

# Utjecaj prirodnih dodataka na bazi maslinova lista tijekom prerade maslina na kvalitativna, nutritivna i senzorna svojstva proizvedenih ulja

---

Novoselić, Anja

Doctoral thesis / Disertacija

2022

Degree Grantor / Ustanova koja je dodijelila akademski / stručni stupanj: **University of Zagreb, Faculty of Food Technology and Biotechnology / Sveučilište u Zagrebu, Prehrambeno-biotehnološki fakultet**

Permanent link / Trajna poveznica: <https://urn.nsk.hr/urn:nbn:hr:159:441313>

Rights / Prava: [Attribution-NoDerivatives 4.0 International/Imenovanje-Bez prerada 4.0 međunarodna](#)

Download date / Datum preuzimanja: **2024-07-14**



Repository / Repozitorij:

[Repository of the Faculty of Food Technology and Biotechnology](#)





Sveučilište u Zagrebu

Prehrambeno-biotehnološki fakultet

Anja Novoselić

**UTJECAJ PRIRODNIH DODATAKA NA  
BAZI MASLINOVA LISTA TIJEKOM  
PRERADE MASLINA NA  
KVALITATIVNA, NUTRITIVNA I  
SENZORNA SVOJSTVA PROIZVEDENIH  
ULJA**

DOKTORSKI RAD

Zagreb, 2022.



Sveučilište u Zagrebu

Prehrambeno-biotehnološki fakultet

Anja Novoselić

**UTJECAJ PRIRODNIH DODATAKA NA  
BAZI MASLINOVA LISTA TIJEKOM  
PRERADE MASLINA NA  
KVALITATIVNA, NUTRITIVNA I  
SENZORNA SVOJSTVA PROIZVEDENIH  
ULJA**

DOKTORSKI RAD

Mentor:

dr. sc. Karolina Brkić Bubola

Zagreb, 2022.



University of Zagreb

Faculty of Food Technology and Biotechnology

Anja Novoselić

**INFLUENCE OF NATURAL ADDITIVES  
BASED ON OLIVE LEAVES DURING  
OLIVE PROCESSING ON QUALITY,  
NUTRITIONAL AND SENSORY  
PROPERTIES OF PRODUCED OIL**

DOCTORAL DISSERTATION

Supervisor:  
Karolina Brkić Bubola, PhD

Zagreb, 2022

Tema rada prihvaćena je na 7. redovitoj sjednici Fakultetskog vijeća Prehrambeno-biotehnološkog fakulteta Sveučilišta u Zagrebu akad. god. 2020./2021., održanoj 23. travnja 2021. godine, a Senat Sveučilišta u Zagrebu donio je odluku o odobravanju pokretanja postupka stjecanja doktorata znanosti na svojoj 11. sjednici u akad. god. 2020./2021., održanoj 8. lipnja 2021. godine.

Istraživanje je provedeno u okviru HRZZ projekta „Projekt razvoja karijera mladih istraživača - izobrazba novih doktora znanosti” (DOK-2018-01-469) sufinanciran sredstvima Europskog socijalnog fonda u okviru Operativnog programa Učinkoviti ljudski potencijali 2014.-2020., financijskom potporom Hrvatske zaklade za znanost. Istraživanje je financirano od strane projekta „Advanced solutions for assuring the overall authenticity and quality of olive oil – OLEUM“ (GA br. 635690) i Instituta za poljoprivredu i turizam.

## **Informacije o mentoru**

**Dr. sc. Karolina Brkić Bubola** zaposlena je kao znanstvena suradnica na Institutu za poljoprivredu i turizam u Poreču. Od 2018. g. izabrana je u znanstveno zvanje znanstvena savjetnica. Diplomirala je 2004. g. na Prehrambeno-biotehnološkom fakultetu Sveučilišta u Zagrebu, gdje je 2011. g. obranila i doktorski rad te stekla akademski stupanj doktora znanosti u području biotehničkih znanosti, polju prehrambene tehnologije. Na Institutu je zaposlena od 2005. g., gdje je od 2005. g. zamjenica voditeljice Prehrambeno-biotehnološkog laboratorija, akreditiranog prema normi ISO/IEC 17025 za analizu kvalitete i autentičnosti maslinovih ulja, a od 2008. g. voditeljica je akreditiranog i službenog Panela za senzornu analizu djevičanskih maslinovih ulja, priznatog od strane Međunarodnog vijeća za maslinu (International Olive Council, IOC) i Ministarstva poljoprivrede RH. Područje njenog znanstvenog interesa su kemija i analitika te senzorna svojstva maslinovog ulja, s posebnim naglaskom na istraživanju odziva senzorni aktivnih kemijskih spojeva na tehnološke i druge izvore varijabilnosti, kao i njihovu povezanost sa senzornom kvalitetom proizvoda. Sudjelovala je u 12 znanstvenih projekata, većinom vezanih uz kvalitetu i tehnologiju maslinovih ulja te senzorna svojstva poljoprivredno-prehrambenih proizvoda. Bila je voditeljica VIP projekta "Primjena filtracije u svrhu poboljšanja kvalitete maslinovih ulja" financiranog od strane Ministarstva poljoprivrede RH, te voditeljica istraživačke skupine Instituta unutar HORIZON 2020 projekta "Advanced solutions for assuring the overall authenticity and quality of olive oil – OLEUM" financiranog od strane EU. Od 2018. g. voditeljica je dva Projekta razvoja karijera mladih istraživača, Hrvatske zaklade za znanost. Do danas je objavila 1 poglavlje u knjizi te više od 40 znanstvenih radova, od kojih je 31 rad zastupljen u CC i SCI Expanded bazama. Sudjelovala je na više od 40 međunarodnih konferencija, od čega je na 3 bila član organizacijskog odbora. Citirana je više od 350 puta uz h-indeks 13. Recenzirala je stotinjak znanstvenih članaka za 15 uglednih znanstvenih časopisa. 2008. g. dobila je stipendiju IOC-a za usavršavanje u senzornoj analizi maslinovih ulja na Sveučilištu u Jaenu, Španjolska, a dodatno se usavršavala u senzornoj analizi i poboljšanju kvalitete maslinovog ulja na edukacijama u Španjolskoj, Italiji, Tunisu i Hrvatskoj. U 2014. g. bila je dobitnica povelje „Vitezica hrvatskog maslinovog ulja“, priznanja za znanstveni i stručni rad na polju proizvodnje maslinovog ulja. Članica je stručnih društava: European Federation of the Science and Technology of Lipids, Hrvatskog kemijskog društva i Hrvatskog društva prehrambenih tehnologa, biotehnologa i nutricionista. Članica je međunarodnih ocjenjivačkih panela svjetskih natjecanja maslinovih ulja (NYIOOC, New Yorku, SAD; EVOOLEUM, Cordoba, Španjolska). Od 2014. g. članica je radne skupine stručnjaka za analizu maslinovih ulja u Europskoj komisiji, a od 2018. g.

članica IOC radne skupine za senzornu analizu maslinovih ulja (predstavica RH). Od 2021. g. članica je Matičnog odbora za biotehničke znanosti Agencije za znanost i visoko obrazovanje.



*Na početku želim uputiti najveće zahvale mentorici dr. sc. Karolini Brkić Bubola na sveobuhvatnoj podršci, pomoći i suradnji koju mi je pružala u proteklih pet godina rada na Institutu. Bila mi je uzor i putokaz na mom putu proučavanja i upoznavanja maslinovog ulja. Na njezin poticaj nastala je ideja za ovaj doktorski rad.*

*Veliko hvala prof. dr. sc. Dubravki Škevin, dr. sc. Igoru Lukiću i izv. prof. dr. sc. Klari Kraljić koji su svojim sugestijama pomogli unapređenju moje doktorske disertacije.*

*Posebna zahvala ravnatelju dr. sc. Deanu Banu na svemu, posebno na financijskoj pomoći u realizaciji ovog istraživanja. Velike zahvale kolegicama Dori, Marini i Ivani koje su bile uvijek uz mene te nesebično dijelile svoja znanja koja su mi bila od velike pomoći u radu. Zahvale upućujem kolegama i dragim prijateljima s Instituta Sari R., Tini J.P., Tini Š., Ani Č., Eni B., Živki K., Marici S., Danku C., Marinu K., Adrianu F., Elvinu Š., Bernardu P. i Marijanu B., te radnicima s imanja koji su mi bili podrška u realizaciji i provedbi istraživanja.*

*Hvala gosp. Kraljeviću, vlasniku uljare „Cuj“ koji je omogućio preradu maslina i proizvodnju ulja u svom pogonu.*

*Zahvaljujem suradnicima sa sveučilišta u Bologni za pomoć pri analizi uzoraka za izradu doktorske disertacije.*

*Odajem veliku zahvalnost svojim roditeljima, bratu i prijateljima na poticaju i ljubavi koju su mi pružali tijekom ovog izazovnog životnog perioda.*



**Sveučilište u Zagrebu****Prehrambeno-biotehnološki fakultet****Sveučilišni poslijediplomski studij Biotehnologija i bioproceno inženjerstvo, prehrambena tehnologija i nutricionizam****UDK: 547.56:633.852.73:665.327.3:665.7.035.7(043.3)****Znanstveno područje: Biotehničke znanosti****Znanstveno polje: Prehrambena tehnologija****UTJECAJ PRIRODNIH DODATAKA NA BAZI MASLINOVA LISTA TIJEKOM PRERADE MASLINA NA KVALITATIVNA, NUTRITIVNA I SENZORNA SVOJSTVA PROIZVEDENIH ULJA****Anja Novoselić, mag. ing. agr.****Rad je izrađen** na Institutu za poljoprivredu i turizam u Poreču**Mentor:** dr. sc. Karolina Brkić Bubola, znanstvena savjetnica**Kratki sažetak**

Cilj ovog rada je bio istražiti mogućnosti obogaćivanja djevičanskih maslinovih ulja fenolnim i hlapljivim tvarima primjenom prirodnih dodataka na bazi maslinova lista tijekom proizvodnje. U tu svrhu ispitani su utjecaji dodatka maslinova lista i vodenih ekstrakata maslinova lista tijekom proizvodnje maslinovih ulja na sastav fenolnih i hlapljivih tvari te na sastav masnih kiselina, pigmente, voskove, etilne estere masnih kiselina i senzorna svojstva proizvedenih ulja. U istraživanju su korišteni list i plod triju sorti maslina (Buža, Istarska bjelica, Leccino). Izučavano je može li primjena navedenih dodataka smanjiti negativan učinak proizvodnih čimbenika (kasniji stupanj zrelosti maslina, produljeno trajanje skladištenja maslina i skladištenja ulja) na sastav fenolnih i hlapljivih tvari u ulju. Utjecaj dodataka na bazi maslinova lista imao je različito djelovanje na parametre kvalitete u sortnim uljima ovisno o sortimentu prerađenih plodova te o količini dodanog lišća masline i vrsti dodanog vodenog ekstrakta maslinova lista. Primjena prirodnih dodataka na bazi maslinova lista nije negativno utjecala na senzorni profil istraženih sortnih ulja, odnosno u navedenim uljima nije utvrđeno postojanje mana. Utvrđene su interakcije između faktora 'dodatak maslinova lista/vodenog ekstrakta maslinova lista' i 'vremena skladištenja plodova' u njihovom utjecaju na ukupne identificirane fenolne spojeve i na ukupne identificirane hlapljive tvari. Dodatak maslinova lista utjecao je na povećanje indeksa ekstraktabilnosti tijesta maslina te na porast prinosa ulja u industrijskim uvjetima prerade maslina i proizvodnje ulja. Dobiveni rezultati značajno doprinose znanju o mogućnostima obogaćivanja ulja prirodnim antioksidansima, što može biti iskorišteno za proizvodnju maslinovih ulja boljih nutritivnih i senzornih svojstava te produljene trajnosti.

**Broj stranica:** 186**Broj slika:** 29**Broj tablica:** 29**Broj literaturnih navoda:** 196**Broj priloga:** 0**Jezik izvornika:** hrvatski**Ključne riječi:** maslinovo ulje, list masline, kontrola kvalitete, fenolni spojevi, hlapljive tvari, prinos ulja, oksidacijska stabilnost, senzorna svojstva**Datum obrane:** 25. srpnja 2022.**Stručno povjerenstvo za obranu:**

1. prof. dr. sc. Dubravka Škevin
2. izv. prof. dr. sc. Klara Kraljić
3. dr. sc. Igor Lukić, znanstveni savjetnik
4. doc. dr. sc. Ivona Elez Garofulić (zamjenski član)

**Rad je pohranjen u:** knjižnici Prehrambeno-biotehnološkog fakulteta u Zagrebu, Kačićeva 23; Nacionalnoj i sveučilišnoj knjižnici u Zagrebu, Hrvatske bratske zajednice 4; Sveučilištu u Zagrebu, Trg Republike Hrvatske 14.

## **BASIC DOCUMENTATION CARD**

---

**Doctoral dissertation**

**University of Zagreb**

**Faculty of Food Technology and Biotechnology**

**Postgraduate study in Biotechnology and Bioprocess Engineering, Food Technology and Nutrition**

**UDK: 547.56:633.852.73:665.327.3:665.7.035.7(043.3)**

**Scientific Area: Biotechnical Sciences**

**Scientific Field: Food Technology**

### **INFLUENCE OF NATURAL ADDITIVES BASED ON OLIVE LEAVES DURING OLIVE PROCESSING ON QUALITY, NUTRITIONAL AND SENSORY PROPERTIES OF PRODUCED OIL**

**Anja Novoselić, mag. ing. agr.**

**Thesis performed** at the Institute of Agriculture and Tourism, Poreč

**Supervisor:** Scientific advisor, Karolina Brkić Bubola, PhD

#### **Short abstract**

The aim of this work was to investigate the possibilities of enrichment of virgin olive oil with phenolic and volatile compounds by applying natural additives based on olive leaf during production. For this purpose, it was investigated how the addition of olive leaf and its aqueous extracts during production affects the composition of phenolic and volatile compounds, as well as the composition of fatty acids, pigments, waxes, fatty acid ethyl esters, and sensory properties of produced oils. Olive leaves and fruits of three olive varieties were included in the research (Leccino, Istarska bjelica, Buža). It was investigated if the application of these additives can reduce the negative effect of production factors (later stages of fruit ripening, prolonged duration of olive storage and oil storage) on the composition of phenolic and volatile compounds in the oil. The influence of olive leaf-based supplements had a different effect on quality parameters in varietal oils depending on the variety of processed fruits and on the amount of olive leaves added, as well as on the type of olive leaf aqueous extract added. The application of natural additives based on olive leaf did not adversely affect the sensory profile of the investigated varietal oils, that is the occurrence of defects was not established. Interactions were found between the factors 'addition of olive leaf/olive leaf water extract' and 'storage time of fruits' in their influence on total phenolic compounds identified and on total volatile compounds identified. The addition of olive leaf caused an increase in olive paste extractability index and an increase in oil yield in industrial conditions of olive processing and oil production. The obtained results significantly contribute to the knowledge about the possibilities of improving oils with natural antioxidants, which could be used for the production of olive oils with better nutritional and sensory properties and extended shelf life.

**Number of pages:** 186

**Number of figures:** 29

**Number of tables:** 29

**Number of references:** 196

**Number of supplements:** 0

**Original in:** Croatian\*

**Key words:** olive oil, olive leaf, quality control, phenolic compounds, volatile compounds, oil yield, oxidative stability, sensory attributes

**Date of the thesis defense:** 25<sup>th</sup> July 2022

#### **Reviewers:**

1. Full professor Dubravka Škevin, PhD
2. Associate professor Klara Kraljić, PhD
3. Scientific advisor Igor Lukić, PhD
4. doc.dr.sc. Ivona Elez Garofulić (substitute)

**Thesis deposited in:** Library of Faculty of Food Technology and Biotechnology, Kačićeva 23; National and University Library, Hrvatske bratske zajednice 4; University of Zagreb, Trg Republike Hrvatske 14.

# **UTJECAJ PRIRODNIH DODATAKA NA BAZI MASLINOVA LISTA TIJEKOM PRERADE MASLINA NA KVALITATIVNA, NUTRITIVNA I SENZORNA SVOJSTVA PROIZVEDENIH ULJA**

Cilj ovog rada je bio istražiti mogućnosti obogaćivanja djevičanskih maslinovih ulja fenolnim i hlapljivim tvarima primjenom prirodnih dodataka na bazi maslinova lista tijekom proizvodnje. U tu svrhu ispitani su utjecaji dodatka maslinova lista i vodenih ekstrakata maslinova lista tijekom proizvodnje maslinovih ulja na sastav fenolnih i hlapljivih tvari te na sastav masnih kiselina, pigmente, voskove, etilne estere masnih kiselina i senzorna svojstva proizvedenih ulja. U istraživanju su korišteni list i plod triju sorti maslina (Buža, Istarska bjelica, Leccino). Izučavano je može li primjena navedenih dodataka smanjiti negativan učinak proizvodnih čimbenika (kasniji stupanj zrelosti maslina, produljeno trajanje skladištenja maslina i skladištenja ulja) na sastav fenolnih i hlapljivih tvari u ulju. Utjecaj dodataka na bazi maslinova lista imao je različito djelovanje na parametre kvalitete u sortnim uljima ovisno o sortimentu prerađenih plodova te o količini dodanog lišća masline i vrsti dodanog vodenog ekstrakta maslinova lista. Primjena prirodnih dodataka na bazi maslinova lista nije negativno utjecala na senzorni profil istraženih sortnih ulja, odnosno u navedenim uljima nije utvrđeno postojanje mana. Utvrđene su interakcije između faktora 'dodatak maslinova lista/vodenog ekstrakta maslinova lista' i 'vremena skladištenja plodova' u njihovom utjecaju na ukupne identificirane fenolne spojeve i na ukupne identificirane hlapljive tvari. Dodatak maslinova lista utjecao je na povećanje indeksa ekstraktabilnosti tijesta maslina te na porast prinosa ulja u industrijskim uvjetima prerade maslina i proizvodnje ulja. Dobiveni rezultati značajno doprinose znanju o mogućnostima obogaćivanja ulja prirodnim antioksidansima, što može biti iskorišteno za proizvodnju maslinovih ulja boljih nutritivnih i senzornih svojstava te produljene trajnosti.

**KLJUČNE RIJEČI:** maslinovo ulje, list masline, kontrola kvalitete, fenolni spojevi, hlapljive tvari, prinos ulja, oksidacijska stabilnost, senzorna svojstva

# **INFLUENCE OF NATURAL ADDITIVES BASED ON OLIVE LEAVES DURING OLIVE PROCESSING ON QUALITY, NUTRITIONAL AND SENSORY PROPERTIES OF PRODUCED OIL**

The aim of this work was to investigate the possibilities of enrichment of virgin olive oil with phenolic and volatile compounds by applying natural additives based on olive leaf during production. For this purpose, it was investigated how the addition of olive leaf and its aqueous extracts during production affects the composition of phenolic and volatile compounds, as well as the composition of fatty acids, pigments, waxes, fatty acid ethyl esters, and sensory properties of produced oils. Olive leaves and fruits of three olive varieties were included in the research (Leccino, Istarska bjelica, Buža). It was investigated if the application of these additives can reduce the negative effect of production factors (later stages of fruit ripening, prolonged duration of olive storage and oil storage) on the composition of phenolic and volatile compounds in the oil. The influence of olive leaf-based supplements had a different effect on quality parameters in varietal oils depending on the variety of processed fruits and on the amount of olive leaves added, as well as on the type of olive leaf aqueous extract added. The application of natural additives based on olive leaf did not adversely affect the sensory profile of the investigated varietal oils, that is the occurrence of defects was not established. Interactions were found between the factors 'addition of olive leaf/olive leaf water extract' and 'storage time of fruits' in their influence on total phenolic compounds identified and on total volatile compounds identified. The addition of olive leaf caused an increase in olive paste extractability index and an increase in oil yield in industrial conditions of olive processing and oil production. The obtained results significantly contribute to the knowledge about the possibilities of improving oils with natural antioxidants, which could be used for the production of olive oils with better nutritional and sensory properties and extended shelf life.

**KEY WORDS:** olive oil, olive leaf, quality control, phenolic compounds, volatile compounds, oil yield, oxidative stability, sensory attributes

# SADRŽAJ

<b>1. UVOD .....</b>	<b>1</b>
<b>2. OPĆI DIO .....</b>	<b>3</b>
<b>2.1. MASLINA .....</b>	<b>3</b>
2.1.1. Plod masline .....	4
2.1.2. List masline .....	4
<b>2.2. MASLINOVO ULJE.....</b>	<b>8</b>
2.2.1. Proizvodnja maslinovog ulja .....	9
<b>2.3. KVALITETA I SASTAV MASLINOVOG ULJA .....</b>	<b>11</b>
2.3.1. Osnovni parametri kvalitete .....	11
2.3.2. Sadržaj etilnih estera masnih kiselina i voskova .....	12
2.3.3. Sastav masnih kiselina.....	12
2.3.4. Antioksidansi.....	13
2.3.5. Hlapljive tvari.....	16
2.3.6. Senzorna svojstva maslinovog ulja .....	17
<b>2.4. UTJECAJ DODATKA MASLINOVA LISTA TIJEKOM EKSTRAKCIJE MASLINOVOG ULJA NA KVALITETU I SASTAV PROIZVEDENOG ULJA .....</b>	<b>18</b>
<b>2.5. UTJECAJ DODATKA VODENOG EKSTRAKTA MASLINOVA LISTA TIJEKOM EKSTRAKCIJE MASLINOVOG ULJA NA KVALITETU I SASTAV PROIZVEDENOG ULJA .....</b>	<b>20</b>
<b>2.6. ČIMBENICI KOJI UTJEČU NA KVALITETU, NUTRITIVNA I SENZORNA SVOJSTVA MASLINOVOG ULJA.....</b>	<b>21</b>
2.6.1. Utjecaj sortimenta.....	21
2.6.2. Utjecaj stupnja zrelosti .....	22
2.6.3. Utjecaj vremena skladištenja plodova prije prerade maslina .....	23
2.6.4. Utjecaj vremena skladištenja maslinovog ulja .....	24
<b>3. MATERIJALI I METODE .....</b>	<b>25</b>
<b>3.1. MATERIJALI .....</b>	<b>25</b>
3.1.1. Istraživane sorte.....	25
3.1.2. Pokusni nasadi u istraživanju .....	25
3.1.3. Berba plodova i lišća maslina.....	25
3.1.4. Prerada plodova maslina.....	26
3.1.5. Priprema vodenih ekstrakata na bazi maslinova lista .....	27
<b>3.2. EKPERIMENTALNI DIZAJN .....</b>	<b>28</b>
<b>3.3. METODE ANALIZE MASLINOVIH ULJA .....</b>	<b>31</b>

3.3.1. Određivanje parametara kvalitete .....	31
3.3.2. Određivanje sadržaja etilnih estera masnih kiselina i voskova .....	31
3.3.3. Određivanje sastava masnih kiselina .....	32
3.3.4. Određivanje pigmenata .....	32
3.3.5. Određivanje antioksidacijske aktivnosti .....	33
3.3.6. Određivanje oksidacijske stabilnosti .....	33
3.3.7. Određivanje fenolnih spojeva .....	34
3.3.8. Određivanje ukupnih fenolnih spojeva u ulju i vodenim ekstraktima .....	34
3.3.9. Određivanje hlapljivih tvari .....	34
3.3.10. Senzorna analiza maslinovog ulja .....	35
3.3.12. Statistička analiza podataka .....	36
<b>4. REZULTATI .....</b>	<b>37</b>
<b>4.1. UTJECAJ KOLIČINE DODANOG MASLINOVA LISTA NA KVALITETU, NUTRITIVNA I SENZORNA SVOJSTVA PROIZVEDENIH SORTNIH ULJA .....</b>	<b>37</b>
<b>4.2. UTJECAJ VRSTE VODENOG EKSTRAKTA MASLINOVA LISTA NA KVALITETU, NUTRITIVNA I SENZORNA SVOJSTVA PROIZVEDENIH SORTNIH ULJA .....</b>	<b>53</b>
<b>4.3. UTJECAJ DODATKA MASLINOVA LISTA / VODENOG EKSTRAKTA MASLINOVA LISTA NA KVALITETU, NUTRITIVNA I SENZORNA SVOJSTVA ULJA PROIZVEDENIH OD PLODOVA RAZLIČITOG STUPNJA ZRELOSTI .....</b>	<b>67</b>
<b>4.4. UTJECAJ DODATKA MASLINOVA LISTA / VODENOG EKSTRAKTA MASLINOVA LISTA NA FENOLNE SPOJEVE I HLAPLJIVE TVARI ULJA PROIZVEDENIH OD PLODOVA MASLINA SKLADIŠTENIH U RAZLIČITIM UVJETIMA .....</b>	<b>77</b>
<b>4.5. UTJECAJ DODATKA MASLINOVA LISTA TIJEKOM PROIZVODNJE ULJA U INDUSTRIJSKIM UVJETIMA NA TRAJNOST I OKSIDACIJSKU STABILNOST ULJA .....</b>	<b>89</b>
<b>5. RASPRAVA .....</b>	<b>102</b>
<b>5.1. UTJECAJ KOLIČINE DODANOG MASLINOVA LISTA NA KVALITETU, NUTRITIVNA I SENZORNA SVOJSTVA PROIZVEDENIH SORTNIH ULJA .....</b>	<b>102</b>
5.1.1. Parametri kvalitete .....	102
5.1.2. Etilni esteri masnih kiselina .....	104
5.1.3. Voskovi .....	105
5.1.4. Pigmenti .....	105
5.1.5. Fenolni spojevi .....	106
5.1.6. Antioksidacijska aktivnost .....	110
5.1.7. Hlapljive tvari .....	111
5.1.8. Senzorna svojstva .....	116
<b>5.2. UTJECAJ VRSTE VODENOG EKSTRAKTA MASLINOVA LISTA NA KVALITETU, NUTRITIVNA I SENZORNA SVOJSTVA PROIZVEDENIH SORTNIH ULJA .....</b>	<b>120</b>
5.2.1. Parametri kvalitete .....	120



5.2.2. Pigmenti.....	121
5.2.3. Fenolni spojevi .....	122
5.2.4. Antioksidacijska aktivnost.....	125
5.2.5. Hlapljive tvari.....	126
5.2.6. Senzorna svojstva .....	128
<b>5.3. UTJECAJ DODATKA MASLINOVA LISTA / VODENOG EKSTRAKTA MASLINOVA LISTA NA KVALITETU I NUTRITIVNA SVOJSTVA ULJA PROIZVEDENIH OD PLODOVA RAZLIČITOG STUPNJA ZRELOSTI.....</b>	<b>129</b>
5.3.1. Parametri kvalitete.....	129
5.3.2. Pigmenti.....	131
5.3.3. Fenolni spojevi .....	132
5.3.4. Hlapljive tvari.....	136
<b>5.4. UTJECAJ DODATKA MASLINOVA LISTA / VODENOG EKSTRAKTA MASLINOVA LISTA NA FENOLNE SPOJEVE I HLAPLJIVE TVARI ULJA PROIZVEDENIH OD PLODOVA MASLINA SKLADIŠTENIH U RAZLIČITIM UVJETIMA.....</b>	<b>140</b>
5.4.1. Utjecaj faktora dodatka maslinova lista i vremena skladištenja plodova na fenolne spojeve.....	140
5.4.2. Utjecaj faktora dodatka vodenog ekstrakta maslinova lista na fenolne spojeve.....	144
5.4.3. Utjecaj faktora dodatka maslinova lista i vremena skladištenja plodova na hlapljive tvari.....	148
5.4.4. Utjecaj faktora dodatka vodenog ekstrakta maslinova lista i vremena skladištenja plodova na hlapljive tvari.....	152
<b>5.5. UTJECAJ DODATKA MASLINOVA LISTA TIJEKOM PROIZVODNJE ULJA U INDUSTRIJSKIM UVJETIMA NA TRAJNOST I OKSIDACIJSKU STABILNOST ULJA.....</b>	<b>155</b>
5.5.1. Parametri kvalitete.....	155
5.5.2. Sastav masnih kiselina.....	157
5.5.3. Pigmenti i antioksidacijska aktivnost .....	158
5.5.4. Oksidacijska stabilnost .....	160
5.5.5. Ukupni fenoli.....	161
5.5.6. Fenolni spojevi .....	161
5.5.7. Hlapljive tvari.....	163
5.5.8. Senzorna svojstva .....	165
5.5.9. Prinos ulja i indeks ekstraktabilnosti .....	166
<b>6. ZAKLJUČAK.....</b>	<b>167</b>
<b>7. LITERATURA .....</b>	<b>170</b>
<b>ŽIVOTOPIS.....</b>	<b>185</b>
<b>POPIS OBJAVLJENIH RADOVA .....</b>	<b>185</b>

**(Ostali dijelovi doktorata bit će dostupni nakon objave svih podataka)**  
**(Other parts of the thesis will be available after the publication of all the  
research data.)**

## 7. LITERATURA

1. Abaza, L., Taamalli, A., Nsir, H., Zarrouk, M. (2015). Olive Tree (*Olea europaea* L.) Leaves: Importance and Advances in the Analysis of Phenolic Compounds. *Antioxidants*, **4**(4), 682–698. doi: 10.3390/antiox4040682
2. Afaneh, I., Yateem, H., Al-Rimawi, F. (2015). Effect of olive leaves drying on the content of oleuropein. *Am. J. Anal. Chem.*, **6**, 246-252. doi: 10.4236/ajac.2015.63023
3. Agalias, A., Melliou, E., Magiatis, P., Mitaku, S., Gikas, E., Tsaibopoulos, A. (2005). Quantitation of oleuropein and related metabolites in decoctions of *Olea europaea* leaves from ten Greek cultivated varieties by HPLC with diode array detection (HPLC-DAD). *J. Liq. Chromatogr. Relat. Technol.*, **28**(10), 1557-1571. doi: 10.1081/JLC-200058355
4. Aguilera, M. P., Jimenez, A., Sanchez-Villasclaras, S., Uceda, M., Beltran, G. (2015) Modulation of bitterness and pungency in virgin olive oil from unripe “Picual” fruits. *Eur. J. Lipid Sci. Technol.* **117**(9), 1463-1472. doi: 10.1002/ejlt.201400432
5. Ahmad-Qasem, M. H., Canovas, J., Barrajon-Catalan, E., Carreres, J. E., Micol, V., Garcia-Perez, J. V. (2014). Influence of olive leaf processing on the bioaccessibility of bioactive polyphenols. *J. Agric. Food Chem.*, **62**(26), 6190-6198. doi: 10.1021/jf501414h
6. Ahmad-Qasem, M. H., Cánovas, J., Barrajon-Catalan, E., Micol, V., Cárcel, J. A., García-Pérez, J. V. (2013). Kinetic and compositional study of phenolic extraction from olive leaves (var. Serrana) by using power ultrasound. *Innov. Food Sci. Emerg. Technol.*, **17**, 120-129. doi: 10.1016/j.ifset.2012.11.008
7. Alcázar Román, R., Amorós, J.A., Pérez de los Reyes, C., Navarro, F.G., Bravo, S. (2014). Major and trace element content of olive leaves. *Olivae*, **119**, 1–7.
8. Allouche, Y., Jiménez, A., Gaforio, J. J., Uceda, M., Beltrán, G. (2007). How heating affects extra virgin olive oil quality indexes and chemical composition. *J. Agric. Food Chem.*, **55**(23), 9646-9654. doi:
9. American Oil Chemists’ Society (1997). AOCS Method Cd 12b-92. Official methods and recommended practices of the American Oil Chemists’ Society, Oil stability index (OSI). Sampling and analysis of commercial fats and oils, AOCS Press, 6th ed., USA, 1-5.
10. Ammar, S., Zribi, A., Ben Mansour, A., Ayadi, M., Abdelhedi, R., Bouaziz, M. (2014b). Effect of processing systems on the quality and stability of Chemlali olive oils. *J. Oleo Sci.*, **63**(4), 311–323. doi: 10.5650/jos.ess13180
11. Ammar, S., Zribi, A., Gargouri, B., Flamini, G., Bouaziz, M. (2014a). Effect of addition of olive leaves before fruits extraction process to some monovarietal Tunisian extra-virgin olive oils using chemometric analysis. *J. Agric. Food Chem.*, **62**(1), 251–263. doi: 10.1021/jf404395x
12. Ammar, I., BenAmira, A., Khemakem, I., Attia, H., Ennouri, M. (2017). Effect of *Opuntia ficus-indica* flowers maceration on quality and on heat stability of olive oil. *J. Food Sci. Technol.*, **54**(6), 1502-1510. doi: 10.1007/s13197-017-2581-0
13. Andrewes, P., Busch, J.L.H.C., De Joode, T., Groenewegen, A., Alexandre, H. (2003). Sensory properties of virgin olive oil polyphenols: Identification of deacetoxy-ligstroside aglycon as a key contributor to pungency. *J. Agric. Food Chem.*, **51**(5), 1415–1420. doi: 10.1021/jf026042j

14. Angerosa, F. (2002). Influence of volatile compounds on virgin olive oil quality evaluated by analytical approaches and sensor panels. *Eur. J. Lipid Sci. Technol.* **104**(9-10), 639-660. doi: 10.1002/1438-9312(200210)104:9/10<639::AID-EJLT639>3.0.CO;2-U
15. Angerosa, F., Servili, M., Selvaggini, R., Taticchi, A., Esposto, S., Montedoro, G. (2004) Volatile compounds in virgin olive oil: occurrence and their relationship with the quality. *J. Chromatogr. A* **1054**(1-2), 17-31. doi: 10.1016/j.chroma.2004.07.093
16. Aparicio, R., Aparicio-Ruiz, R. (2000). Authentication of vegetable oils by chromatographic techniques. *J. Chromatogr. A*, **881**(1-2), 93–104. doi: 10.1016/S0021-9673(00)00355-1
17. Azaizeh, H., Halahlih, F., Najami, N., Brunner, D., Faulstich, M., Tafesh, A. (2012). Antioxidant activity of phenolic fractions in olive mill wastewater. *Food Chem.*, **134**(4), 2226–2234. doi: 10.1016/j.foodchem.2012.04.035
18. Baccouri, O., Bendini, A., Cerretani, L., Guerfel, M., Baccouri, B., Lercker, G., Zarrouk, M., Miled, D. D. B. (2008) Comparative study on volatile compounds from Tunisian and Sicilian monovarietal virgin olive oils. *Food Chem.* **111**(2), 322-328. doi: 10.1016/j.foodchem.2008.03.066
19. Bajoub, A., Sánchez-Ortiz, A., Ouazzani, N., Fernández-Gutiérrez, A., Beltrán, G., Carrasco-Pancorbo, A. (2015) First comprehensive characterization of volatile profile of north Moroccan olive oils: a geographic discriminant approach. *Food Res. Int.* **76**, 410-417. doi: 10.1016/j.foodres.2015.05.043
20. Bayram, B., Ozcelik, B., Grimm, S., Roeder, T., Schrader, C., Ernst, I.M., Wagner, A.E., Grune, T., Frank, J., Rimbach, G. (2012) A diet rich in olive oil phenolics reduces oxidative stress in the heart of SAMP8 mice by induction of Nrf 2-dependent gene expression. *Rejuvenation Res.*, **15**(1), 71–81. doi: 10.1089/rej.2011.1245
21. Beltrán, G., del Río, C., Sánchez, S., & Martínez, L. (2004). Seasonal changes in olive fruit characteristics and oil accumulation during ripening process. *J. Sci. Food Agric.* **84**(13), 1783-1790. doi: 10.1002/jsfa.1887
22. Beltrán, G., Uceda, M., Jiménez, A., Aguilera, M. P. (2003) Olive oil extractability index as a parameter for olive cultivar characterisation. *J. Sci. Food Agric.* **83**(6), 503–506. doi: 10.1002/jsfa.1369
23. Benavente-Garcia O, Castillo J, Lorente J, Ortuno A, Del Rio JA (2000) Antioxidant activity of phenolics extracted from *Olea europaea* L. leaves. *Food Chem.*, **68**(4), 457–462. doi: 10.1016/S0308-8146(99)00221-6
24. Bendini, A., Cerretani, L., Carrasco-Pancorbo, A., Gómez-Caravaca, A. M., Segura-Carretero, A., Fernández-Gutiérrez, A., Lercker, G. (2007). Phenolic molecules in virgin olive oils: a survey of their sensory properties, health effects, antioxidant activity and analytical methods. An overview of the last decade Alessandra. *Molecules*, **12**(8), 1679-1719. doi: 10.3390/12081679
25. Bianchi, G., Murelli, C., Vlahov, G. (1992). Surface waxes from olive fruits. *Phytochemistry*, **31**(10), 3503–3506. doi: 10.1016/0031-9422(92)83716-C
26. Bianchi, G., Vlahov, G., Anglani, C., Murelli, C. (1992). Epicuticular wax of olive leaves. *Phytochemistry*, **32**(1), 49–52. doi: 10.1016/0031-9422(92)80104-M

27. Biedermann, M., Bongartz, A., Mariani, C., Grob, K. (2008). Fatty acid methyl and ethyl esters as well as wax esters for evaluating the quality of olive oils. *Eur. Food Res. Technol.*, **228**, 65–74. doi: 10.1007/s00217-008-0907-x
28. Boggia, R., Borgogni, C., Hysenaj, V., Leardi, R., Zunin, P. (2014). Direct GC-(EI)MS determination of fatty acid alkyl esters in olive oils. *Talanta*, **119**, 60–67. doi: 10.1016/j.talanta.2013.10.055
29. Boskou D, Tsimidou M, Biekas G (2006) Polar phenolic compounds. AOCS Press, 73-92.
30. Boss, A., Bishop, K.S., Marlow, G., Barnett, M.P.G., Ferguson, L.R. (2016). Evidence to Support the Anti-Cancer Effect of Olive Leaf Extract and Future Directions. *Nutrients* **8**(8), 513. doi: 10.3390/nu8080513
31. Bouaziz, M., Chamkha, M., Sayadi, S. (2004) Comparative study on phenolic content and antioxidant activity during maturation of the olive cultivar Chemlali from Tunisia. *J. Agric. Food Chem.* **52**(17), 5476-5481. doi: 10.1021/jf0497004
32. Bouaziz, M., Feki, I., Ayadi, M., Jemai, H., Sayadi, S. (2010). Stability of refined olive oil and olive-pomace oil added by phenolic compounds from olive leaves. *Eur. J. Lipid Sci. Technol.*, **112**(8), 894-905. doi:10.1002/ejlt.200900166.
33. Bouaziz, M., Fki, I., Jemai, H., Ayadi, M., Sayadi, S. (2008) Effect of storage on refined and husk olive oils composition; stabilization by addition of natural antioxidants from Chemlali olive leaves. *Food Chem.* **108**(1), 253–262. doi: 10.1016/j.foodchem.2007.10.074
34. Boudhrioua, N., Bahloul, N., Slimen, B. I., Kechaou, N. (2009). Comparison on the total phenol contents and the color of fresh and infrared dried olive leaves. *Ind. Crops Prod.*, **29**(2-3), 412-419. doi:10.1016/j.indcrop.2008.08.001.
35. Brahmi, F., Dabbou, S., Flamini, G., Edziri, H., Mastouri, M., Hammami, M. (2011) Fatty acid composition and biological activities of volatiles from fruits of two Tunisian olive cultivars. *Int. J. Food Sci. Tech.* **46**(6), 1316-1322. doi: 10.1111/j.1365-2621.2011.02616.x
36. Brahmi, F., Mechri, B., Dhibi, M., Hammami, M. (2013). Variations in phenolic compounds and antiradical scavenging activity of *Olea europaea* leaves and fruits extracts collected in two different seasons. *Ind. Crops Prod.*, **49**, 256-264. doi: 10.1016/j.indcrop.2013.04.042
37. Briante, R., Patumi, M., Terenziani, S., Bismuto, E., Febbraio, F., Nucci, R. (2002) *Olea europaea* L. leaf extract and derivatives: antioxidant properties. *J. Agric. Food Chem.* **50**(17), 4934-4940. doi: 10.1021/jf025540p
38. Brkić Bubola, K., Koprivnjak, O., Sladonja, B. (2012) Influence of filtration on volatile compounds and sensory profile of virgin olive oils. *Food Chem.* **132**(1), 98-103. doi: 10.1016/j.foodchem.2011.10.038
39. Brkić Bubola, K., Lukić, M., Novoselić, A., Krapac, M., Lukić, I. (2020) Olive fruit refrigeration during prolonged storage preserves the quality of virgin olive oil extracted therefrom. *Foods*, **9**(10), 1445. doi: 10.3390/foods9101445
40. Brkić, K., Radulović, M., Sladonja, B., Lukić, I., Šetić, E. (2006). Application of Soxtec apparatus for oil content determination in olive fruit. *Riv. Ital. Sostanze Gr.* **83**(3), 115–119.

41. Camposeo, S., Vivaldi, G. A., Gattullo, C. E. (2013). Ripening indices and harvesting times of different olive cultivars for continuous harvest. *Sci. Hort.*, **151**, 1-9. doi: 10.1016/j.scienta.2012.12.019
42. Caponio F, Difonzo G, Calasso M, Cosmai L, De Angelis M (2019) Effects of olive leaf extract addition on fermentative and oxidative processes of table olives and their nutritional properties. *Food Res. Int.* **116**,1306–1317. doi:10.1016/j.foodres.2018.10.020
43. Carrasco-Pancorbo, A., Cerretani, L., Bendini, A., Segura-Carretero, A., Del Carlo, M., Gallina-Toschi, T., Lercker, G., Compagnone, D., Fernandez-Gutierrez, A. (2005). Evaluation of the antioxidant capacity of individual phenolic compounds in virgin olive oil. *J. Agric. Food Chem.*, **53**(23), 8918-8925. doi: 10.1021/jf0515680
44. Cavalheiro, C.V., Picoloto, R.S., Cichoski, A.J., Wagner, R., de Menezes, C.R., Zepka, L.Q., Da Croce, D.M., Barin, J.S. (2015). Olive leaves offer more than phenolic compounds—Fatty acids and mineral composition of varieties from Southern Brazil. *Ind. Crops Prod.*, **71**, 122–127. doi: 10.1016/j.indcrop.2015.03.054
45. Cavalli, J. F., Fernandez, X., Lizzani-Cuvelier, L., Loiseau, A. M. (2003). Comparison of static headspace, headspace solid phase microextraction, headspace sorptive extraction, and direct thermal desorption techniques on chemical composition of French olive oils. *J. Agric. Food Chem.*, **51**(26), 7709-7716. doi: 10.1021/jf034834n
46. Cecchi, L., Migliorini, M., Mulinacci, N. (2021) Virgin olive oil volatile compounds: composition, sensory characteristics, analytical approaches, quality control, and authentication. *J. Agric. Food Chem.* **69**(7), 2013-2040. doi: 10.1021/acs.jafc.0c07744
47. Cecchi, T., Alfei, B. (2013) Volatile profiles of Italian monovarietal extra virgin olive oils via HS-SPME–GC–MS: Newly identified compounds, flavors molecular markers, and terpenic profile. *Food Chem.* **141**(3), 2025-2035. doi: 10.1016/j.foodchem.2013.05.090
48. Choe, E., Min, D. B. (2006). Mechanisms and factors for edible oil oxidation. *Compr. Rev. Food Sci. Food Saf.*, **5**(4), 169-186. doi: 10.1111/j.1541-4337.2006.00009.x
49. Cicerale, S., Lucas, L., Keast, R. (2010) Biological activities of phenolic compounds present in virgin olive oil. *Int. J. Mol. Sci.*, **11**(2), 458-479. doi: 10.3390/ijms11020458
50. Clodoveo, M. L. (2012) Malaxation: Influence on virgin olive oil quality. Past, present and future - An overview. *Trends in Food Sci. Technol.* **25**(1), 13–23. doi: 10.1016/j.tifs.2011.11.004
51. Commission Regulation (EU) No 1226/2014 of 17 November 2014 on the authorisation of a health claim made on foods and referring to the reduction of disease risk Text with EEA relevance, *OJ L 331*, 18.11.2014, p. 3–5, Pristupljeno: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014R1226>
52. Commission Regulation (EU) No 432/2012 of 16 May 2012 establishing a list of permitted health claims made on foods, other than those referring to the reduction of disease risk and to children’s development and health Text with EEA relevance, *OJ L 136*, 25.5.2012, p. 1–40, Pristupljeno: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32012R0432>
53. Conte, L., Bendini, A., Valli, E., Lucci, P., Moret, S., Maquet, A., Lacoste, F., Brereton, P., García-González, D.-L., Moreda, W., Toschi, T. G. (2020). Olive oil quality and authenticity: A review of current EU legislation, standards, relevant methods of analyses,

- their drawbacks and recommendations for the future. *Trends Food Sci. Technol.*, **105**, 483-493. doi:
54. Criado, M. N., Motilva, M. J., Goñi, M., Romero, M. P. (2007). Comparative study of the effect of the maturation process of the olive fruit on the chlorophyll and carotenoid fractions of drupes and virgin oils from Arbequina and Farga cultivars. *Food Chem.*, **100**(2), 748-755. doi: 10.1016/j.foodchem.2005.10.035
  55. Damak, N., Bouaziz, M., Ayadi, M., Sayadi, S., Damak, M. (2008). Effect of the maturation process on the phenolic fractions, fatty acids, and antioxidant activity of the Chétoui olive fruit cultivar. *J. Agric. Food Chem.*, **56**(5), 1560–1566. doi: 10.1021/jf072273k
  56. Đanfranko Pribetić, Sorte maslina u Istri, MIH, 2006, ISBN 9539536502
  57. De Leonardis A, Aretini A, Alfano G, Macciola V, Ranalli G (2007) Isolation of a hydroxytyrosol-rich extract from olive leaves (*Olea europaea* L.) and evaluation of its antioxidant properties and bioactivity. *Eur. Food Res. Technol.*, **226**, 653–659 doi: 10.1007/s00217-007-0574-3
  58. del Mar Contreras, M., Lama-Muñoz, A., Espínola, F., Moya, M., Romero, I., Castro, E. (2020). Valorization of olive mill leaves through ultrasound-assisted extraction. *Food Chem.*, **314**, 126218. doi: 10.1016/j.foodchem.2020.126218
  59. Di Giovacchino, L., Angerosa, F., Di Giacinto, L. (1996) Effect of mixing leaves with olives on organoleptic quality of oil obtained by centrifugation. *J. Am. Oil Chem. Soc.* **73**(3), 371-374. doi: 10.1007/BF02523433
  60. Di Giovacchino, L., Sestili, S., Di Vincenzo, D. (2002) Influence of olive processing on virgin olive oil quality. *Eur J Lipid Sci Technol.*, **104**(9-10), 587–601. doi: 10.1002/1438-9312(200210)104:9/10<587::AID-EJLT587>3.0.CO;2-M
  61. Dođru, E., Çelik, Ş., Yakar, Y, Ünver, N. (2021) Zeytin yaprađı ilavesinin zeytinyađının bazı karakteristik özelliklerine etkisi. *Harran J. Agric. Food Sci.* **25**(1), 72-85. doi: 10.29050/harranziraat.744568
  62. EFSA NDA Panel (EFSA Panel on Dietetic Products, Nutrition and Allergies), 2014. Scientific Opinion on the substantiation of a health claim related to olive leaf (*Olea europaea* L.) water extract and increase in glucose tolerance pursuant to Article 13(5) of Regulation (EC) No 1924/2006. *EFSA Journal* 2014;12(5):3655, 10 pp. doi:10.2903/j.efsa.2014.3655
  63. EFSANDA Panel. Scientific Opinion on the substantiation of health claims related to polyphenols in olive and protection of LDL particles from oxidative damage. *EFSA J* 2011, 9, 2033, doi: 10.2903/j.efsa.2011.2033.
  64. Espejo Maqueda, J. (2005). Estudio anlítico comparado entre el aceite de acebuchina y el aceite de oliva virgen. Doktorska disertacija, Sveučilište u Sevilli, Španjolska.
  65. European Economic Community - EEZ (1991). Characteristics of olive oil and olive-residue oil and the relevant methods of analysis. Regulation EEC/2568/91 and later modifications. Official Journal of European Communities, L24, 1-83. Regulation, European Economic Community.
  66. Fernández-Escobar, R., Moreno, R., García-Creus, M. (1999). Seasonal changes of mineral nutrients in olive leaves during the alternate-bearing cycle. *Sci. Hortic.*, **82**(1-2), 25–45. doi: 10.1016/S0304-4238(99)00045-X

67. Ferreira, I. C. F. R., Barros, L., Soares, M. E., Bastos, M. L., Pereira, J. A. (2007). Antioxidant activity and phenolic contents of *Olea europaea* L. leaves sprayed with different copper formulations. *Food Chem.*, **103**(1), 188–195. doi: 10.1016/j.foodchem.2006.08.006
68. Fiedor, J. and Burda, K. (2014) Potential role of carotenoids as antioxidants in human health and disease. *Nutrients*, **6**(2), 466-488. doi: 10.3390/nu6020466
69. Frankel, E., Bakhouch, A., Lozano-Sánchez, J., Segura-Carretero, A., Fernández-Gutiérrez, A., (2013). Literature review on production process to obtain extra virgin olive oil enriched in bioactive compounds. Potential use of byproducts as alternative sources of polyphenols. *J. Agric. Food Chem.*, **61**(22), 5179-5188. doi: 10.1021/jf400806z
70. Fregapane, G., Salvador, M. D. (2017) 12 Oxidative stability and the role of minor and functional components of olive oil. *Olives and Olive Oil as Functional Foods: Bioactivity, Chemistry and Processing*, 249.
71. Gallina-Toschi, T., Cerretani, L., Bendini, A., Bonoli-Carbognin, M., Lercker, G. (2005). Oxidative stability and phenolic content of virgin olive oil: An analytical approach by traditional and high resolution techniques. *J. Sep. Sci.*, **28**(9-10), 859–870. doi: 10.1002/jssc.200500044
72. Gambacorta, G., Faccia, M., Previtali, M. A., Pati, S., Notte, E. L., Baiano, A. (2010) Effects of olive maturation and stoning on quality indices and antioxidant content of extra virgin oils (cv. Coratina) during storage. *J. Food Sci.* **75**(3), C229-C235.
73. García, A., Brenes, M., Martínez, F., Alba, J., García, P., Garrido, A. (2001). High-performance liquid chromatography evaluation of phenols in virgin olive oil during extraction at laboratory and industrial scale. *JAOCS*, **78**(6), 625-629. doi: 10.1007/s11746-001-0316-x
74. García, A., Rodríguez-Juan, E., Rodríguez-Gutiérrez, G., Rios, J. J., & Fernández-Bolaños, J. (2016) Extraction of phenolic compounds from virgin olive oil by deep eutectic solvents (DESs). *Food Chem.* **197**, 554-561. doi: 10.1016/j.foodchem.2015.10.131
75. Garcia-Oliveira, P., Jimenez-Lopez, C., Lourenço-Lopes, C., Chamorro, F., Gonzalez Pereira, A., Carrera-Casais, A., Fraga-Corral, M., Carpena, M., Simal-Gandara, J., Prieto, M. A. (2021). Evolution of flavors in extra virgin olive oil shelf-life, *Antioxidants*, **10**(3), 368, doi: 10.3390/antiox10030368
76. García-Rodríguez, R., Romero-Segura, C., Sanz, C., Pérez, A. G. (2015). Modulating oxidoreductase activity modifies the phenolic content of virgin olive oil. *Food Chem.*, **171**, 364-369. doi: 10.1016/j.foodchem.2014.09.009
77. Gargouri, B., Ammar, S., Zribi, A., Mansour, A. B., Bouaziz, M. (2013). Effect of growing region on quality characteristics and phenolic compounds of chemlali extra-virgin olive oils. *Acta Physiol. Plant*, **35**(9), 2801–2812. doi: 10.1007/s11738-013-1312-z
78. Genovese, A., Caporaso, N., & Sacchi, R. (2021) Flavor Chemistry of Virgin Olive Oil: An Overview. *Appl. Sci.* **11**(4), 1639. doi: 10.3390/app11041639
79. Ghanbari, R., Anwar, F., Alkharfy, K.M., Gilani, A.-H., Saari, N. (2012). Valuable Nutrients and Functional Bioactives in Different Parts of Olive (*Olea europaea* L.)—A Review. *Int. J. Mol. Sci.*, **13**(3), 3291–3340. doi: 10.3390/ijms13033291



80. Gill, C.I.R., Boyd, A., McDermott, E., McCann, M., Servili, M., Selvaggini, R., Taticchi, A., Esposito, S., Montedoro, G., McGlynn, H., Rowland, I. (2005). Potential anti-cancer effects of virgin olive oil phenols on colorectal carcinogenesis models in vitro. *Int. J. Cancer*, **117**, 1–7. doi: 10.1002/ijc.21083
81. Giuffrida, D., Salvo, F., Salvo, A., La Pera, L., Dugo, G. (2007). Pigments composition in monovarietal virgin olive oils from various sicilian olive varieties. *Food Chem.*, **101**(2), 833-837. doi: 10.1016/j.foodchem.2005.12.030
82. Gómez-Alonso, S., Salvador, M. D., Fregapane, G. (2002). Phenolic compounds profile of Cornicabra virgin olive oil. *J. Agric. Food Chem.*, **50**(23), 6812–6817. doi: 10.1021/jf0205211
83. Gomez-Rico, A., Inarejos-Garcia, A. M., Salvador, M. D., Fregapane, G. (2009). Effect of malaxation conditions on phenol and volatile profiles in olive paste and the corresponding virgin olive oils (*Olea europaea* L. Cv. Cornicabra). *J. Agric. Food Chem.*, **57**(9), 3587-3595. doi: 10.1002/ejlt.201200104
84. Grompone, M. A., Callejas, N., Martínez, N., Feller, C., Amarillo, M., Irigaray, B. A. (2016) Variation of the content of ethyl esters in extra virgin olive oils during their shelf life. *J. Food Sci. Eng.*, **6**, 21-25. doi: 10.17265/2159-5828/2016.01.003
85. Guerfel, M., Baccouri, O., Boujnah, D., Zarrouk, M. (2008) Changes in lipid composition, water relations and gas exchange in leaves of two young ‘Chemlali’ and ‘Chetoui’ olive trees in response to water stress. *Plant Soil* **311**(1), 121-129. doi: 10.1007/s11104-008-9663-8
86. Guinda, Á., Rada, M., Delgado, T., Gutiérrez-Adán, P., Castellano, J.M. (2010). Pentacyclic triterpenoids from olive fruit and leaf. *J. Agric. Food Chem.*, **58**(17), 9685–9691. doi: 10.1021/jf102039t
87. Gutfinger, T. (1981). Polyphenols in olive oils. *J. Am. Oil Chem. Soc.* **58**(11), 966-968. doi: 10.1007/BF02659771
88. Gutiérrez, F., Arnaud, T., Garrido, A. (2001) Contribution of polyphenols to the oxidative stability of virgin olive oil. *J. Sci. Food Agric.* **81**(15), 1463–1470. doi: 10.1002/jsfa.958
89. Hachicha Hbaieb, R., Kotti, F., García-Rodríguez, R., Gargouri, M., Sanz, C., Pérez, A. G. (2015). Monitoring endogenous enzymes during olive fruit ripening and storage: Correlation with virgin olive oil phenolic profiles. *Food Chem.* **174**, 240–247. doi: 10.1016/j.foodchem.2014.11.033
90. Hashmi, M.A., Khan, A., Hanif, M., Farooq, U., Perveen, S. (2015) Traditional Uses, Phytochemistry, and Pharmacology of *Olea europaea* (Olive). *Evid. Based Complement Alternat. Med.*, **2015**, 541591. doi: 10.1155/2015/541591
91. Hayes, J. E., Allen, P., Brunton, N., O’Grady, M. N., Kerry, J. P. (2011) Phenolic composition and in vitro antioxidant capacity of four commercial phytochemical products: Olive leaf extract (*Olea europaea* L.), lutein, sesamol and ellagic acid. *Food Chem.*, **126**(3), 948-955. doi: 10.1016/j.foodchem.2010.11.092
92. Hbaieb, R. H., Kotti, F., Cortes-Francisco, N., Caixach, J., Gargouri, M., Vichi, S. (2016a). Ripening and storage conditions of Chétoui and Arbequina olives: Part II. Effect on olive endogenous enzymes and virgin olive oil secoiridoid profile determined by high resolution mass spectrometry. *Food Chem.*, **210**, 631-639. doi: 10.1016/j.foodchem.2016.01.089

93. Hbaieb, R. H., Kotti, F., Gargouri, M., Msallem, M., Vichi, S. (2016b). Ripening and storage conditions of Chétoui and Arbequina olives: Part I. Effect on olive oils volatiles profile. *Food Chem*, **203**, 548-558. doi: 10.1016/j.foodchem.2016.05.026
94. Herrero, M., Temirzoda, T. N., Segura-Carretero, A., Quirantes, R., Plaza, M., Ibañez, E. (2011). New possibilities for the valorization of olive oil by-products. *J. Chromatogr. A*, **1218**(42), 7511-7520. doi: 10.1016/j.chroma.2011.04.053
95. Hooper, L., Bartlett, C., Smith, G. D., Ebrahim, S. (2002). Systematic review of long-term effects of advice to reduce dietary salt in adults. *British Medical Journal*, **325**, 628–632. doi: 10.1136/bmj.325.7365.628
96. Inarejos-García, A. M., Santacatterina, M., Salvador, M. D., Fregapane, G., Gómez-Alonso, S. (2010). PDO virgin olive oil quality—Minor components and organoleptic evaluation. *Food Research International*, **43**(8), 2138-2146. doi: 10.1021/jf070628u
97. International Olive Council (2017) Determination of the Content of Waxes, Fatty Acid Methyl Esters and Fatty Acid Ethyl Esters by Capillary Gas Chromatography; COI/T.20/Doc. No 28/Rev.2, Madrid, Spain.
98. Jaber, H., Ayadi, M., Makni, J., Rigane, G., Sayadi, S., Bouaziz, M. (2012). Stabilization of refined olive oil by enrichment with chlorophyll pigments extracted from Chemlali olive leaves. *Eur. J. Lipid Sci. Technol.*, **114**(11), 1274–1283. doi: 0.1002/ejlt.201100176
99. Japon-Lujan, R., Ruiz-Jiménez, J., Luque de Castro, M. D. (2006a). Discrimination and classification of olive tree varieties and cultivation zones by biophenol contents. *J. Agric. Food Chem.*, **54**(26), 9706-9712. doi: 10.1021/jf062546w
100. Jerman Klen, T., Golc Wondra, A., Vrhovsek, U., Mozetič Vodopivec, B. (2015) Phenolic profiling of olives and olive oil process-derived matrices using UPLC-DAD-ESI-QTOF-HRMS analysis. *J. Agric. Food Chem.* **63**(15), 3859-3872. doi: 10.1021/jf506345q
101. Jiang, L., Yamaguchi, T., Takamura, H., Matoba, T. (2005) Characteristics of Shodo Island olive oils in Japan: fatty acid composition and antioxidative compounds. *Food Sci. Technol. Res.* **11**(3), 254-260. doi: 10.3136/fstr.11.254
102. Kalua, C. M., Allen, M. S., Bedgood, D. R., Bishop, A. G., Prenzler, P. D., Robards, K. (2007) Olive oil volatile compounds, flavour development and quality: A critical review. *Food Chem.*, **100**(1), 273–286. doi: 10.1016/j.foodchem.2005.09.059
103. Kiritsakis, K., Kontominas, M. G., Kontogiorgis, C., Hadjipavlou-Litina, D., Moustakas, A., Kiritsakis, A. (2010) Composition and antioxidant activity of olive leaf extracts from Greek olive cultivars. *J. Am. Oil Chem. Soc.* **87**(4), 369-376.
104. Kiritsakis, K., Rodríguez-Pérez, C., Gerasopoulos, D., & Segura-Carretero, A. (2017). Olive oil enrichment in phenolic compounds during malaxation in the presence of olive leaves or olive mill wastewater extracts. *Eu. J. Lipid Sci. Technol.* **119**(9), 1600425. doi: 10.1002/ejlt.201600425
105. Klisović, D., Novoselić, A., Lukić, I., Brkić Bubola, K. (2022). Extra virgin olive oil under simulated consumption conditions: Evaluation of quality, health, and flavour properties. *J. Food Compos. Anal.*, **110**, 104570. doi: 10.1016/j.jfca.2022.104570
106. Koprivnjak, O., Brkić Bubola, K., Kosić, U. (2016) Sodium chloride compared to talc as processing aid has similar impact on volatile compounds but more favorable on ortho-

- diphenols in virgin olive oil. *Eu. J. Lipid Sci. Technol.* **118**(2), 318–324. doi: 10.1002/ejlt.201500014
107. Koprivnjak, O., Šetić, E., Lušić, D., Peršurić, Đ. (2002). Autochthonous olive cultivars in Istria (Croatia) – Morphological characteristics and oil quality. Proceedings of ECOLIVA – 1st International IFOAM Conference on Organic Olive Production, Jaén (Španjolska), 22–25 May, pp. 599– 605.
108. Koprivnjak, O., Škevin, D., Valić, S., Majetić, V., Petričević, S., Ljubenković, I. (2008). The antioxidant capacity and oxidative stability of virgin olive oil enriched with phospholipids. *Food Chem.*, **111**(1), 121-126. doi: 10.1016/j.foodchem.2008.03.045
109. Koprivnjak, Olivera Djevičansko maslinovo ulje : od masline do stola. Poreč: MIH, 2006 (monografija)
110. Korukluoglu, M., Sahan, Y., Yigit, A., Ozer, E. T., Gucer, S. (2010). Antibacterial activity and chemical constitutions of *Olea europaea* L. leaf extracts. *J. Food Process. Preserv.*, **34**(3), 383–396. doi: 10.1111/j.1745-4549.2008.00318.x
111. Kosma, I. S., Kontominas, M. G., Badeka, A. V. (2020) The application of chemometrics to volatile compound analysis for the recognition of specific markers for cultivar differentiation of Greek virgin olive oil samples. *Foods*, **9**(11), 1672. doi: 10.3390/foods9111672
112. Kovačić, I., Bilić, J., Dudaš, S., Poljuha, D. (2017). Phenolic content and antioxidant capacity of istrian olive leaf infusions. *Poljoprivreda*, **23**(2), 38–45. doi: 10.18047/poljo.23.2.6
113. Lafka, T.-I., Lazou, A., Sinanoglou, V., Lazos, E. (2013). Phenolic Extracts from Wild Olive Leaves and Their Potential as Edible Oils Antioxidants. *Foods*; **2**(1), 18–31. doi: 10.3390/foods2010018
114. Lalas, S., Athanasiadis, V., Gortzi, O., Bounitsi, M., Giovanoudis, I., Tsaknis, J., Bogiatzis, F. (2011). Enrichment of table olives with polyphenols extracted from olive leaves. *Food Chem.*, **127**(4), 1521-1525. doi: 10.1016/j.foodchem.2011.02.009
115. Lee, O. H., Lee, B. Y., Lee, J., Lee, H. B., Son, J. Y., Park, C. S., Shetty, K., Kim, Y. C. (2009). Assessment of phenolics-enriched extract and fractions of olive leaves and their antioxidant activities. *Bioresour. Technol.*, **100**(23), 6107-6113. doi: 10.1016/j.biortech.2009.06.059
116. Li, X., Zhu, H., Shoemaker, C. F., Wang, S. C. (2014). The effect of different cold storage conditions on the compositions of extra virgin olive oil. *Journal of the American Oil Chemists' Society*, **91**(9), 1559-1570. doi:
117. Liakopoulos, G., Karabourniotis, G. (2005). Boron deficiency and concentrations and composition of phenolic compounds in *Olea europaea* leaves: a combined growth chamber and field study. *Tree Physiol.*, **25**(3), 307-315. doi: 10.1093/treephys/25.3.307
118. Lobo-Prieto, A., Tena, N., Aparicio-Ruiz, R., Morales, M. T., García-González, D. L. (2020) Tracking sensory characteristics of virgin olive oils during storage: Interpretation of their changes from a multiparametric perspective. *Molecules*, **25**(7), 1686. doi: 10.3390/molecules25071686
119. Lockyer, S., Yaqoob, P., Spencer, J.P.E., Rowland, I. (2012). Olive leaf phenolics and cardiovascular risk reduction: Physiological effects and mechanisms of action. *Nutrition and Aging*, **1**(2), 125-140. doi: 10.3233/NUA-2012-0011

120. Lukić, I., Horvat, I., Godena, S., Krapac, M., Lukić, M., Vrhovsek, U., Brkić Bubola, K. (2018) Towards understanding the varietal typicality of virgin olive oil by correlating sensory and compositional analysis data: a case study. *Food Res. Int.* **112**, 78–89. doi: 10.1016/j.foodres.2018.06.022
121. Lukić, I., Žanetić, M., Jukić Špika, M., Lukić, M., Koprivnjak, O., Brkić Bubola, K. (2017). Complex interactive effects of ripening degree, malaxation duration and temperature on Oblica cv. virgin olive oil phenols, volatiles and sensory quality. *Food Chem.* **232**, 610–620. doi: 10.1016/j.foodchem.2017.04.047
122. Luna, G., Morales, M. T., Aparicio, R. (2006) Characterisation of 39 varietal virgin olive oils by their volatile compositions. *Food Chem.* **98**(2), 243-252. doi: 10.1016/j.foodchem.2005.05.069
123. Malheiro, R., Casal, S., Teixeira, H., Bento, A., Pereira, J.A. (2013) Effect of olive leaves addition during the extraction process of overmature fruits on olive oil quality. *Food Bioprocess Technol.*, **6**, 509–521. doi: 10.1007/s11947-011-0719-z
124. Malheiro, R., Rodrigues, N., Bissaro, C., Leimann, F., Casal, S., Ramalhosa, E., Pereira, J. A. (2017) Improvement of sensorial and volatile profiles of olive oil by addition of olive leaves. *Eur. J. Lipid Sci. Technol.* **119**(11), 1700177. doi: 10.1002/ejlt.201700177
125. Malik, N. S., Bradford, J. M. (2008). Recovery and stability of oleuropein and other phenolic compounds during extraction and processing of olive (*Olea europaea* L.) leaves. *J. Food Agric. Environ.*, **6**(2), 8-13.
126. Manai, H., Mahjoub-Haddada, F., Oueslati, I., Daoud, D., Zarrouk, M. (2008). Characterization of monovarietal virgin olive oils from six crossing varieties. *Sci. Hortic.*, **115**(3), 252–260. doi: 10.1016/j.scienta.2007.10.011
127. Mansouri, F., Ben Moumen, A., Belhaj, K., Richard, G., Fauconnier, M.-L., Sindic, M. Serghini Caid, H., Elamrani A. (2018). Effect of crop season on the quality and composition of extra virgin olive oils from Greek and Spanish varieties grown in the oriental region of Morocco. *Emir. J. Food Agric.*, **30**(7), 549–562. doi: 10.9755/ejfa.2018.v30.i7.1738
128. Marx, Í. M., Casal, S., Rodrigues, N., Cruz, R., Veloso, A. C., Pereira, J. A., Peres, A. M. (2021a) Impact of incorporating olive leaves during the industrial extraction of cv. arbequina oils on the physicochemical–sensory quality and health claim fulfillment. *Eur. Food Res. Technol.* 1-13. doi: 10.1007/s00217-021-03870-3
129. Marx, Í.M.G., Rodrigues, N., Veloso, A.C.A., Casal, S., Pereira, J.A., Peres, A.M. (2021b) Effect of malaxation temperature on the physicochemical and sensory quality of cv. Cobrançosa olive oil and its evaluation using an electronic tongue. *LWT - Food Sci. Technol.* **137**, 110426. doi: 10.1016/j.lwt.2020.110426
130. Meirinhos, J., Silva, B. M., Valentão, P., Seabra, R. M., Pereira, J. A., Dias, A., Andrade, P. B., Ferreres, F. (2005). Analysis and quantification of flavonoidic compounds from Portuguese olive (*Olea europaea* L.) leaf cultivars. *Nat. Prod. Res.*, **19**(2), 189-195. doi: 10.1080/14786410410001704886
131. Mert, C., Barut, E., Ipek, A. (2013). Quantitative seasonal changes in the leaf phenolic content related to the alternate-bearing patterns of olive (*Olea europaea* L. cv. Gemlik). *J. Agr. Sci. Tech.*, **15**, 995-1006

132. Milani, A., Lucci, P., Sedran, M., Moret, E., Moret, S., Conte, L. (2020). Improved method for determination of waxes in olive oils: Reduction of silica and use of a less hazardous solvent. *OCL—Oilseeds Fats Crops Lipids*, **27**, 20. doi: 10.1051/ocl/2020016
133. Mínguez-Mosquera, M.I., Rejano-Navarro, L., Gandul-Rojas, B., SanchezGomez, A. H., Garrido-Fernandez, J. (1991) Color-pigment correlation in virgin olive oil. *J. Am. Oil Chem. Soc.* **68**(5), 332–336. doi: 10.1007/BF02657688
134. Molina-Alcaide, E., Yáñez-Ruiz, D. R. (2008). Potential use of olive by-products in ruminant feeding: A review. *Anim. Feed Sci. Technol.*, **147**(1-3), 247-264. doi: 10.1016/j.anifeedsci.2007.09.021
135. Montaña, A., Hernández, M., Garrido, I., Llerena, J.L., Espinosa, F. (2016) Fatty acid and phenolic compound concentrations in eight different monovarietal virgin olive oils from extremadura and the relationship with oxidative stability. *Int. J. Mol. Sci.*, **17**(11), 1960. doi:10.3390/ijms17111960
136. Morales, M. T., Przybylski, R. (2013). Olive oil oxidation. In *Handbook of olive oil* (pp. 479-522). Springer, Boston, MA.
137. Nenadis, N., Moutafidou, A., Gerasopoulos, D., Tsimidou, M. (2010) Quality characteristics of olive leaf-olive oil preparations. *Eur. J. Lipid Sci. Technol.* **112**(12), 1337-1344. doi: 10.1002/ejlt.201000332
138. Olias, J. M., Perez, A. G., Rios, J. J., Sanz, L. C. (1993) Aroma of virgin olive oil: biogenesis of the " green" odor notes. *J. Agric. Food Chem.* **41**(12), 2368-2373. doi: 10.1021/jf00036a029
139. Ortega-García, F., Peragón, J. (2010). Phenol metabolism in the leaves of the olive tree (*Olea europaea* L.) cv. Picual, Verdial, Arbequina, and Frantoio during ripening. *J. Agric. Food Chem.*, **58**(23), 12440-12448. doi: 10.1021/jf102827m
140. Ouni, Y., Flamini, G., Guerfel, M., Ben Youssef, N., Daoud, D., Zarrouk, M. (2011) The compositional quality and volatile compounds of samples from the blend of monovarietal olive oils cultivated in Tunisia. *Inter. J. Food Sci. Technol.* **46**(4), 678–686. doi: 10.1111/j.1365-2621.2011.02549.x
141. Paiva-Martins, F., Correia, R., Félix, S., Ferreira, P., Gordon, M. H. (2007) Effects of enrichment of refined olive oil with phenolic compounds from olive leaves. *J. Agric. Food Chem.* **55**(10), 4139-4143. doi: 10.1021/jf063093y
142. Paiva-Martins, F., Gordon, M. H. (2001). Isolation and characterization of the antioxidant component 3, 4-dihydroxyphenylethyl 4-formyl-3-formylmethyl-4-hexenoate from olive (*Olea europaea*) leaves. *J. Agric. Food Chem.*, **49**(9), 4214-4219. doi: 10.1021/jf010373z
143. Patui, S., Braidot, E., Peresson, C., Tubaro, F., Mizzau, M., Rabiei, Z., Conte, L., Macrì, F., Vianello, A. (2010). Lipoxygenase and hydroperoxide lyase activities in two olive varieties from Northern Italy. *Eur. J. Lipid Sci. Technol.*, **112**(7), 780-790. doi: 10.1002/ejlt.200900167
144. Pereira, A.P., Ferreira, I.C., Marcelino, F., Valentão, P., Andrade, P.B., Seabra, R., Estevinho, L., Bento, A., Pereira, J.A. (2007) Phenolic compounds and antimicrobial activity of olive (*Olea europaea* L. Cv. Cobrançosa) leaves. *Molecules*, **12**(5), 1153-1162. doi: 10.3390/12051153

145. Perona, J. S., Botham Contents, K. M. (2013). Olive Oil as a Functional Food: Nutritional and Health Benefits. U: Handbook of Olive Oil: Analysis and Properties (Aparicio, R., Harwood, J.). Springer, SAD, 678–703.
146. Peršurić, Ž., Saftić, L., Klisović, D., Pavelić, S. K. (2019). Polyphenol-based design of functional olive leaf infusions. *Food Technol. Biotechnol.* **57**(2), 171–182. doi: 10.17113/ftb.57.02.19.5921
147. Poljuha, D., Sladonja, B., Brkić Bubola, K., Radulović, M., Brščić, K., Šetić, E., Krapac, M., Milotić, A. (2008) A multidisciplinary approach to the characterisation of autochthonous Istrian olive (*Olea europaea* L.) varieties. *Food Technol. Biotechnol.* **46**(4), 347-354.
148. Raffo, A., Bucci, R., D'Aloise, A., Pastore, G. (2015) Combined effects of reduced malaxation oxygen levels and storage time on extra-virgin olive oil volatiles investigated by a novel chemometric approach. *Food Chem.* **182**, 257-267. doi: 10.1016/j.foodchem.2015.02.128
149. Ranalli, A., Contento, S., Lucera, L., Di Febo, M., Marchegiani, D., Di Fonzo, V. (2006). Factors affecting the contents of iridoid oleuropein in olive leaves (*Olea europaea* L.). *J. Agric. Food Chem.*, **54**(2), 434-440. doi: 10.1021/jf051647b
150. Rapoport, Hava F., Andrea Fabbri, and Luca Sebastiani. (2016) "Olive biology." The olive tree genome: 13-25.
151. Regulation (EC) No 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods, *OJ L 404, 30.12.2006, p. 9–25*;  
Pristupljeno: <https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32006R1924>
152. Rigacci, S., Guidotti, V., Bucciantina, M., Parri, M., Nediani, C., Cerbai, E., Stefani, M., Berti, A. (2010) Oleuropein aglycon prevents cytotoxic amyloid aggregation of human amylin. *J. Nutr. Biochem.*, **21**(8), 725–726. doi: 10.1016/j.jnutbio.2009.04.010
153. Riley, F. R. (2002). Olive oil production on bronze age Crete: nutritional properties, processing methods and storage life of Minoan olive oil. *Oxf. J. Archaeol.*, **21**(1), 63-75. doi: 10.1111/1468-0092.00149
154. Rodríguez-Pérez, C., Quirantes-Piné, R., Amessis-Ouchemoukh, N., Madani, K., Segura-Carretero, A., Fernández-Gutierrez, A. (2013). A metabolite-profiling approach allows the identification of new compounds from *Pistacia lentiscus* leaves. *J. Pharm. Biomed. Anal.*, **77**, 167-174. doi: 10.1016/j.jpba.2013.01.026
155. Rotondi, A., Bendini, A., Cerretani, L., Mari, M., Lercker, G., Toschi, T. G. (2004). Effect of olive ripening degree on the oxidative stability and organoleptic properties of cv. Nostrana di Brisighella extra virgin olive oil. *J. Agric. Food Chem.*, **52**(11), 3649-3654. doi: 10.1021/jf049845a
156. Ryan, D., Antolovich, M., Prenzler, P., Robards, K., Lavee, S. (2002) Biotransformations of phenolic compounds in *Olea europaea* L. *Sci. Hortic.*, **92**(2), 147–176. doi:10.1016/S0304-4238(01)00287-4
157. Salas, J. J., Sánchez, C., García-González, D. L., Aparicio, R. (2005) Impact of the suppression of lipoxygenase and hydroperoxide lyase on the quality of the green odor in green leaves. *J. Agric. Food Chem.* **53**(5), 1648-1655. doi: 10.1021/jf0403311

158. Salvador, M. D., Aranda, F., Gomez-Alonso, S., Fregapane, G. (2000) Quality characteristics of Cornicabra virgin olive oil. *Res. Adv. Oil Chem.* **1**, 31-39.
159. Samaniego-Sánchez, C., Quesada-Granados, J. J., de la Serrana, H. L. G., López-Martínez, M. C. (2010).  $\beta$ -Carotene, squalene and waxes determined by chromatographic method in picual extra virgin olive oil obtained by a new cold extraction system. *J. Food Compos. Anal.*, **23**(7), 671-676. doi: 10.1016/j.jfca.2010.03.010
160. Sánchez, J., Salas, J. J. (2000). Biogenesis of olive oil aroma. In Handbook of olive oil (pp. 79-99). Springer, Boston, MA. doi: 10.1007/978-1-4757-5371-4\_4
161. Sánchez-Ortiz, A., Bejaoui, M. A., Quintero-Flores, A., Jiménez, A., Beltrán, G. (2018). Biosynthesis of volatile compounds by hydroperoxide lyase enzymatic activity during virgin olive oil extraction process. *Food Res. Int.*, **111**, 220-228. doi: 10.1016/j.foodres.2018.05.024
162. Sanmartin C, Venturi F, Sgherri C, Nari A, Macaluso M, Flamini G, Quartacci M, Taglieri I, Andrich G, Zinnai A (2018). The effects of packaging and storage temperature on the shelf-life of extra virgin olive oil. *Heliyon* **4**(1), e00888. doi:10.1016/j.heliyon.2018.e00888
163. Sanmartin, C., Taglieri, I., Macaluso, M., Sgherri, C., Ascrizzi, R., Flamini, G., Venturi, F., Quartacci, M.F., Luro, F., Curk, F., Pistelli, L. (2019) Cold-pressing olive oil in the presence of cryomacerated leaves of olea or citrus: nutraceutical and sensorial features. *Molecules*, **24**(14), 2625. doi: 10.3390/molecules24142625
164. Sari, H.A., Ekinci, R. (2017). The effect of ultrasound application and addition of leaves in the malaxation of olive oil extraction on the olive oil yield, oxidative stability and organoleptic quality. *Food Sci. Technol.*, **37**(3), 493–499. doi: 10.1590/1678-457X.22916
165. Savournin, C., Baghdikian, B., Elias, R., Dargouth-Kesraoui, F., Boukef, K., Balansard, G. (2001). Rapid high-performance liquid chromatography analysis for the quantitative determination of oleuropein in *Olea europaea* leaves. *J. Agric. Food Chem.*, **49**(2), 618-621. doi: 10.1021/jf000596+
166. Schaffer, S., Podstawa, M., Visioli, F., Bogani, P., Muller, W.E., Eckert, G.P. (2007) Hydroxytyrosol-rich olive millwastewater extract protects brain cells in vitro and ex vivo. *J. Agric. Food Chem.*, **55**, 5043–5049. doi: 10.1021/jf0703710
167. Servili, M., Montedoro, G. (2002). Contribution of phenolic compounds to virgin olive oil quality. *Eur. J. Lipid Sci. Technol.*, **104**(9–10), 602–613. doi: 10.1002/1438-9312(200210)104:9/10<602::AID-EJLT602>3.0.CO;2-X
168. Servili, M., Selvaggini, R., Esposto, S., Taticchi, A., Montedoro, G., Morozzi, G. (2004). Health and sensory properties of virgin olive oil hydrophilic phenols: agronomic and technological aspects of production that affect their occurrence in the oil. *J. Chromatogr. A*, **1054**(1-2), 113-127. doi: 10.1016/j.chroma.2004.08.070
169. Servili, M., Taticchi, A., Esposto, S., Urbani, S., Selvaggini, R., Montedoro, G. (2007). Effect of olive stoning on the volatile and phenolic composition of virgin olive oil. *J. Agric. Food Chem.*, **55**(17), 7028-7035. doi: 10.1021/jf070600i
170. Sevim, D., Tuncay, O. (2013). Effect of olive leaves addition before extraction of turkish olive cultivars on olive oil minor components and antioxidant activity. *Open Access Sci. Rep.* **2**, 1–8. doi:10.4172/scientificreports

171. Sevim, D., Tuncay, O., Koseoglu, O. (2013) The effect of olive leaf addition on antioxidant content and antioxidant activity of “Memecik” olive oils at two maturity stages. *J. Am. Oil Chem. Soc.* **90**(9), 1359-1369. doi: 10.1007/s11746-013-2282-4
172. Silva, S., Gomes, L., Leitao, F., Coelho, A.V., Vilas Boas, L. (2006). Phenolic compounds and antioxidant activity of *Olea europaea* L.) fruits and leaves. *Food Sci. Technol. Int.*, **12**(5), 385–396. doi: 10.1177/1082013206070166
173. Škevin, D., Rade, D., Štrucelj, D., Mokrovčak, Ž., Nederal, S., Benčić, Đ. (2003). The influence of variety and harvest time on the bitterness and phenolic compounds of olive oil. *Eur. J. Lipid Sci. Technol.*, **105**(9), 536– 541. doi: 10.1002/ejlt.200300782
174. Sladonja, B., Poljuha, D. (2015). Characterisation of Autochthonous Olive Varieties in Istria.
175. Službena stranica Međunarodnog vijeća za masline, Pristupljeno: <https://www.internationaloliveoil.org/wp-content/uploads/2021/12/HO-CE901-17-12-2021-P.pdf>
176. Suárez, M., Romero, M. P., Ramo, T., Motilva, M. J. (2011) Stability of a phenol-enriched olive oil during storage. *Eur. J. Lipid Sci. Technol.* **113**(7), 894-903. doi: 10.1002/ejlt.201000432
177. Suárez, M., Romero, M., Motilva, M. (2010). Development of a phenol-enriched olive oil with phenolic compounds from olive cake. *J. Agric. Food Chem.*, **58**(19), 10396-10403. doi: 10.1021/jf102203x
178. Sudjana, A. N., D’Orazio, C., Ryan, V., Rasool, N., Ng, J., Islam, N., Rileya, T.V., Hammer, K. A. (2009). Antimicrobial activity of commercial *Olea europaea* (olive) leaf extract. *Int. J. Antimicrob. Agents*, **33**(5), 461-463. doi: 10.1016/j.ijantimicag.2008.10.026
179. Taghvaei, M., Jafari, S.M. (2015). Application and stability of natural antioxidants in edible oils in order to substitute synthetic additives. *J. Food Sci. Technol.*, **52**, 1272–1282. doi: 10.1007/s13197-013-1080-1
180. Talhaoui, N. (2016). Analytical, Agronomic, and Biological Evaluation of Phenolic Compounds in *Olea europaea* Products and By-Products. Doktorska disertacija, University of Granada, Granada, Španjolska, URI: <http://hdl.handle.net/10481/43641>
181. Talhaoui, N., Gómez-Caravaca, A. M., León, L., De la Rosa, R., Segura-Carretero, A., Fernández-Gutiérrez, A. (2014). Determination of phenolic compounds of ‘Sikitita’olive leaves by HPLC-DAD-TOF-MS. Comparison with its parents ‘Arbequina’and ‘Picual’olive leaves. *LWT-Food Sci. Technol.*, **58**(1), 28-34. doi: 10.1016/j.lwt.2014.03.014
182. Tarchoune, I., Sgherri, C., Eddouzi, J., Zinnai, A., Quartacci, M. F., Zarrouk, M. (2019) Olive leaf addition increases olive oil nutraceutical properties. *Molecules*, **24**(3), 545. doi: 10.3390/molecules24030545
183. Tayoub, G., Sulaiman, H., Hassan, A. H., Alorfi, M. (2012). Determination of oleuropein in leaves and fruits of some Syrian olive varieties. *Int. J. Med. Aromat. Plants*, **2**(3), 428-433.
184. Tovar, M. J., Motilva, M. J., & Romero, M. P. (2001). Changes in the phenolic composition of virgin olive oil from young trees (*Olea europaea* L. cv. Arbequina) grown



- under linear irrigation strategies. *J. Agric. Food Chem.*, **49**(11), 5502-5508. doi: 10.1021/jf0102416
185. TRADE STANDARD APPLYING TO OLIVE OILS AND OLIVE POMACE OILS - COI/T.15/NC No 3/Rev. 14 November 2019, Pristupljeno: <https://www.internationaloliveoil.org/wp-content/uploads/2019/12/trade-standard-REV-14-Eng.pdf>
186. Tura, D., Failla, O., Bassi, D., Attilio, C., Serraiocco, A. (2013). Regional and cultivar comparison of Italian single cultivar olive oils according to flavor profiling. *Eur. J. Lipid Sci. Technol.*, **115**(2), 196-210. doi:
187. Turner, R., Etienne, N., Garcia-Alonso, M., de Pascual-Teresa, S., Minihane, A.M., Weinberg, P.D., Rimbach, G. (2010). Antioxidant and anti-atherogenic activities of olive oil phenolics. *Int. J. Vitaminol. Nutr. Res.*, **75**, 61–70. doi: 10.1024/0300-9831.75.1.61
188. Velasco, J., Dobarganes, C. (2002). Oxidative stability of virgin olive oil. *Eur. J. Lipid Sci. Technol.* **104**(9–10), 661–676. doi: 10.1002/1438-9312(200210)104:9/10<661::AID-EJLT661>3.0.CO;2-D
189. Venturi, F., Sanmartin, C., Taglieri, I., Nari, A., Andrich, G., Terzuoli, E., Donnini, S., Nicolella, C., Zinnai, A. (2017). Development of Phenol-Enriched Olive Oil with Phenolic Compounds Extracted from Wastewater Produced by Physical Refining. *Nutrients*, **9**(8), 916. doi: 10.3390/nu9080916
190. Vidal, A.M., Alcalá S., Ocaña, M.T., De Torres, A., Espínola, F., Moya, M. (2020). Elaboration of extra-virgin olive oils rich in oleocanthal and oleacein: pilot plant's proposal. *Eur. Food Res. Technol.*, **246**, 1459–1468. doi: 10.1007/s00217-020-03503-1
191. Vogel, P., Machado, I. K., Garavaglia, J., Zani, V. T., de Souza, D., Dal Bosco, S. M. (2015). Polyphenols benefits of olive leaf (*Olea europaea* L) to human health. *Nutr. Hosp.*, **31**(3), 1427-1433. doi: 10.3305/nh.2015.31.3.8400
192. Yousfi, K., Weiland, C. M., García, J. M., de La Rábida, C. D. P., Tejero, A. P. G. (2013). Responses of fruit physiology and virgin oil quality to cold storage of mechanically harvested 'Arbequina' olives cultivated in hedgerow. *Grasas y Aceites*, **64**, 5.
193. Yuan, J.-J., Wang, C.-Z., Ye, J.-Z., Tao, R., Zhang, Y.-S. (2015). Enzymatic hydrolysis of oleuropein from *Olea europaea* (olive) leaf extract and antioxidant activities. *Molecules*, **20**(2), 2903–2921. doi: 10.3390/molecules20022903
194. Zámocký, M., Obinger, C. (2010). Molecular phylogeny of heme peroxidases. In *Biocatalysis Based on Heme Peroxidases*, 1st ed.; Torres, E., Ayala, M., Eds.; Springer: Berlin/Heidelberg, Germany,; pp. 7–35. doi: 10.1007/978-3-642-12627-7\_2
195. Žanetić, M., Gugić, M. (2005). Čuvanje djevičanskog maslinovog ulja. *Pomol. Croat.*, **11**(1-2), 31-41. Preuzeto s <https://hrcak.srce.hr/1928>
196. Živković, J., Nikolić, G., Vidović, S., Kosić, U., Mujić, I., Ruznić, A., Jokić, S., Trutić, N. (2011). Phenolic compounds in olive leaf extract as a source of useful antioxidants. *Croat. J. Food Technol. Biotech. Nutr.*, **6**(3-4), 129–133. URI:<https://hrcak.srce.hr/76263>

## ŽIVOTOPIS

Anja Novoselić rođena je 23. veljače 1992. u Rijeci. Osnovnu školu i Opću gimnaziju završila je u Puli. Na Agronomskom fakultetu u Zagrebu 2013. stekla je zvanje prvostupnika hortikulture. Godine 2015. sudjelovala je u programu Erasmus u Ljubljani gdje je obavljala stručnu praksu na Biotehničkom fakultetu na Zavodu za prehranu u laboratoriju za hranu i vino. Na Agronomskom fakultetu u Zagrebu 2016. stekla je titulu magistra inženjera hortikulture, usmjerenje Vinogradarstvo i vinarstvo. Zaposlena je na Institutu za poljoprivredu i turizam u Poreču od 2016. kao analitičar u Prehrambeno – biotehnološkom laboratoriju na kemijskim i senzornim analizama maslinovog ulja. Od 2018. radila je kao stručni suradnik na projektu Interreg Mediteran MITOMED + (Modeli integriranih oblika turizma na Mediteranu plus) na provedbi projektnih aktivnosti i u organizaciji međunarodnih konferencija. Godine 2018. počinje raditi kao asistent na projektu Hrvatske zaklade za znanost „Projekt razvoja karijera mladih istraživača – Izobrazba novih doktora znanosti“, te kao doktorand na radnom mjestu asistenta na projektu „Advanced solutions for assuring the overall authenticity and quality of olive oil – OLEUM“. Istovremeno na Prehrambeno – biotehnološkom fakultetu upisala je sveučilišni poslijediplomski studij Biotehnologija i bioproceno inženjerstvo, prehrambena tehnologija i nutricionizam, smjer Prehrambena tehnologija. Istraživanje za izradu doktorskog rada provela je u sklopu „Projekt razvoja karijera mladih istraživača – Izobrazba novih doktora znanosti“.

## POPIS OBJAVLJENIH RADOVA

### Radovi u časopisima

1. Brkić Bubola, K., Klisović, D., Lukić, I., **Novoselić, A.** (2020) Vegetable species significantly affects the phenolic composition and oxidative stability of extra virgin olive oil used for roasting. *LWT - Food Science and Technology*, **129**, 109628.
2. Brkić Bubola, K., Lukić, M., **Novoselić, A.**, Krapac, M., Lukić, I. (2020) Olive fruit refrigeration during prolonged storage preserves the quality of virgin olive oil extracted therefrom. *Foods*, **9**, 17.
3. Klisović, D., **Novoselić, A.**, Režek Jambrak, A., Brkić Bubola, K. (2021) The utilisation solutions of olive mill by-products in the terms of sustainable olive oil production: a review. *International Journal of Food Science and Technology*, **56** (10), 4851-4860.
4. Brkić Bubola, K., Šetić, E., Krapac, M., **Novoselić, A.** (2021) Preliminary characterization of morphological and sensorial profile of the fresh fig (*Ficus carica* L.) fruits obtained from four Croatian cultivars. *Acta Horticulturae*, **1310**, 101-107.
5. **Novoselić, A.**, Klisović, D., Lukić, I., Lukić, M., Brkić Bubola, K. (2021). The use of olive leaves in Buža olive cultivar oil production: exploring the impact on oil yield and chemical composition. *Agriculture*, **11**, 917.
6. Klisović, D., **Novoselić, A.**, Lukić, I., Brkić Bubola K. (2022). Extra virgin olive oil under simulated consumption conditions: evaluation of quality, health, and flavour properties. *Journal of Food Composition and Analysis*, **110**, 104570, DOI:10.1016/j.jfca.2022.104570

### Radovi u zbornicima radova sa skupova

1. **Novoselić, A.**, Klisović, D., Lukić, I., Horvat, I., Brkić Bubola, K. (2020) The strategies for antioxidant enrichment of Buža cv. virgin olive oil. *Proceedings of 55th Croatian & 15th International Symposium on Agriculture*, Vodice, Croatia, 533-537.
2. Klisović, D., **Novoselić, A.**, Lukić, I., Brkić Bubola, K. (2020) Evolution of phenolic compounds and oxidation parameters after storage of Istarska bjelica and Buža cv. virgin olive oil. *Proceedings of 55th Croatian & 15th International Symposium on Agriculture*, Vodice, Croatia, 527-532.