. OBJAVLJENI I SAOPŠTENI NAUČNI RADOVI I DRUGI VIDOVI ANGAŽOVANJA U NAUČNOISTRAŽIVAČKOM I STRUČNOM RADU

2.1. SPISAK RADOVA DR NEVENE LUKOVIĆ PRE IZBORA U ZVANJE NAUČNI SARADNIK

Klasifikacija naučnoistraživačkih rezultata prema kategorijama naučnoistraživačkih rezultata do podnošenja molbe za izbor u zvanje naučni saradnik (period od marta 2015. godine) izvršena je prema Pravilniku o postupku i načinu vrednovanja, i kvantitativnom iskazivanju naučnoistraživačkih rezultata istraživača (Sl. glasnik R. Srbije br. 38/2008).

1. Monografije, monografske studije, tematski zbornici, leksikografske i kartografske publikacije međunarodnog značaja (M10)

1.1. Monografska studija/poglavlje u knjizi M12 ili rad u tematskom zborniku međunarodnog značaja (M14) (1x4=4)

1.1.1. N. Luković, Z. Knežević-Jugović, D. Bezbradica, "Biodiesel fuel production by enzymatic transesterification of oils: recent trends, challenges and future perspectives", *Alternative Fuel*, pp. 47-72, 2011, (ISSN 978-953-308-55-0).

2. Naučni radovi objavljeni u časopisima međunarodnog značaja (M20)

2.1. Radovi u vrhunskim međunarodnim časopisima (M21) (2x3=6)

2.1.1. N. Ognjanović, D. Bezbradica, Z. Knežević-Jugović, "Enzymatic conversion of sunflower oil to biodiesel in a solvent-free system: Process optimization and the immobilized system stability", *Bioresource Technology*, vol. 100, no. 21, pp. 5146-

5154, 2009, (ISSN 0960-8524) (IF(2008)=4.453) (IF(2010, petogodišnji)=4.901); Biotechnology & Applied Microbiology (18/145); Agricultural Engineering (1/9).

- 2.1.2. S. Jakovetić, N. Luković, N. Bošković-Vragolović, D. Bezbradica, R. Picazo-Espinosa, Z. Knežević-Jugović, "A comparative study of batch and fluidized bed reactors for lipase-catalyzed ethyl cinnamate synthesis", *Industrial and Engineering Chemistry Research*, vol. 52, no. 47, pp. 16689-16697, 2013, (ISSN 0888-5885), (IF (2011)=2.237); Engineering/Chemical (30/133).

2.2. Radovi u istaknutim međunarodnim časopisima (M22) (1x5=5)

- 2.2.1. Ali Saied Moftah, S. Grbavčić, M. Žuža, N. Luković, D. Bezbradica, Z. Knežević-Jugović, "Adding Value to the Oli Cake as a Waste from Oil Processing Industry: Production of Lipase and Protease by *Candida utilis* in Solid State Fermentation", *Applied Biochemistry and Biotechnology*, vol 166, no. 2, pp. 348-364, 2012, (ISSN 0273-2289) (IF (2010)=1.879) (IF(2011, petogodišnji)=1.998); Biology and Applied Microbiology (79/160).

2.3. Radovi u međunarodnom časopisu (M23) (5x3=15)

- 2.3.1. D. Bezbradica, I. Karalazić, N. Ognjanović, D. Mijin, S. Šiler-Marinković and Z. Knežević, "Studies on the specificity of *Candida rugosa* lipase catalyzed esterification reactions in organic media", *Journal of Serbian Chemical Society*, vol. 71, no. 1, pp. 31-41, 2006 (ISSN 0352-5139) (IF(2006)=0.536) (IF2007, petogodišnji)=0.591); Chemistry/Multidisciplinary (101/124).
- 2.3.2. N. Ognjanović, D. Bezbradica, Z. Knežević, "Optimization of the production of biodiesel by a commercial immobilized lipase in a solvent free system using response surface methodology ", *Journal of Serbian Chemical Society*, vol. 73, no.2, pp. 147–156, 2008, (ISSN 0352-5139) (IF(2009)=0.820) (IF(2009, petogodišnji)=0.774), Chemistry/Multidisciplinary (87/140).
- 2.3.3. N. Ognjanović, S. Petrović, D. Bezbradica, Z. Knežević-Jugović, "Lipaze kao biokatalizatori u sintezi biodizela", *Hemijska Industrija*, vol. 64 no. 1, pp. 1-8, 2010 (ISSN 0367-598X) (IF(2010)=0.205); Engineering/Chemical (120/133).
- 2.3.4. M. Bradić, N. Ognjanović, D. Bezbradica, S. Grbavčić, N. Avramović, D. Mijin, Z. Knežević-Jugović, "Enzimski sinteza monoacilglicerola", *Hemijska Industrija*, vol. 64, no. 5, pp. 375-388, 2010 (ISSN 0367-598X) (IF(2010)=0.205); Engineering/Chemical (120/133).
- 2.3.5. O.S. Moftah, S.Ž. Grbavčić, W.S. Moftah, N. Luković, O.L. Prodanović, S.M. Jakovetić, Z.D. Knežević-Jugović, Lipase production by *Yarrowia lipolytica* using olive oil processing wastes as substrates, *Journal of Serbian Chemical Society*, vol. 78, no. 6, pp. 781–794, 2013, (ISSN: 0352-5139) (IF(2012)=0,912) Chemistry/Multidisciplinary (100/152).

3. Zbornici međunarodnih naučnih skupova (M30)

3.1. Saopštenje sa međunarodnog skupa štampano u celini (M33) (2x1=2)

- 3.1.1. N. Ognjanović, D. Bezbradica, Z. Knežević, "Use of novel acyl acceptors in lipase-catalyzed biodiesel synthesis", *Proceedings of the 35th International Conference of SSCHE 2008*, Tatranske Matliare, Slovakia, 26.-30. May, 2008, pp. 228-1 – 228-6
- 3.1.2. S. Grbavčić, N. Ognjanović, M. Žuža, O. Ali Saied Moftah, D. Bezbradica, Z. Knežević-Jugović, "*Pseudomonas putida* lipase: production, properties and applicability as detergent additive", *Proceedings of the 39th International Conference of SSCHE 2012*, High Tatras, Slovakia, 21.-25. May 2012., pp. 1433-1438, ISBN: 978-80-89475-04-9

3.2. Saopštenje sa međunarodnog skupa štampano u izvodu (M34) (5x0.5=2.5)

- 3.2.1. Z. Knežević, N. Ognjanović, D. Bezbradica, "Immobilized *Rhizomucor miehei* lipase for biodiesel production in a solvent-free medium", *1st International Symposium on Environmental Biocatalysis 2006*, Cordoba, Spain, Book of Abstracts, P-56.
- 3.2.2. Z. Knežević-Jugović, D. Bezbradica, N. Ognjanović, Lipase-catalyzed synthesis of biodiesel in solvent-free system with different acyl acceptors, 14th European Congress on Biotechnology, New Biotechnology, Volume 25, Supplement 1, 2009, pp S159-S160
- 3.2.3. A. Stefanović, J. Jovanović, A. Gluvić, S. Jakovetić, N. Luković, M. Žuža, Z. Knežević-Jugović, Kinetic model of the hydrolysis of egg white proteins by Alcalase, *ICOSECS 8*, Belgrade, 2013, Book of Abstracts, F PO2, 235
- 3.2.4. S. Jakovetić, N. Luković, S. Grbavčić, J. Jovanović, A. Stefanović, M. Carević, Z. Knežević-Jugović, The kinetic study of oleyl cinnamate synthesis, *ICOSECS 8*, Belgrade, 2013, Book of Abstracts, F P13, 246
- 3.2.5. S. Jakovetić, N. Luković, S. Grbavčić, B. Jugović, M. Gvozdenović, B. Grgur, Z. Knežević-Jugović, Enzymatic hydrolysis of egg-white proteins in a membrane reactor, *ICOSECS 8*, Belgrade, 2013, Book of Abstracts, F P33, 266

4. Časopisi nacionalnog značaja (M50)

4.1. Rad u vodećem časopisu nacionalnog značaja (M51) (1x2=2)

- 4.1.1. N. Ognjanović, S. Šaponjić, D. Bezbradica, Z. Knežević-Jugović, "Lipase catalyzed biodiesel synthesis with different acyl acceptors", *APTEFF* 39 (2008) 161-169, ISSN 1450-7188

5. Zbornici skupova nacionalnog značaja (M60)

5.1. Saopštenje sa skupa nacionalnog značaja štampano u celini (M63) (9x0.5=4.5)

- 5.1.1. **N. Ognjanović**, D. Bezbradica, Z. Knežević, "Optimizacija enzimskog postupka sinteze biodizela imobilisanom lipazom iz *Candida antarctica*", *Zbornik radova prezentovanih u okviru 45. savetovanja SHD*, 2007., Novi Sad, pp. 69-72.
- 5.1.2. **N. Ognjanović**, D. Bezbradica, Z. Knežević, "Primena novih acil akceptora u procesu enzimski katalizovane sinteze biodizela ", *Zbornik radova prezentovanih u okviru 46. savetovanja SHD*, 2008., Beograd, pp. 55-58.
- 5.1.3. M. Bradić, **N. Ognjanović**, N. Avramović, D. Bezbradica, D. Mijin, I. Karadžić, Z. Knežević-Jugović, "Enzimsko dobijanje monoacilglicerola glicerolizom suncokretovog ulja", *Zbornik radova prezentovanih u okviru 48. savetovanja SHD*, 2010., Novi Sad, pp. 196-199.
- 5.1.4. **N. Ognjanović**, S. Grbavčić, M. Žuža, Z. Knežević-Jugović, D. Bezbradica, "Primena modifikacije nosača Eupergit® C 250 L cisteinom i glutaralhidom u imobilizaciji lipaze iz *C. rugosa*", *Konferencija Biotehnologija za održivi razvoj*, Tehnološko-metalurški fakultet, Beograd, 2010, pp. 37-40.
- 5.1.5. S. Grbavčić, Omar Ali Saied, J. Jovanović, **N. Ognjanović**, M. Žuža, D. Bezbradica, Z. Knežević-Jugović, "Proizvodnja lipaza i proteaza iz *Candida utilis* tehnikom gajenja na čvrstoj podlozi", *Konferencija Biotehnologija za održivi razvoj*, Tehnološko-metalurški fakultet, Beograd, 2010, pp. 49-52.
- 5.1.6. Omar Ali Saied Moftah, Sanja Grbavčić, **N. Luković**, Milena Žuža, Dejan Bezbradica, Zorica Knežević-Jugović, "Karakterizacija lipaze iz *Candida utilis* dobijene tehnikom gajenja na čvrstoj podlozi korišćenjem uljane pogače maslina kao supstrata", *Zbornik radova prezentovanih u okviru 49. savetovanja SHD*, Kragujevac, 13-14. 05. 2011, pp. 151-154.
- 5.1.7. S. Jakovetić, M. Carević, S. Grbavčić, M. Stojanović, **N. Luković**, M. Žuža, M. Mihailović, "Esterification of phenolic acids catalyzed by lipase B from *Candida antarctica*", *Prva konferencija mladih hemičara Srbije*, Beograd, 19-20. oktobar 2012, CD Knjiga radova, ISBN: 978-86-7132-051-1, str. 54-57.
- 5.1.8. J. Jovanović, A. Stefanović, M. Žuža, N. Šekuljica, S. Jakovetić, **N. Luković**, Z. Knežević-Jugović, „Empirijski kinetički model hidrolize proteina belanceta pretretiranih ultrazvučnim talasima visoke frekvencije“, XIX Savetovanje o biotehnologiji, Čačak 07-08. mart, Zbornik radova, Vol. 19 (21), 2014. 281-285, ISBN 987-86-87611-31-3
- 5.1.9. M. Žuža, A. Gluvić, S. Jakovetić, **N. Luković**, A. Stefanović, J. Jovanović, Z. Knežević-Jugović, „Antioksidativna aktivnost hidrolizata belanceta i njegovih frakcija dobijenih membranskom ultrafiltracijom“, XIX Savetovanje o biotehnologiji, Čačak 07-08. mart, Zbornik radova, Vol. 19 (21), 2014. 275-279, ISBN 987-86-87611-31-3

5.2. Saopštenje sa nacionalnog skupa štampano u izvodu (M64) (3x0.2=0.6)

- 5.2.1. N. Ognjanović, D. Bezbradica, Z. Knežević, „Optimizacija procesa sinteze biodizela katalizovana lipazama *Zbornik radova prezentovanih u okviru 44. savetovanja SHD*, Beograd, 2006, Izvodi radova, BT-P05, 32.
- 5.2.2. N. Ognjanović, D. Bezbradica, Z. Knežević, „Optimizacija procesa sinteze biodizela imobilisanom lipazom iz *Candida antarctica* u sistemu bez organskog rastvarača“, *VII simpozijum Savremene tehnologije i privredni razvoj*, Leskovac, 2007, Zbornik izvoda radova, BIH-4/BE-4, 36.
- 5.2.3. Z. Knežević-Jugović, N. Ognjanović, D. Bezbradica, „Sinteza biodizela u sistemu bez organskog rastvarača primenom novih acil akceptora“, *Čistije tehnologije i novi materijali*, Beograd, 2008, Knjiga izvoda radova, C10, 70.

2.2. Radovi posle izbora u zvanje naučni saradnik sa kojima konkuriše za izbor u zvanje viši naučni saradnik

Klasifikacija naučnoistraživačkih rezultata prema kategorijama naučnoistraživačkih rezultata posle podnošenja molbe za izbor u zvanje naučni saradnik, izvršena je prema Prilogu 2, Pravilnika o postupku i načinu vrednovanja, i kvantitativnom iskazivanju naučnoistraživačkih rezultata istraživača („Službeni glasnik RS“, br. 24/2016, 21/2017 i 38/2017).

1. Naučni radovi objavljeni u časopisima međunarodnog značaja (M20)

1.1. Radovi u međunarodnim časopisima izuzetnih vrednosti (M21a) (1x10=10)

- 1.1.1. S. Jakovetić, N. Luković, B. Jugović, M. Gvozdenović, S. Grbavčić, J. Jovanović, Z. Knežević-Jugović, Production of Antioxidant Egg White Hydrolysates in a Continuous Stirred Tank Enzyme Reactor Coupled with Membrane Separation Unit. *Food and Bioprocess Technology*, vol. 8, no. 2, pp. 287-300, 2015, (ISSN 1935-5130) (IF (2013)=3,126) (IF(2013,petogodišnji)=3.564); *Food Science and Technology* (12/122).

1.2. Radovi u vrhunskim međunarodnim časopisima (M21) (4x8=32)

- 1.2.1. N. Šekuljica, N. Prlainović, S. Jakovetić, S. Grbavčić, N. Ognjanović, Z. Knežević-Jugović, D. Mijin, Removal of anthraquinone dye by cross-linked enzyme aggregates from fresh horseradish extract, *CLEAN – Soil Air Water*, vol. 44, no. 7, pp. 891-900, 2016 (ISSN: 1863-0650) (IF (2014)=1,945); (IF(2014, petogodišnji)=2.153); *Water Resources* (23/83).
- 1.2.2. S. Jakovetić Tanasković, B. Jokić, S. Grbavčić, I. Drvenica, N. Prlainović, N. Luković, Z. Knežević-Jugović, Immobilization of *Candida antarctica* lipase B on kaolin and its application in synthesis of lipophilic antioxidants, *Applied Clay Science*, vol. 135, pp. 103-111, 2017 (ISSN 0169-1317) (IF(2017)=3,641) (IF(2017, petogodišnji)=3.616); *Chemistry, Physical* (52/147); *Material Science, Multidisciplinary* (68/285).

- 1.2.3. A.A. Salim, S. Grbavčić, N. Šekuljica, A. Stefanović, S. Jakovetić Tanasković, **N. Luković**, Knežević-Jugović Z. Production of enzymes by a newly isolated *Bacillus* sp. TMF-1 in solid state fermentation on agricultural by-products: The evaluation of substrate pretreatment methods, *Bioresource Technology*, vol. 228, pp. 193-200, 2017, (ISSN 0960-8524) (**IF(2017)=5.807**) (IF(2016, petogodišnji)=6.102) *Agricultural Engineering* (1/14); *Biotechnology and Applied Microbiology* (13/161).
- 1.2.4. S. Djurović S, B. Nikolić, **N. Luković**, J. Jovanović, A. Stefanović, N. Šekuljica, D. Mijin, Z. Knežević-Jugović, The impact of high-power ultrasound and microwave on the phenolic acid profile and antioxidant activity of the extract from yellow soybean seeds, *Industrial Crops and Products*, vol. 122, pp. 223-231, 2018 (ISSN 0926-6690) (**IF(2018)=4.191**) (IF(2018, petogodišnji)=4.419); *Agricultural Engineering* (2/13).

1.3. Radovi u istaknutim međunarodnim časopisima (M22) (1x5=5)

- 1.3.1. M. Elmalimadi, A. Stefanović, N. Šekuljica, M. Žuža, **N. Luković**, J. Jovanović, Z. Knežević-Jugović, The synergistic effect of heat treatment on alcalase-assisted hydrolysis of wheat gluten proteins: Functional and antioxidant properties, *Journal of Food Processing and Preservation*, vol. 41, no. 5, 2017, (ISSN 0145-8892) (**IF(2017)=1.510**) (IF(2017, petogodišnji)=1.494); *Food Science and Technology* (77/133).
- 1.3.2. D. Bezbradica, M. Ćorović, S. Tanasković, **N. Luković**, M. Carević, A. Milivojević, Z. Knežević-Jugović, "Enzymatic Syntheses of Esters - Green Chemistry for Valuable Food, Fuel and Fine Chemicals", *Current Organic Chemistry*, 2017, vol 21, no.2, pp.104-138, 2017, (ISSN 1385-2728) (**IF(2017)=2.193**) (IF(2015, petogodišnji)=2.436); *Chemistry, Organic* (26/57)

1.4. Radovi u međunarodnom časopisu (M23) (2x3=6)

- 1.4.1. A. Salim, S. Grbavčić, N. Šekuljica, M. Vukašinić-Sekulić, J. Jovanović, S. Jakovetić Tanasković, **N. Luković**, Knežević-Jugović, Enzyme production by solid-state fermentation on soybean meal: a comparative study of conventional and ultrasound-assisted extraction methods, *Biotechnology and Applied Biochemistry*, vol. 66, no. 3, pp. 361-368, 2019, (ISSN 0885-4513) (**IF(2018)=1.559**) (IF(2018, petogodišnji)=1.498); *Biotechnology and Applied Microbiology* (125/162).
- 1.4.2. S. Đurović, V. Dragičević, H. Waisi, M. Pagnacco, **N. Luković**, Z. Knežević-Jugović, B. Nikolić, Enhancement of antioxidant activity and bioactive compound contents in yellow soybean by plant-based products, *Archives of Biological Sciences*, vol. 71, no. 3, pp 425-434, 2019, (ISSN 0354-4664) (**IF(2017)=0.648**) (IF(2018, petogodišnji)=0.515); *Biology* (78/87).

2. Zbornici međunarodnih naučnih skupova (M30)

2.1. Saopštenje sa međunarodnog skupa štampano u celini (M33) (2x1=2)

- 2.1.1. Z. Knežević-Jugović, A. Stefanović, J. Jovanović, M. Žuža, S. Grbavčić, S. Jakovetić, M. Dojčinović, **N.Luković** “Ultrasound-induced changes in functional properties of egg white proteins and in their susceptibility to enzymatic hydrolysis”, *Proceedings of the 41st International Conference of Slovak Society of Chemical Engineering*, Tatranské Matliare, Slovakia, 126–135, 26-30 May 2014, ISBN 978-80-89475-13-1.
- 2.1.2. N. Šekuljica, A.A. Salim, **N.Luković**, J. Jovanović, S. Jakovetić Tanasković, S. Grbavčić, Z. Knežević-Jugović, Solid-state fermentation of soybean meal: hydrolytic enzymes production and improvement in bioactivity, Editors: Markoš, J., Mihal, M., In *Proceedings of the 46th International Conference of the Slovak Society of Chemical Engineering*, Tatranské Matliare, Slovakia, May 20-23, 2019, *Proceedings* sp.102-1–102-10, ISBN: 978-80-8208-011-0, EAN: 9788082080110

2.2. Saopštenje sa međunarodnog skupa štampano u izvodu (M34) (5x0.5=2.5)

- 2.2.1. **N. Luković**, S. Jakovetić, S. Grbavčić, J. Jovanović, A. Stefanović, N. Šekuljica, Z. Knežević-Jugović, „Production of antioxidative egg-white hydrolysates in a circle batch membrane reactor“, 7th Central European Congress Food-CEFood, Food Chain Intergadion, Ohrid, Macedonia, 21-24 May 2014, Book of Abstract, page 220, ISBN 987-608-4565-05-5.
- 2.2.2. J. Jovanović, A. Stefanović, S. Jakovetić, **N. Luković**, N. Šekuljica, M. Žuža, Z. Knežević-Jugović, „Antioxidant activity and functional properties of peptides derived from egg white proteins by two-step enzymatic hydrolysis“, Food Quality & Safety, Health & Nutrition 1st Conference, 27-29 November 2014, Skopje, Macedonia, Book of Abstract, page 76, ISBN 978-608-4565-06-2
- 2.2.3. A. Stefanović, J. Jovanovic, N. Šekuljica, S. Grbavčić, **N. Luković**, B. Bugarski, Z. Knežević-Jugović, Structural and functional characterization of papain-assisted ultrasound pretreated egg white hydrolysis, *2nd International Conference on Ultrasound-based Applications: from analysis to synthesis – ULTRASONIC 2016*, Caparica-Almada, Portugal, 6th-8th June 2016, Book of Abstracts, page 43, ISBN: 978-989-99361-9-5-
- 2.2.4. J. Jovanović, A. Stefanović, A. Culetu, D. Duta, **N. Luković**, S. Jakovetić Tanasković, N. Šekuljica, Z. Knežević-Jugović, Enzymatic treatment of soy protein concentrate: influence on the potential techno-functional and antioxidant properties, In: Vladimir Kakurinov, prof. Dr (editor): Food Quality and Safety, Health and Nutrition Congress-NUTRICON 2019, Ohrid, Macedonia, 12-14 June 2019, Book of Abstracts, page 75, ISBN 987-608-4565-13-0
- 2.2.5. **N. Luković**, A. Ali Salim, S. Grbavčić, S. Jakovetić Tanasković, J. Jovanović, N. Šekuljica, Z. Knežević-Jugović, Effect of moisture content on enzyme production by solid state fermentation on soybean meal, In: Vladimir Kakurinov, prof. Dr

(editor): Food Quality and Safety, Health and Nutrition Congress-NUTRICON 2019, Ohrid, Macedonia, 12-14 June 2019, Book of Abstracts, page 73, ISBN 987-608-4565-13-0

3. Tehnička rešenja

3.1. Novo tehničko rešenje primenjeno na međunarodnom nivou (M81) (1x8=8)

3.1.1. N. Šekuljica, J. Jovanović, N. Luković, S. Jakovetić-Tanasković, I. Gazikalović, A. Stefanović, Z. Knežević-Jugović, Primena enzimskog procesa i sonikacije za unapređenje prinosa proteina i kvaliteta proteinskog brašna (Application of enzymatic processes and sonication for proteina meal improvement), 2020.

4. Patenti (M90)

4.1. Objavljen patent na nacionalnom nivou (M94) (1x7=7)

4.1.1. M. Milivojevic, M. Zuza, V. Đorđević, M. Jonovic, N. Lukovic, B. Bugarski, Z. Knežević-Jugović, „Dobijanje nanocestica kalcijum-alginata ultrasoničnim raspršivanjem kao nosača za imobilizaciju enzima“, Patentna prijava P-2018/0459, Zavoda za intelektualnu svojinu Republike Srbije, Glasnik intelektualne svojine, 2018/8; Datum objavljivanja patenta 31.8.2018.

3. ANALIZA PUBLIKOVANIH RADOVA

Naučnoistraživački rad dr Nevene Luković može se podeliti u više grupa na osnovu tema istraživanja. Prvu grupu čine radovi (2.2.3., 2.4.1., 3.1.2., 3.2.5.)u kojima su prikazani rezultati proučavanja mogućnosti korišćenja poljoprivrednog otpada kao supstrata za mikrobiološku proizvodnju enzima putem fermentacije na čvrstim nosačima SSF (*na engleskom* solid state fermentation). Primarni cilj je valorizacija različitih sporednih proizvoda i otpadnih tokova industrije prerade soje, kukuruza, suncokreta i drugog poljoprivrednog materijala biološkom konverzijom u industrijski važne proizvode kao što su enzimi. Istovremeno, izvršena je i analizafermentacionih podloga radi evaluacije uticaja proizvodnih mikroorganizama na nutritivnikvalitet fermentacione pogače. U radu 2.2.3. prvo je izvršeno testiranje velikog broja komercijalnih i autohtonih bakterija iz različitih vrsta roda *Bacillus*. Testiranje velikog broja sojeva je vršeno u cilju pronalaženja produktivnog soja koji može uspešno da sintetiše celulaze, mananaze, proteaze i amilaze u velikom prinosu bez stvaranja sporednih proizvoda i drugih enzima kako bi u sledećim fazama mogle da se primene jednostavne metode za izdvajanje i prečišćavanje enzima.Odabrani soj je takođe ispunio uslov da može uspešno da raste i da sintetiše enzime na čvrstim agro-industrijskim otpadnim materijalima.Kako izabrani soj nije bio komercijalno dostupan mikroorganizam, izvršena je njegova identifikacija.Prvo je izvršen preliminarni mikroskopski pregled kojim se utvrdilo da soj pripada rodu *Bacillus*,a zatim je izvršena pouzdana identifikacije sekvenciranjem 16S rRNA gena.Analizom sekvence koristeći BLAST omogućena je komparativna analiza genoma DNA sekvence, gde je potvrđenoda je soj

iz roda *Bacillus*, najverovatnije *Bacillus thurgensis*. Soj je označen kao *Bacillus* sp. TMF1, i deponovan je u NCBI Genbank pod pristupnim kodom KX960141.

U ovom radu je ispitano nekoliko različitih podloga: sojina sačma, sojine ljuspice, kukuruzna sačma, pšenična pleva i pogača masline nakon ekstrakcije ulja. Ove podloge su podvrgnute različitim pretretmanima da bi se utvrdio njihov uticaj na dostupnost hranljivih materija i posledično, na veći prinos sintetisanih enzima. Naime, pretretmani se obično vrše u cilju poboljšanja biodigestibilnosti supstrata degradacijom neprobojnih kompleksa i istovremeno menjaju fizička svojstva supstrata, tj. poroznost i veličinu aglomerata, čime se povećava dostupnost nutritijenata mikroorganizmima. Izbor odgovarajućeg pretretmana mora ispuniti nekoliko kriterijuma i mora da se odredi za svaki supstrat, mikroorganizam i/ili željeni enzim. U idealnom slučaju, pretretman ne sme da dovede do značajnog gubitka fermentabilnih nutritijenata, ne sme da se koriste toksične hemikalije ili da sam proces dovede do proizvodnje toksičnih jedinjenja. Takođe, prednosti imaju oni protokoli koji imaju minimalni zahtev za energijom, skupom opremom ili hemiklijama. Tradicionalno korišćene metode su kiselinski i bazni pretretmani. Međutim, kao efikasne metode sve više se koriste ultrazvuk visokog intenziteta i mikrotalasi zbog svoje velike učinkovitosti prilikom tretiranja različite vrste biomasa. Ispitivanja su pokazala da od svih primenjenih pretretmana podloge, hemijski tretmani daju najbolje rezultate. Najveći prinos proizvedenih proteaza ($50,5 \text{ IUg}^{-1}$) i α -amilaza ($50,75 \text{ IUg}^{-1}$), ostvaren je na bazno pretretiranoj kukuruznoj plevi. Bazni pretretman je takođe imao pozitivan uticaj na proizvodnju celulaza na kukuruznim mekinjama ($1,19 \text{ IUg}^{-1}$), a najveći prinos pektinaza je dobijen na netretiranoj sojinoj pogači ($64,90 \text{ IUg}^{-1}$). Ultrazvučni pretretmani su imali slab uticaj, a mikrotalasi pretretmani su imali pozitivan efekat samo na proizvodnju enzima na pšeničnoj plevi. Ispitivanje je pokazalo da je neophodno izvršiti detaljnu analizu za svaku podlogu i željeni enzim, jer u zavisnosti od sastava podloge zavisi i izbor pretretmana.

Istraživanja su pokazala da fermentacija na čvrstim nosačima ima niz prednosti u odnosu na submerznu fermentaciju kao što su velika produktivnost i dobijanje visoko koncentrovanog finalnog proizvoda. Međutim, da bi se zadržala ta prednost, moraju se optimizovati metode ekstrakcije i prečišćavanja finalnog proizvoda. Ekstrakcija i prečišćavanje finalnog proizvoda značajno doprinosi ukupnim troškovima proizvodnje, te je od ključnog značaja razvoj efikasnog postupka za ekstrakciju fermentisanih supstrata. U radu 2.4.1. ispitane su različite metode za ekstrakciju enzima (proteaza, amilaza, celulaza) dobijenih fermentacijom *B. subtilis* na sojinoj sačmi. Ispitano je nekoliko faktora klasične metode ekstrakcije kao što su vrsta i količina rastvarača, pH rastvora, brzina mešanja, vreme i temperatura. Da bi se procenio uticaj tih različitih faktora na uspešnost ekstrakcije enzima, primenjena je metoda višefaktornih eksperimentalnih planova (centralni kompozicioni rotabilni plan), koji omogućava da se utvrdi uticaj nekoliko faktora istovremeno, kao i da se odredi intenzitet tih uticaja kao i njihova moguća interakcija. Paralelno je ispitan i uticaj inovativne tehnike ekstrakcije, ultrazvučne ekstrakcije, u cilju unapređenja ekstrakcije enzima. Dakle, u ovom radu su poređena dva različita pristupa ekstrakcije enzima iz reakcione smeše. U pogledu klasičnih metoda ekstrakcije proteaza,

najvažniji parametri su linearni koeficijent (pH) i kvadratni koeficijent (odnos čvrsto/tečno i temperatura). Generalno, alkalna sredina je pogodovala ekstrakciji proteaza, kao i mala količina rastvarača u odnosu na čvrstu fazu. Mada se moglo očekivati da višak rastvarača pogoduje ekstrakciji enzima usled razlike koncentracije između čvrste supstance i rastvarača, to ovde nije slučaj jer višak tečnosti može biti otežavajući za naknadne korake prečišćavanja. Model predviđa da je na pH9 moguće ostvariti prinos proteaza od 250IU za 15minuta ekstrakcije. Analiza ekstrakcije α -amilaze je pokazala da je najbitniji parametar odnos čvrste supstance i rastvarača. Visoke vrednosti aktivnosti enzima, amilaza, postižu se u sistemima gde je visok odnos rastvarač/supstrat. Takođe, negativni koeficijent interakcije između temperature i odnos čvrsto/tečno, ukazuje da pod datim uslovima produženo vreme ekstrakcije može da ima pozitivan efekat na aktivnost ekstrahovane α -amilaze. Prinos od 810IU se može postići nakon 45 minuta, pri obrtaju od 250rpm, i pH7. Na primeru celulaze je pokazano da se vrednosti ekstrahovanog enzima mogu menjati i do 70% samo promenom uslova ekstrakcije. Dokazano je da se za ekstrakciju celulaze iz ekstrakcione smeše moraju koristiti velike vrednosti obrtaja što ukazuje na to da je proizvedeni enzim verovatno čvrsto vezan za supstrat. Prinosi svih enzima ekstrahovanih klasičnom metodom ekstrakcije upoređeni su sa vrednostima dobijenih ultrazvučnom ekstrakcijom.

Ultrazvučno potpomognuta ekstrakcija (*na engl. ultrasound assisted extraction, UAE*) je nova alternativna metoda ekstrakcije koja povećava prinos ekstrakcije i to pod relativno nižim temperaturama i za kraće vreme u poređenju sa konvencionalnim tehnikama. Otkriveno je da UAE promovise prenos mase i uzrokuje rupturu ćelijskog zida usled dejstva akustične kavitacije. Ova tehnika ima veliku primenu u ekstrakciji različitih bioaktivnih jedinjenja iz biljnog materijala kao što su antioksidansi, gde je otkriveno da UAE može efikasno da smanji dugotrajne konvencionalne metode ekstrakcije uz smanjenje potrošnje organskih rastvarača, pa se stoga smatra ekološki prihvatljivijim rešenjima. Ultrazvučno potpomognuta ekstrakcije je na primeru ekstrakcije proteaza iz reakcione smeše pokazala znatne prednosti. Naime, ista vrednost aktivnosti proteaza je ostvarena posle 15 minuta klasične ekstrakcije naspram 2,5 minuta UAE. Za iste te vrednosti aktivnosti proteaza, potrebno je u slučaju konvencionalnih ekstrakcija utrošiti značajno više rastvarača nego u slučaju UAE ekstrakcije čime se dobija znatno razblažen enzimski preparat koji je neophodno koncentrisati. Slični rezultati su dobijeni i na primeru ekstrakcije α -amilaze. Koncentracija enzima dobijena klasičnom ekstrakcijom iznosila je $8,2 \text{ IU ml}^{-1}$, dok je ultrazvučnom ekstrakcijom ta vrednost $16,5 \text{ IU ml}^{-1}$, te se može smatrati da je ultrazvučna ekstrakcija efikasnija skoro 100%. Jedino se u slučaju ekstrakcije celulaza pokazalo da klasična ekstrakcija daje bolje rezultate, što je verovatno posledica loše odabranih uslova ultrazvučne ekstrakcije (amplitude ultrazvuka).

U publikaciji 3.2.5. izvršena je analiza uticaja sadržaja vode na fermentaciju *B.subtilis* na sojinoj sačmi, a potom su u publikaciji 3.1.2. ovako dobijeni enzimi (proteaze, amilaze, celulaze i pektinaze) naknadno analizirani, odnosno određivani su temperaturni i pH optimum njihove aktivnosti. Naime, proizvedeni enzimi su veoma različitih biohemijskih svojstava, uključujući

aktivnosti na određenim temperaturama i širokom opsegu pH. Najviša aktivnost za proteaze, amilaze i celulaze je postignuta na višim temperaturama od 50°C, što ukazuje na visok potencijal ovih enzima za primenu u industrijskim procesima koji se odigravaju na povišenim temperaturama (npr. formulacije za detergente). Nadalje, pH optimum dobijenih enzima iz *B. subtilis* su u skladu sa literaturnim podacima, te je pH optimum za celulaze pH 3, za pektinaze pH 9, dok je za proteaze potvrđeno da je enzim stabilan u rasponu pH 7-10. Finalno, izvršena je i analiza fermentisane podloge radi evaluacije uticaja proizvodnih mikroorganizama na nutritivni kvalitet fermentacione pogače.

Druga grupa radova prikazuje rezultate istraživanja fokusiranih na ispitivanja hidrolizata proteina belanaca dobijenih primenom različitih vrsta endo- i egzoproteaza u jednostepenim i/ili dvostepenim enzimskim postupcima (publikacije 2.1.1., 3.1.1., 3.2.1., 3.2.2., 3.2.3). U ovu grupu spadaju i radovi u kojima su prikazani postupci proizvodnje bioaktivnih peptida iz pšeničnog glutena (2.3.1.) i unapređenje funkcionalnih svojstava hidrolizata glutena dobijenih kombinovanjem termičkog pretretmana i naknadne enzimske hidrolize. U publikacijama su objavljeni rezultati ispitivanja koji se bave unapređenjem bioloških svojstava proteina belanceta i dobijanje hidrolizata, koji pored visoke nutritivne vrednosti, imaju i izražena biološka svojstva, kao što su antioksidativna, antimikrobna i antiproliferativna aktivnost. U radovima 3.1.1. i 3.2.3. osvrtno je bio na razvoju novih procesa za proizvodnju hidrolizata belanceta, tj. na ispitivanju uticaja dejstva ultrazvučnih talasa na strukturu proteina, kao i na njihovu dostupnost proteolitičkim enzimima radi oslobađanja biološki aktivnih peptide. Hidrolizati pripremljeni jednostepenom i dvostepenom hidrolizom ultrazvučno tretiranih proteina belanceta u ultrazvučnom kupatilu frekvence 40 kHz i ultrazvučnom sondom frekvence 20 kHz su ispoljili najveći stepen ravnotežne hidrolize ali i najizraženije sposobnosti neutralisanja slobodnih radikala. Ovako pripremljeni hidrolizati bogati biološki aktivnim peptidima treba da poseduju i odgovarajuća senzorna i tehnološko-funkcionalna svojstva kako bi se mogli inkorporirati kao dodaci funkcionalnoj hrani, što je i bila tematika publikacija 3.2.2. i 3.2.3. U ovim radovima ispitan je uticaj dužine trajanja ultrazvučnog pretretmana na površinske karakteristike molekula proteina belanceta i, samim tim, i na funkcionalna svojstva poput rastvorljivosti, kapaciteta i stabilnosti pene i emulgujućih svojstava. Utvrđeno je da se posle ultrazvučnog tretmana nativnog belanceta smanjuje veličina agregata molekula proteina, povećava rastvorljivost proteina, ali i da dolazi do poboljšanja emulgujućih svojstava. Ultrazvučni pretretman materijala (2.2.4.) je primenjen za ekstrakciju biološki aktivnih komponenata iz sojinih ljuspica, gde se pretretman ultrazvučnim talasima generisanim ultrazvučnom sondom frekvencije 20 kHz pokazao kao veoma efikasan. Druga grupa radova je fokusirana na povećanje prinosa proteina belanceta sa antioksidativnom aktivnošću primenom protočnog membranskog reaktora. U radovima 2.1.1. i 3.2.1. ispitana je primena membranskog protočnog reaktora sa separacionim modulom i polietilensulfonskom membranom veličine pora 10 kDa i pri tome je izvršena optimizacija procesnih parametara (temperatura, enzim/supstrat odnos, pH, brzina mešanja, vrsta propelera za mešanje, protok reakcione smeše). Ovako je omogućena proizvodnja frakcije peptida tačno definisanih bioloških svojstava u kontinualnom procesu.

U sledećoj grupi radova ispitani su postupci imobilizacije enzima i njihova primena u različitim reakcijama koje imaju praktični značaj kao što su razgradnja sintetičkih boja (2.2.1.) ili sinteza estara (2.2.2.). Tematika publikacije 2.2.1. odnosi se na imobilizaciju peroksidaze izolovane iz svežeg ekstrakta rena u obliku umreženih enzimskih agregata (imobilizacija bez nosača). Ovako imobilisana peroksidaza je korišćena za reakciju obezbojavanja sintetičke antrahinonske boje Acid Violet 109. Optimizovani su postupci imobilizacije i poređeni su rezultati dobijeni u šaržnom reaktoru i reaktoru sa pakovanim slojem (sa recirkulacijom reakcione smeše). Oba sistema su pokazala visok stepen zadržane aktivnosti i operativne stabilnosti, pri čemu je sistem sa pakovanim slojem zadržao 60% početne aktivnosti nakon 6 uzastopnih ciklusa obezbojavanja. Tematika publikacije (2.2.2.) odnosi se na imobilizaciju lipaze iz *Candida antarctica* na kaolin metodom adsorpcije. Ispitani su parametri imobilizacije kao što su pH, jonska jačina i koncentracija proteina u funkciji prinosa imobilizacije i aktivnosti enzima. Ovako imobilisani enzim je uspešno korišćen u sintezi lipofilnih antioksidanasa, pri čemu je ostvaren prinos od 100%.

Istrazivanje u oblasti proučavanja mineralne prehrane biljaka i uicaj na bioproduktivitet (rast ili prinos), i druge fiziološke parametre biljaka, konkretno soje, prikazano je u okviru publikacije 2.4.2. Poseban osvrt je dat na povećanje antioksidativne aktivnosti i sadržaja fenolnih jedinjenja, pri čemu je utvrđeno da se ciljanom biofortifikacijom određenim prirodnim đubrivima može uticati na promenu sadržaja i akumuliranje različitih biokativnih jedinjenja. U revijalnom radu 2.3.2 dat je opširan prikaz primene enzima u sintezi velikog broja estara (aroma estri, flavonoidi, vitamin C, biodizel).

4. CITIRANOST

Naučni radovi dr Nevene Luković su citirani 289 puta, odnosno 251 put (bez autocitata svih autora, izvor izvor SCOPUS na dan 22.5.2020.) Citirani su sledeći radovi:

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5. ELEMENTI ZA KVALITATIVNU OCENU NAUČNOG DOPRINOSA KANDIDATA I MINIMALNI KVANTITATIVNI USLOVI ZA IZBOR

5.1. Pokazatelji uspeha u naučnom radu

- Kandidatkinja je bila autor ili koautor jednog poglavlja, 18 naučnih radova i 14 saopštenja na međunarodnom nivou i jednog naučnog rada i 12 saopštenja na nacionalnom nivou. Dr Nevena Luković je do sada bila autor i koautor jednog poglavlja u knjizi međunarodnog značaja (M14), jednog rada u međunarodnom časopisu izuzetnih vrednosti (M21a) (nakon izbora u prethodno zvanje), 6 radova u vrhunskim međunarodnim časopisima (M21) (4 nakon izbora u prethodno zvanje), 3 rada u istaknutim međunarodnim časopisima (M22) (dva nakon izbora u prethodno zvanje), 7 radova u međunarodnim časopisima (M23) (dva nakon izbora u prethodno zvanje). Dr Nevena Luković je koautor 4 publikacije na međunarodnim naučnim konferencijama štampanim u celini (M33) (dva nakon izbora u prethodno zvanje) i 10 štampanih u izvodu (M34) (5 nakon izbora u prethodno zvanje). Bila je autor jednog rada u vodećim časopisima nacionalnog značaja (M51), 9 saopštenja na skupovima nacionalnog značaja (M63) i 3 publikovana u izvodu (M64) (pre izbora u prethodno zvanje). Dr Nevena Luković ima prihvaćeno tehničko rešenje primenjeno na međunarodnom nivou (M81) i objavljen patent na nacionalnom nivou (M94). Naučni radovi dr Nevene Luković su citirani 251 put (bez autocitata svih autora, izvor SCOPUS na dan 22.5.2020.) Vrednost h-indeksa je 10.

Dr Nevena Luković je učestvovala ili učestvuje na istraživanjima u okviru tri domaća, jednog inovacionog projekta i dva međunarodna naučnoistraživačka projekta. Dr Nevena Luković je recenzirala nekoliko radova u vrhunskim međunarodnim časopisima (Waste Management (IF=5.431), Journal of Cleaner Production (IF=6.395)).

5.2. Razvoj uslova za naučni rad, obrazovanje i formiranje naučnih kadrova

Tokom realizacije naučnih projekata kandidatkinja je aktivno učestvovala u realizaciji naučne saradnje Tehnološko-metalurškog fakulteta sa drugim institucijama, u zemlji i inostranstvu.

Kandidatkinja je učestvovala u izradi jednog magistarskog rada, dva diplomatska rada, dva master rada i tri završna rada. Dr Nevena Luković je bila uključena u osmišljavanje i planiranje eksperimenata, rešavanje problema uočenih u toku realizacije istraživanja kao i analizu i diskusiju rezultata i pisanje publikacija. Kandidatkinja je član komisije dva master rada (Isidora Milošević “Unapređenje nutritivnih svojstava sojine sačme fermentacijom pomoću probiotskog soja *Bacillus subtilis*”, Milica Veselinović “Modifikacija gluten iz pšeničnog brašna i pšeničnih mekinja fermentacijom pomoću probiotskog soja *Bacillus subtilis*”) i član komisije za ocenu i odbranu doktorske disertacije (Abdalla Ali Salim, “Production of hydrolytic enzymes by fermentation on agricultural by-products using *Bacillus* sp.”)

Dr Nevena Luković je bila angažovana na izvođenju vežbi iz predmeta Industrijska mikrobiologija sa genetikom, Laboratorijski praktikum, Biotehnoški praktikum, Tehnologija ugljenih hidrata i Enzimsko inženjerstvo. Kandidatkinja od školske 2015/2016. drži nastavu na

Master studijama na Katedri za biohemijski inženjerstvo i biotehnologiju na predmetu "Primena enzima u prehrambenoj industriji". U studentskim anketama, pedagoški rad dr Nevene Luković ocenjen je prosečnom vrednošću studentske ocene 4,96.

5.3. Kvalitet naučnih rezultata

Nakon izbora u prethodno naučno zvanje – naučni saradnik, dr Nevena Luković je objavila 16 bibliografskih jedinica i to jedan rad u međunarodnom časopisu izuzetnih vrednosti (M21a), 4 rada u vrhunskim međunarodnim časopisima (M21), 2 rada u istaknutim međunarodnim časopisima (M22), 2 rada u međunarodnim časopisima (M23), 2 publikacije na međunarodnim naučnim konferencijama štampanim u celini (M33) i 5 publikacija štampanih u izvodu (M34). Dr Nevena Luković ima prihvaćeno tehničko rešenje primenjeno na međunarodnom nivou (M81) i objavljen patent na nacionalnom nivou (M94) (sve nakon izbora u prethodno zvanje).

Naučni radovi dr Nevene Luković su citirani 289 puta, odnosno 251 put (bez autocitata svih autora, izvor izvor SCOPUS na dan 22.5.2020.) vrednost *h*-indeksa je 10. Velika pozitivna citiranost radova kandidata ukazuje na aktuelnost, uticajnost i ugled objavljenih radova. Prosečan broj autora po radu za ukupno navedenu bibliografiju iznosi 6,1. Na pet radova (od kojih je jedno poglavlje u knjizi međunarodnog značaja, jedan rad u vrhunskom međunarodnom časopisu, dva u međunarodnom časopisu i jedan rad u vodećem nacionalnom časopisu) i osam saopštenja dr Nevena Luković je bila prvi autor.

Radovi kandidatkinje su višestruko citirani u u uticajnim časopisima M21a kategorije: Renewable and Sustainable Energy Reviews (IF=10,556), Applied Energy (IF=8,426), Bioresource Technology (IF=6,669), Journal of Cleaner Production (IF=6,395), Reviews in Environmental Science and Biotechnology (IF=5,761), Renewable Energy (IF=5,439).

5.4 Stepen samostalnosti u naučnoistraživačkom radu i uloga u realizaciji radova u naučnim centrima u zemlji i inostranstvu

Dr Nevena Luković je tokom dosadašnjeg naučnoistraživačkog rada pokazala visok stepen samostalnosti u idejama, kreiranju i realizaciji eksperimenata, obradi eksperimentalnih rezultata i pisanju naučnih publikacija. Rezultate svojih istraživanja je sistematski analizirala, objasnila i publikovala u uticajnim međunarodnim časopisima. Velika pozitivna citiranost radova kandidata ukazuje na aktuelnost, uticajnost i ugled objavljenih radova. Dr Nevena Luković je pokazala spremnost za sticanje novih znanja, multidisciplinarni pristup i uspostavljanja naučne saradnje.

Najznačajnija naučna ostvarenja u poslednjih pet godina (pet odabranih referenci)

1.N. Ognjanović, D. Bezbradica, Z. Knežević-Jugović, "Enzymatic conversion of sunflower oil to biodiesel in a solvent-free system: Process optimization and the immobilized system stability",

Bioresource Technology, vol. 100, no. 21, pp. 5146-5154, 2009, (ISSN 0960-8524) **(IF(2008)=4.453)** (IF(2010, petogodišnji)=4.901); *Biotechnology & Applied Microbiology* (18/145); *Agricultural Engineering* (1/9). **(M21a)**, rad citiran 113 puta, baza Scopus.

2. **N. Luković**, Z. Knežević-Jugović, D. Bezbradica, "Biodiesel fuel production by enzymatic transesterification of oils: recent trends, challenges and future perspectives", *Alternative Fuel*, pp. 47-72, 2011, (ISSN 978-953-308-55-0). **(M14)**

2. S. Jakovetić, **N. Luković**, B. Jugović, M. Gvozdenović, S. Grbavčić, J. Jovanović, Z. Knežević-Jugović, Production of Antioxidant Egg White Hydrolysates in a Continuous Stirred Tank Enzyme Reactor Coupled with Membrane Separation Unit. *Food and Bioprocess Technology*, vol. 8, no. 2, pp. 287-300, 2015, (ISSN 1935-5130) **(IF (2013)=3,126)** (IF(2013,petogodišnji)=3.564); *Food Science and Technology* (12/122). **(M21a)**

4. A.A. Salim, S. Grbavčić, N. Šekuljica, A. Stefanović, S. Jakovetić Tanasković, **N. Luković**, Knežević-Jugović Z. Production of enzymes by a newly isolated *Bacillus sp.* TMF-1 in solid state fermentation on agricultural by-products: The evaluation of substrate pretreatment methods, *Bioresource Technology*, vol. 228, pp. 193-200, 2017, (ISSN 0960-8524) **(IF(2017)=5.807)** (IF(2016, petogodišnji)=6.102) *Agricultural Engineering* (1/14); *Biotechnology and Applied Microbiology* (13/161). **(M21)**

5. M. Elmalimadi, A. Stefanović, N. Šekuljica, M. Žuža, **N. Luković**, J. Jovanović, Z. Knežević-Jugović, The synergistic effect of heat treatment on alcalase-assisted hydrolysis of wheat gluten proteins: Functional and antioxidant properties, *Journal of Food Processing and Preservation*, vol. 41, no. 5, 2017, (ISSN 0145-8892) **(IF(2017)=1.510)** (IF(2017, petogodišnji)=1.494); *Food Science and Technology* (77/133). **(M22)**

Sumarni prikaz dosadašnje naučnoistraživačke aktivnosti dr Nevene Luković:

Kategorija rada	Koeficijent kategorije	Broj radova u kategoriji		Zbir	
		Ukupno	Posle izbora	Ukupno	Posle izbora
Poglavlje u knjizi međunarodnog značaja (M14)	4	1	0	4	0
Radovi u međunarodnim časopisima izuzetnih vrednosti (M21a)	10	1	1	10	10
Radovi u vrhunskim međunarodnim časopisima (M21)	8	6	4	48	32
Radovi u istaknutim međunarodnim časopisima (M22)	5	3	2	15	10

Radovi u časopisima međunarodnog značaja (M23)	3	7	2	21	6
Radovi saopšteni na skupovima međunarodnog značaja štampani u celini (M33)	1	4	2	4	2
Radovi saopšteni na skupovima međunarodnog značaja štampani u izvodu (M34)	0,5	10	5	5	2,5
Naučni radovi objavljeni u vodećim časopisima nacionalnog značaja (M51)	2	1	0	2	0
Radovi saopšteni na skupovima nacionalnog značaja štampani u celini (M63)	0,5	9	0	4,5	0
Radovi saopšteni na skupovima nacionalnog značaja štampani u celini (M64)	0,2	3	0	0,6	0
Odbranjena doktorska disertacija (M71)	6	1	0	6	0
Novo tehničko rešenje primenjeno na međunarodnom nivou (M81)	8	1	1	8	8
Objavljen patent na nacionalnom nivou (M94)	7	1	1	7	7
UKUPAN KOEFICIJENT				135,1	77,5

Uslov za izvor u zvanje viši naučni saradnik za tehničko-tehnološke nauke, koje propisuje *Pravilnik o postupku i načinu vrednovanja i kvantitativnom iskazivanju naučnoistraživačkih rezultata istraživača* je da kandidat ima najmanje 50 poena koji treba da pripadaju sledećim kategorijama:

Diferencijalni uslov – od prvog izbora u prethodno zvanje do izbora u zvanje	Potrebno da kandidat ima najmanje XX poena, koji treba da propadaju sledećim kategorijama:	Neophodno	Ostvareno
Viši naučni saradnik	Ukupno	50	77,5
Obavezni (1)	M10+M20+M31+M32+M33+M41+M42+M51+M80+M90+M100	40	75
Obavezni (2)	M21+M22+M23+M81-85+M90-96+M101-103+M108	22	73
	M21+M22+M23	11	58
	M81-85+M90-96+M101-103+M108	5	15

Na osnovu detaljne analize dosadašnjeg naučnoistraživačkog rada i ostvarenih rezultata, dr Nevena Luković, dipl. inž. tehnologije pokazala izrazitu sklonost i sposobnost za bavljenje naučnoistraživačkim radom i ispunjava sve uslove neophodne za sticanje zvanja VIŠI NAUČNI

SARADNIK. Stoga, sa zadovoljstvom predlažemo Nastavno-naučnom veću Tehnološko-metalurškog fakulteta u Beogradu da ovaj izveštaj prihvati i isti prosledi odgovarajućoj komisiji Ministarstva prosvete, nauke i tehnološkog razvoja Republike Srbije na konačno usvajanje.

U Beogradu, 02.07.2020. godine.

Komisija

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