ИЗБОРНОМ ВЕЋУ
ПОЉОПРИВРЕДНОГ ФАКУЛТЕТА
УНИВЕРЗИТЕТА У БЕОГРАДУ

У складу са Законом о науци и истраживањима (“Службени гласник РС” бр. 49/2019) и Правилником о стицању истраживачких и научних звања (“Службени гласник РС” бр. 159/2020 и 14/2023) и на основу одлуке Изборног већа Пољопривредног факултета Универзитета у Београду бр. 300/10-5, 26.9.2024.године, именовани смо у Комисију за спровођење поступка стицања звања, подношење извештаја и оцене научноистраживачког рада кандидата Спасоја Белошевића, мастер инжењера технологије, за избор у звање истраживач сарадник у области биотехничких наука, грана – *прехрамбено инжењерство*, научна дисциплина – *прехрамбена технологија,* ужа научна дисциплина – *биохемијско инжењерство*.
На основу увида у достављену документацију, Комисија у саставу: др Виктор Недовић, редовни професор, Пољопривредног факултета Универзитета у Београду, др Стева Левић, ванредни професор Пољопривредног факултета Универзитета у Београду и др Верица Ђорђевић, доцент Технолошко-металуршког факултета у Београду, подноси следећи:

ИЗВЕШТАЈ

Биографски подаци

Белошевић (Дејан) Спасоје, рођен 17.02.1995. године у Истоку на Косову и Метохији, јужној Српској покрајини. Основно образовање као и Средњу медицинску школу завршио је у Београду. Основне академске студије на Пољопривредном факултету Универзитета у Београду, студијски програм: Прехрамбена технологија - Управљање безбедношћу и квалитетом у производњи хране завршио је 2018. године са просечном оценом 9,66 чиме је заслужио награду факултета за једног од најбољих студената четврте године. Дипломским рад под називом „Примена индекса квалитета за оцену паприке сушене у атмосфери суперкритичног угљендиоксида“ одбранио је 27.09.2018. године са оценом 10. Исте године уписује и мастер академске студије смер Прехрамбена технологија. Мастер рад под називом "Утицај UV зрачења на одабрана својства квалитета кикирикија током вишемесечног периода складиштења" одбранио је 27.09.2019. године и то оценом 10, чиме је остварио укупни просек оцена на мастер академским студијама од 10 и стекао право на звање мастер инжењера технологије.

Добитник је стипендије за талентоване студенте коју додељује „Министарство просвете, науке и технолошког развоја“ за постигнут успех на свим годинама на основним академским студијама. Такође, добитник је стипендије "Задужбине Николе Спасића" за најбољег студента треће године на Пољопривредном факултету Универзитета у Београду, као и награду коју додељује Пољопривредни факултет Универзитета у Београду за једног од 10 најбољих студената Пољопривредног факултета. Добитник је стипендије „Доситеја“ коју додељује Министарство омладине и спорта Републике Србије за постигнут успех на основним и мастер академским студијама. Добитник је стипендије Министарства науке, технолошког развоја и иновација Републике Србије за студенте на докторским академским студијама.

Учествовао је у извођењу наставе и практичних вежби као студент демонстратор у више предмета на Пољопривредном факултету Универзитета у Београду, укључујући:

Сензорна анализа, Управљање квалитетом у производњи хране и Управљање безбедношћу у производњи хране. Школске 2019/2020. године уписао је докторске академске студије, студијски програм Прехрамбена технологија на Пољопривредном факултету Универзитета у Београду. Након избора у звање истраживач приправник започиње рад на Пољопривредном факултету Универзитета у Београду. Јавно је излагао резултате свог научно истраживачког рада на међународним симпонзијумима. Такође, био је учесник у више одржаних међународних конференција у земљи и иностранству. Био је ментор студентима на такмичењу за екоиновативни производ под именом „Екотрофелија“. Редован је студент треће године, положио је све испите предвиђене планом и програмом докторских академских студија. Пријавио је тему докторске дисертације под насловом: „*Добијање и инкапсулација сока од микробиља одабраних биљних врста*“, на Катедри за хемију и Биохемију, која је одлуком Наставно-научног већа прихваћена (Прилог 1). Учествовао је као рецензент у водећим међународним часописима, као што су: Food Bioscience и Food Chemistry (Прилог 2). Тренутно је ангажован на истраживањима у оквиру уговора о реализацији и финансирању научно-истраживачког рада у 2024. години између Пољопривредног факултета у Београду и Министарства науке, технолошког развоја и иновација Републике Србије, евиденциони број уговора: 451-03-65/2024-03/200116.
Знање страних језика: енглески језик (напредни ниво).

Научноистраживачки рад

Кандидат Спасоје Белошевић је до сада показао велико интересовање и склоност ка научноистраживачком раду, са специјалним нагласком на биоактивне компоненте хране, микробиље, инкапсулацију биоактивних компоненти хране, развоју функционалне хране, у коме активно учествујем са колегама и професорима. Ангажован је у Централној лабораторији Катедре за конзервисање и врење, Пољопривредног факултета Универзитета у Београду, где ради на изради своје докторске дисертације.
Аутор је једне научне публикације у категорији **M_{21}**, 13 саопштења на међународним конференцијама (**M_{34}**). Објављени рад (библиографија) и саопштења са међународних конференција су наведени у Прилогу 3 овог Извештаја.

Закључак и предлог

На основу поднете документације и анализе научноистраживачког и стручног рада истраживача приправника Спасоја Белошевића, мастер инжењера технологије, Комисија закључује да је кандидат постигао запажен успех у научном раду. Резултати, усвајање метода научноистраживачког рада, као и залагање и ентузијазам у погледу научног напредовања квалификују га за избор у више истраживачко звање. Оваквим приступом он се развија у перспективног научног радника из области прехрамбена технологија.
Комисија је јединствена у оцени и закључку да истраживач приправник **Спасоје Белошевић**, мастер инжењер технологије, испуњава све потребне услове дефинисане Законом о науци и истраживањима (“Службени гласник РС” бр. 49/2019) и Правилником о стицању истраживачких и научних звања (“Службени гласник РС” бр. 159/2020 и 14/2023) и у складу са тим предлаже Изборном већу и Декану Пољопривредног факултета Универзитета у Београду да Спасоја Белошевића, мастер

инжењера технологије, изабере у звање **истраживач сарадник** у области биотехничких наука, грана – *прехрамбено инжењерство*, научна дисциплина – *прехрамбена технологија*, ужа научна дисциплина – *биохемијско инжењерство*.

У Београду, 30. 09. 2024. год.

ЧЛАНОВИ КОМИСИЈЕ

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ПРИЛОГ
Библиографија

1. Радови објављени у часописима од међународног значаја, (M_{21} -8)

Belošević, S.D., Milinčić, D.D., Gašić, U.M., Kostić, A.Ž., Salević-Jelić, A.S., Marković, J.M., Đorđević, V.B., Lević, S.M., Pešić, M.B., Nedović, V.A. **Broccoli, Amaranth, and Red Beet Microgreen Juices: The Influence of Cold-Pressing on the Phytochemical Composition and the Antioxidant and Sensory Properties.** Foods 2024, 13 (5), 757. https://doi.org/10.3390/foods13050757.

2. Радови саопштени на скуповима од међународног значаја штампани у целини или у изводу у књигама радова (M_{34} -0,5)

Belošević, S.D., Milinčić, D.D., Salević-Jelić, A.S., Lević, S.M., Pešić, M.B., Đorđević, V.B., Nedović, V.A. (2023). **Total phenolic and flavonoids content and antioxidant activity of cold pressed amaranth microgreens juice**. Book of Abstracts of 6th International Symposium of Agricultural Engineering (pp.57). 19th-21st October, Belgrade, Serbia. ISBN 978-86-7834-423-7.

Belošević, S.D., Milinčić, D.D., Salević-Jelić, A.S., Marković, J.M. Lević, S.M., Pešić, M.B., Đorđević, V.B., Marjanović S.M., Nedović, V.A. (2023). **Broccoli microgreens-apple juice as novel beverages: total phenolic, flavonoids and antioxidant activity**. Book of Abstracts of International Conference on Biochemical Engineering and Biotechnology for Young Scientists. (pp.68).7th-8st December, Belgrade, Serbia. ISBN 978-86-7401-389-2.

Belošević, S.D., Milinčić, D.D., Salević-Jelić, A.S., Marković, J.M. Lević, S.M., Pešić, M.B., Đorđević, V.B., Marjanović S.M., Nedović, V.A. (2023). **Characterization of amaranth (Amaranthus tricolor L.) microgreens juice encapsulated within inulin and maltodextrin**. Book of Abstracts of International Conference on Biochemical Engineering and Biotechnology for Young Scientists. (pp.69).7th-8st December, Belgrade, Serbia. ISBN 978-86-7401-389-2.

Marković, J., Mihajlović, D., Salević-Jelić, A., Lević, S., Đorđević, V., **Belošević, S.**, Nedović, V. (2023). **Physicochemical characterization of spray-dried horseradish root juice encapsulated within maltodextrin/alginate**. Book of Abstracts of International Conference on Biochemical Engineering and Biotechnology for Young Scientists (pp. 53), 7th-8th December, Belgrade, Serbia. ISBN 978-86-7401-389-2.

Marković, J., Nedović, V., Salević-Jelić, A., Lević, S., Đorđević, V., **Belošević, S.**, Mihajlović, D. (2023). **Antioxidant potential and phenolics content of horseradish root juice encapsulated within different carbohydrate matrices**. Book of Abstracts of International Conference on Biochemical Engineering and Biotechnology for Young Scientists (pp. 52), 7th-8th December, Belgrade, Serbia. ISBN 978-86-7401-389-2.

Marjanović, S., Stanković, M., **Belošević, S.**, Golubović, V., Vukojević, D., Dobričić, A., Banjac, V., & Marković, Z. (2023). **The effect of using alternative sources of protein from animal species on the production parameters of Rainbow trout**

(Oncorhynchus mykiss). Book of Abstracts of International Conference on Biochemical Engineering and Biotechnology for Young Scientists. (pp.66).7th-8st December, Belgrade, Serbia. ISBN 978-86-7401-389-2.

Marjanović S., Stanković, M., **Belošević, S.**, Golubović, V., Dobričić, A., Ilić, P., & Marković, Z. (2023). **Sensory evaluation of baked Rainbow trout (Oncorhynchus mykiss) fed different non-conventional protein sources**. Book of Abstracts of International Conference on Biochemical Engineering and Biotechnology for YoungScientists. (pp.67).7th-8st December, Belgrade, Serbia. ISBN 978-86-7401-389-2.

Belošević, S. D., Milinčić, D. D., Salević-Jelić, A. S., Marković, J. M., Lević, S. M., Pešić, M. B., Marjanović, S. M., Đorđević, V. B., Nedović, V. A. (2024). **Encapsulation of broccoli microgreen juice: Phytochemical composition and antioxidant activity.** Book of Abstracts of 3rd International UNIFood Conference, University of Belgrade (pp. 38). 28th-29th June, Belgrade, Serbia. ISBN 978-86-7834-438-1.

Belošević, S. D., Milinčić, D. D., Salević-Jelić, A. S., Marković, J. M., Pavlović, V. B., Lević, S. M., Pešić, M. B., Marjanović, S. M., Đorđević, V. B., Nedović, V. A. (2024). **The influence of carbohydrate carriers on the morphology and physical properties of red beet microgreen juice encapsulates.** Book of Abstracts of 3rd International UNIFood Conference, University of Belgrade (pp. 157). 28th-29th June, Belgrade, Serbia. ISBN 978-86-7834-438-1.

Marjanović, M.S., **Belošević, D. S.**, Stanković, B.M., Rašković, S.B., Golubović, B.V., Dobričić, M.A., Vranković, S. J., Marković, Z.Z. (2024). **Effect of various alternative diets on growth parameters and biometric indeces of common carp (Cyprinus carpio).** Book of Abstracts of 3rd International UNIFood Conference, University of Belgrade (pp.117). 28th -29th June, Belgrade, Serbia. ISBN: 978-86-7834-438-1.

Marjanović, M. S., **Belošević,D. S.**, Stanković, B.M., Rakita, M. S., Banjac, V. V., Vranković, S. J., Marković, Z. Z. (2024). **Fatty acid composition of rainbow trout (Oncorhynchus mykiss) fed mealworm, earthworm, and zooplankton diets.** Book of Abstracts of 3rd International UNIFood Conference, University of Belgrade (pp.118). 28th -29th June, Belgrade, Serbia. ISBN: 978-86-7834-438-1.

Marković, J. M., Salević-Jelić, A. S., **Belošević, S. D.**, Pejić, L., D., Rabrenović, B. B., Lević, S. M., Nedović, V. A., Mihajlović, D. M. (2024). **Encapsulated horseradish leaf juice: A potential alternative to synthetic antioxidants in mayonnaise production.** Book of Abstracts of 3rd International UNIFood Conference, University of Belgrade (pp. 119). 28th-29th June, Belgrade, Serbia. ISBN 978-86-7834-438-1.

Marković, J. M., Salević-Jelić, A. S., Milinčić, D. D., **Belošević, S. D.**, Gašić, U. M., Đorđević, V. B., Pešić, M. B., Lević, S. M., Mihajlović, D. M., Nedović, V. A. (2024). **Horseradish leaf juice encapsulates: Physicochemical, spectrophotometric, and chromatographic characterization.** Book of Abstracts of 3rd International UNIFood Conference, University of Belgrade (pp. 160). 28th-29th June, Belgrade, Serbia. ISBN 978-86-7834-438-1.

Прилог 1.

УНИВЕРЗИТЕТ У БЕОГРАДУ

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ВЕЋЕ НАУЧНИХ ОБЛАСТИ
БИОТЕХНИЧКИХ НАУКА

Београд, 10. октобар 2023. године
02-08 Број: 61206-3518/2-23
МЦ

На основу члана 48 став 5 тачка 3 Статута Универзитета у Београду („Гласник Универзитета у Београду", бр. 201/18, 207/19, 213/20, 214/20, 217/20, 230/21, 232/22, 233/22, 236/22, 241/22, 243/22, 244/23 245/23 и 247/23) и члана 32 Правилника о докторским студијама на Универзитету у Београду („Гласник Универзитета у Београду", бр. 191/2016, 212/2019, 215/2020, 217/2020, 228/21, 230/21 и 241/22), а на захтев Пољопривредног факултета, бр. 32/20-4.2. од 27. септембра 2023. године, Веће научних области биотехничких наука, на седници одржаној 10. октобра 2023. године, донело је

О Д Л У К У

ДАЈЕ СЕ САГЛАСНОСТ на одлуку Наставно-научног већа Пољопривредног факултета о прихватању теме докторске дисертације СПАСОЈА БЕЛОШЕВИЋА, под називом: „Добијање и инкапсулација сока од микробиља одабраних биљних врста" и одређивању проф. др Виктора Недовића за ментора.

ПРЕДСЕДНИЦА ВЕЋА
проф. др Мирјана Оцокољић

Доставити:
- Факултету
- архиви Универзитета

Прилог 2.

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foods

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Article

Broccoli, Amaranth, and Red Beet Microgreen Juices: The Influence of Cold-Pressing on the Phytochemical Composition and the Antioxidant and Sensory Properties

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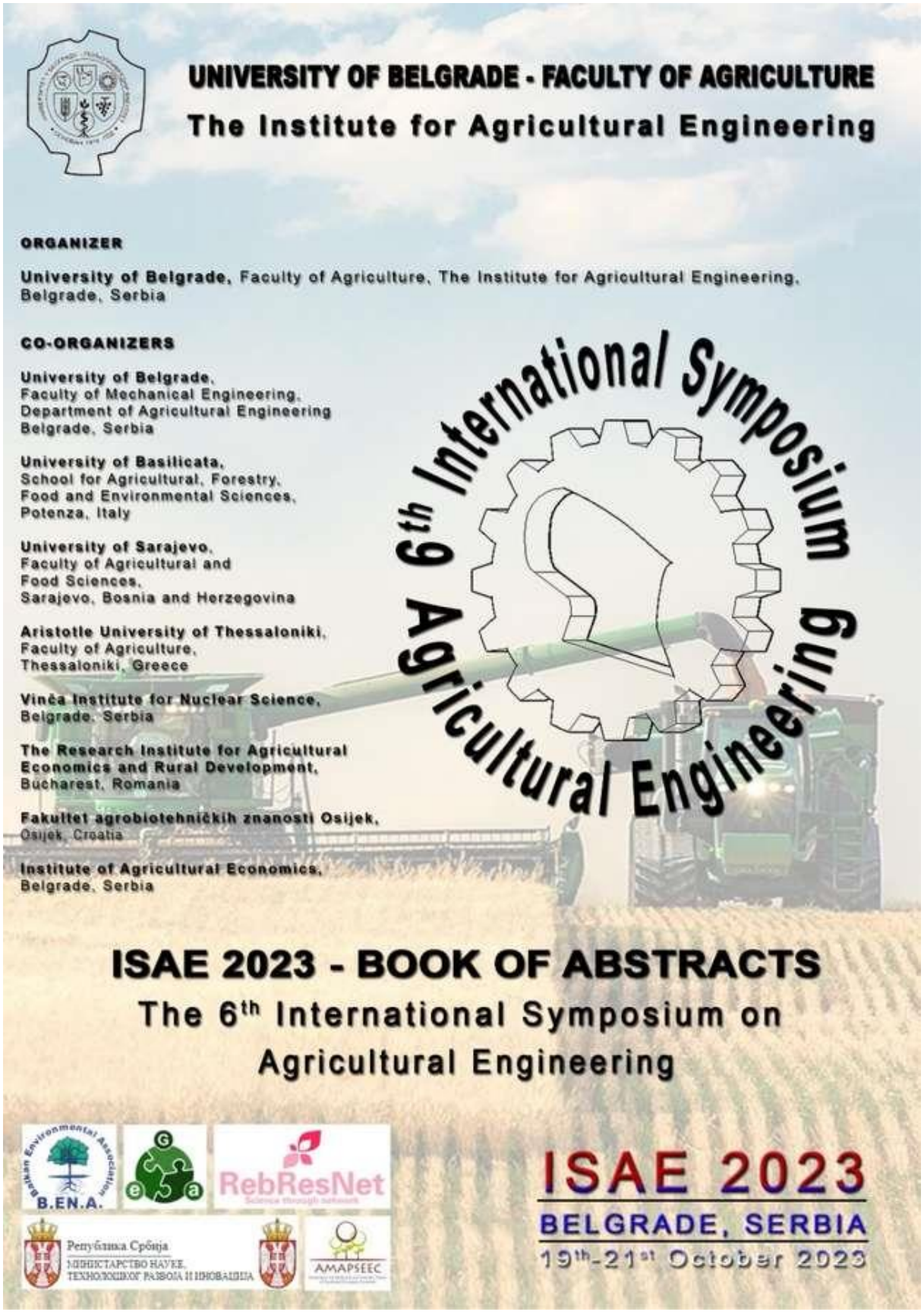
Abstract: The aim of this study was to analyze in detail the phytochemical composition of amaranth (AMJ), red beet (RBJ), and broccoli (BCJ) microgreens and cold-pressed juices and to evaluate the antioxidant and sensory properties of the juices. The results showed the presence of various phenolic compounds in all samples, namely betalains in amaranth and red beet microgreens, while glucosinolates were only detected in broccoli microgreens. Phenolic acids and derivatives dominated in amaranth and broccoli microgreens, while apigenin *C*-glycosides were most abundant in red beet microgreens. Cold-pressing of microgreens into juice significantly altered the profiles of bioactive compounds. Various isothiocyanates were detected in BCJ, while more phenolic acid aglycones and their derivatives with organic acids (quinic acid and malic acid) were identified in all juices. Microgreen juices exhibited good antioxidant properties, especially $ABTS^{\bullet+}$ scavenging activity and ferric reducing antioxidant power. Microgreen juices had mild acidity, low sugar content, and good sensory acceptability and quality with the typical flavors of the respective microgreen species. Cold-pressed microgreen juices from AMJ, RBJ, and BCJ represent a rich source of bioactive compounds and can be characterized as novel functional products.

Keywords: broccoli microgreens; amaranth microgreens; red beet microgreens; microgreen juices; antioxidant activity; apigenin *C*-glycosides

1. Introduction

Microgreens are recognized as new crops and potential foods of the future [1]. They represent a novel and promising source of highly valuable bioactive compounds with health-promoting effects [2–6]. The most commonly grown and studied microgreens are from the Brassicaceae and Amaranthaceae families with crops such as broccoli, cabbage, kale, argula, red beet, chard, amaranth, etc. [1]. So far, the aforementioned microgreen species have been mostly consumed in raw form or as culinary ingredients in dishes due to their high content of bioactive compounds and specific flavor [7]. Previous studies have shown that broccoli, amaranth and red beet microgreens are high in bioactive compounds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TOTAL PHENOLIC AND FLAVONOIDS CONTENT AND ANTIOXIDANT ACTIVITY OF COLD PRESSED AMARANTH MICROGREENS JUICE

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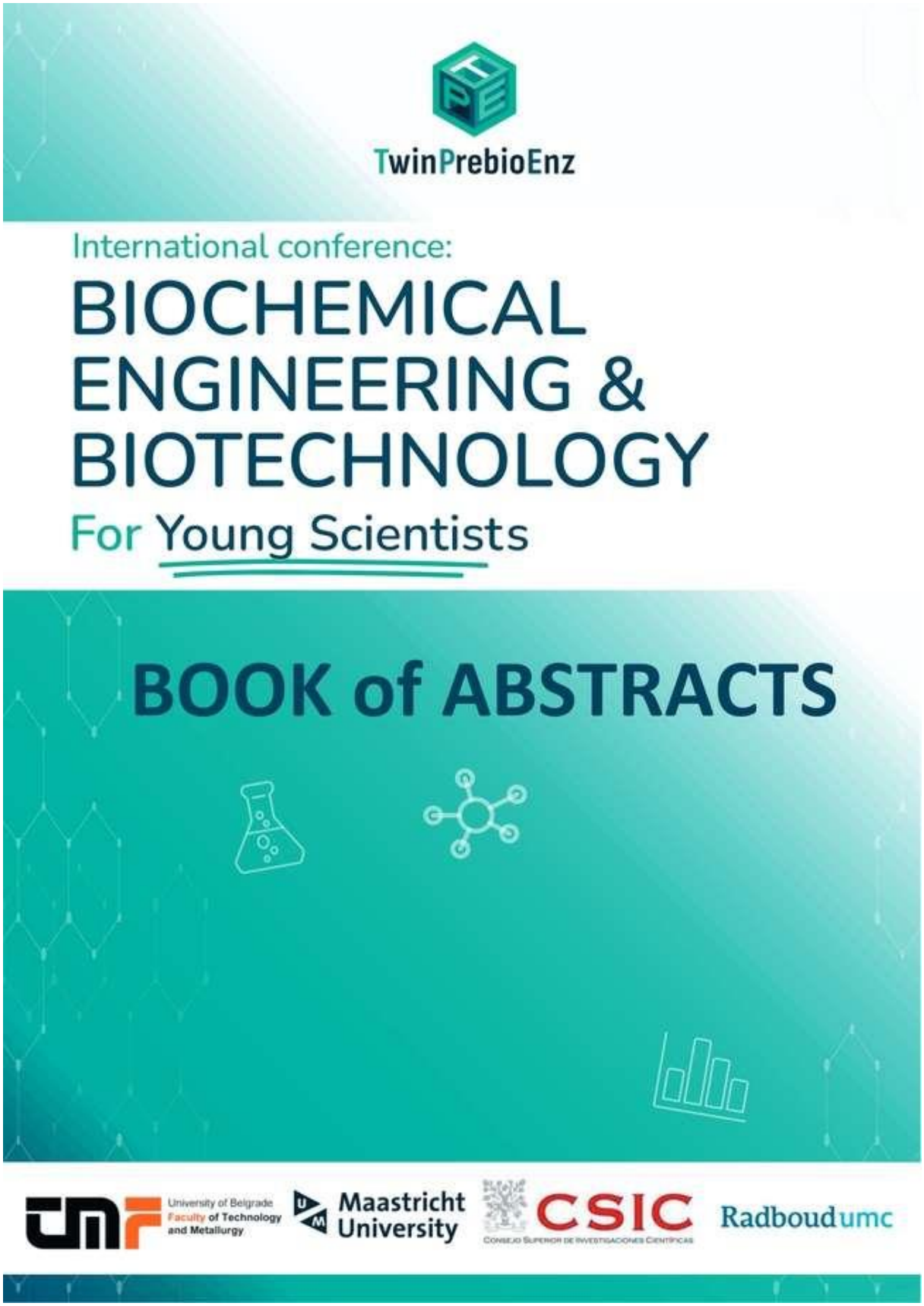
Abstract: Microgreens are recognized as new crops and potential foods of the future, because they are a rich source of highly valuable bioactive compounds with health-beneficial effects. Besides fresh consumption, microgreens can be successfully used for the production of some novel food products. Most often cultivated and analysed microgreens species are from Amaranthaceae families, primarily beet, chard and amaranth. Previous characterization of amaranth microgreens has showed a high content of different biocompounds such as vitamins, phenolic compounds and betalains. However, functional products from amaranth microgreens have only become attractive in recent years and have not been widely investigated until now. So, the aim of this study was production of cold pressed juice of amaranth microgreens and determination of its total phenolic (TPC) and flavonoid (TFC) content, as well as evaluation of antioxidant activity. Amaranth (*Amaranthus tricolor L.*) microgreens juice was obtained by pressing in a super slow cold juicer and further analyzed by well-known spectrophotometric methods such as Folin-Ciocalteu's assay for TPC and colorimetric assay with aluminum chloride for TFC. Antioxidant activity was evaluated using the following assays: $ABTS^{\cdot+}$ radical scavenging activity ($ABTS^{\cdot+}$), $DPPH^{\cdot}$ radical scavenging activity ($DPPH^{\cdot}$) and Ferric reducing antioxidant power assay (FRAP), which are based on different mechanisms of activity. Results were expressed in mg equivalents (gallic acid, quercetin and trolox) per 100mL of the juice. Determined TPC and TFC were 50.86 ± 0.26 mg GAE/100 mL and 45.94 ± 0.63 mg QE/100 mL, respectively. Results for the antioxidant activity were 101.61 ± 2.55 mg TE/100 mL for $ABTS^{\cdot+}$, 14.98 ± 0.06 mg TE/100 mL for $DPPH^{\cdot}$ and 99.93 ± 1.32 mg TE/100 mL for FRAP. As can be seen, the antioxidant activity of the amaranth juice high depends on the nature of amaranth biocompounds and their affinity according to $ABTS^{\cdot+}$ and $DPPH^{\cdot}$ radicals, i.e., the tendency to reduce the $[Fe^{3+}\text{-}(TPTZ)_2]^{3+}$ complex. Finally, the cold pressed amaranth microgreens juice showed the high content of phenolic compounds and good antioxidant activity using some in vitro screening assays, so it can be potentially defined as a novel functional product, however further research is necessary.

Keywords: *microgreens, amaranth, juice, total phenolic content, total flavonoid content, antioxidant activity.*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BROCCOLI MICROGREENS-APPLE JUICE AS NOVEL BEVERAGES: TOTAL PHENOLIC, FLAVONOIDS AND ANTIOXIDANT ACTIVITY

Spasoje Belošević[1]*, Danijel Milinčić[1], Ana Salević-Jelić[1], Jovana Marković[1], Steva Lević[1], Mirjana Pešić[1], Stefan Marjanović[1], Verica Đorđević[2] and Viktor Nedović[1]

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Recently, microgreens have been recognized as a potential food of the future, and their application in the formulation of new products has been scarcely investigated. Only a few studies promote the use of microgreens and sprouts in the formulation of novel products, primarily beverages. The most often cultivated, analyzed and used microgreens are from the *Brassicaceae* family, because they present a good source of bioactive compounds, primarily glucosinolates, isothiocyanates and phenolic compounds. However, products from these microgreens species have a typical flavor, with herbaceous, grassy and sulphurous notes, often repulsive to consumers. Therefore, this study aims to examine total phenolic (TPC) and flavonoids (TFC) content, as well as antioxidant properties ($ABTS^{\bullet+}$ and FRAP) of novel sensorially acceptable broccoli microgreens-apple juice (BC-AJ). Previously produced cold-pressed broccoli microgreens and apple juices were mixed in the ratios 51% and 49% respectively, and further analyzed by well-known spectrophotometric methods such as Folin-Ciocalteu's (TPC) and aluminum chloride (TFC) methods, as well as methods based on radical scavenging ($ABTS^{\bullet+}$) and ion reducing (FRAP) activities for evaluation of antioxidant properties. Results for the TPC and TFC of BC-AJ were 109.78 ± 1.08 mg GAE/100 mL and 64.68 ± 2.25 mg QE/100 mL, respectively. Furthermore, novel BC-AJ had a good ability to scavenge $ABTS^{\bullet+}$ radicals (162.90 ± 4.42 mg TE/100 mL) and a tendency to reduce $[Fe^{3+}\text{-}(TPTZ)_2]^{3+}$ complexes (258.50 ± 3.26 mg TE/100 mL), probably due to the most diverse of phenolic compounds originated from broccoli and apple. Finally, broccoli microgreens-apple juice has a high content of phenolic compounds and good antioxidant properties, so it can be considered as a potentially functional beverage, but future research that includes additional *in vitro* and *in vivo* studies is necessary.

Keywords: broccoli microgreens-apple juice; cold-pressing; total phenolic content; total flavonoid content; antioxidant activity

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CHARACTERIZATION OF AMARANTH (*AMARANTHUS TRICOLOR L.*) MICROGREENS JUICE ENCAPSULATED WITHIN INULIN AND MALTODEXTRIN

Spasoje Bošević[1]*, Danijel Milinčić[1], Ana Salević-Jelić[1], Jovana Marković[1], Steva Lević[1], Mirjana Pešić[1], Stefan Marjanović[1], Verica Đorđević[2] and Viktor Nedović[1]

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Amaranth microgreens represent a rich source of betalains and phenolic compounds, which show a broad range of positive effects on human health. However, these biocompounds are very sensitive and easily degraded, which often limits their application and bioaccessibility. For the above reasons, natural extracts and juices are most often encapsulated using different carriers, which protect and control the release of bioactive compounds. The aim of this study was to encapsulate cold-pressed amaranth (*Amaranthus tricolor* L.) microgreens juice using maltodextrin (AMD) and inulin (AIN) as carriers and to investigate total phenolic content (TPC), total flavonoid content (TFC) and antioxidant properties (ABTS$^{\bullet+}$ and FRAP) of obtained spray-dried powders. To the best of our knowledge, this is the first report on the encapsulation of amaranth microgreens juice. Before analysis, both powders were reconstituted in Milli-Q water (5% solutions) and analyzed using well-known spectrophotometric methods. The results are expressed in mg equivalents (gallic acid, quercetin, Trolox) per 100 g encapsulates. The obtained values for TPC and TFC for AMD were 291.7 ± 3.0 mg GAE/100 g and 291.3 ± 2.5 mg QE/100 g, while values for AIN were 356.9 ± 1.0 mg GAE/100 g and 289.6 ± 3.8 mg QE/100 g. The results of antioxidant activity were as follows: 546.3 ± 12.6 mg TE/100 g (AMD) and 745.2 ± 3.1 mg TE/100 g (AIN) for ABTS$^{\bullet+}$ and 713.3 ± 8.4 mg TE/100 g (AMD) and 905.1 ± 4.5 mg TE/100 g (AIN) for FRAP. Finally, maltodextrin and inulin can be successfully used for the encapsulation of bioactive compounds of amaranth microgreens. In addition, both powders show good antioxidant properties and can be used in the food industry as potentially novel additives or supplements.

Keywords: amaranth microgreens juice; encapsulation; inulin; maltodextrin; antioxidant activity

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PHYSICOCHEMICAL CHARACTERIZATION OF SPRAY-DRIED HORSERADISH ROOT JUICE ENCAPSULATED WITHIN MALTODEXTRIN/ALGINATE

Jovana Marković[1*], Dragana Mihajlović[1], Ana Salević-Jelić[1], Steva Lević[1], Verica Đorđević[2], Spasoje Belošević[1], Viktor Nedović[1]

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Spray-drying is one of the widely used techniques to extend the shelf-life and easier handling of vegetable juices. However, the high temperatures in the spray-drying chamber may cause the degradation of the bioactive components of the juices. Also, the enzyme activity and sugar content of fresh juices can lead to difficulties in drying and resulting in powders with unfavorable physicochemical properties. To overcome these problems, juices can be encapsulated within various biopolymers. Carbohydrates, maltodextrin, and alginate were used as carriers for the spray-drying encapsulation of bioactive components of various plant juices and extracts. To our knowledge, there are no reported studies on the encapsulation of horseradish root juice within these carriers. Therefore, this study aimed to investigate the influence of the maltodextrin/alginate carrier mixture on the physicochemical properties of the horseradish root juice preserved by the spray-drying encapsulation technique.

Root juice powder without a carrier (C, control sample) and maltodextrin/alginate encapsulates of root juice (MD/AL) were prepared by spray-drying. The powders were analyzed using standard analytical methods to determine the moisture content, water activity, hygroscopicity, oil holding capacity, bulk, and tapped density.

Moisture content, water activity, and hygroscopicity were lower in MD/AL (7.8%, 0.28, 22.9 g/100 g) than in C (10.2%, 0.32, 24.4 g/100 g). MD/AL had a higher oil holding capacity (1.4 g oil/g) compared to C (1.1 g oil/g). The values for bulk and tapped density were for MD/AL 0.5 and 0.7 g/cm^3 and C 0.6 and 0.7 g/cm^3, respectively.

Finally, the encapsulation of horseradish root juice in maltodextrin/alginate resulted in powders with significantly better physicochemical properties than spray-dried horseradish root juice without carrier. Based on this study, it can be concluded that the encapsulation process has great potential for the preservation of vegetable juices and provides many perspectives for further research and application in food products.

Keywords: spray-drying; encapsulation; maltodextrin/alginate; physicochemical characterization; horseradish root juice

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ANTIOXIDANT POTENTIAL AND PHENOLICS CONTENT OF HORSERADISH ROOT JUICE ENCAPSULATED WITHIN DIFFERENT CARBOHYDRATE MATRICES

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Horseradish is a plant grown for its succulent and spicy root, which presents a rich source of antioxidants such as phenolic compounds, vitamin C, and isothiocyanates. Due to its antioxidant properties, cold-pressed horseradish root juice could be an active ingredient in functional foods. However, fresh juices undergo enzymatic and microbiological changes, so it is necessary to preserve them. One of the approaches commonly used for this purpose is encapsulation by spray-drying, which involves the entrapping of bioactive components within carrier agents. This ensures the protection of the bioactive component from undesirable external factors and its controlled release. Many studies have shown that the use of a combination of maltodextrin and hydrocolloids as encapsulation carriers results in high-quality encapsulates. So, the aim of this study was the encapsulation of horseradish root juice and the characterization of the obtained encapsulates as potential antioxidants in food production.

Maltodextrin/guar gum (MD/GG) and maltodextrin/gum Arabic (MD/GA) were used as carriers to encapsulate horseradish root juice by spray-drying. Total phenolic, flavonoid, and phenolic acid contents (TPC, TFC, and TPAC, respectively) and antioxidant activity (DPPH, ABTS, and FRAP methods) were determined by standard spectrophotometric methods.

MD/GG and MD/GA with encapsulated horseradish root juice contained 1628 and 1568 mg gallic acid equivalents/100 g, respectively, of TPC; 264 and 253 mg catechin equivalents/100 g, respectively, of TFC; and 3272 and 3397 mg caffeic acid equivalents/100 g, respectively, of TPAC. Results for the antioxidant activity (expressed as mmol Trolox equivalents/100 g) of MD/GG and MD/GA were 0.8 and 0.7, respectively (DPPH); 6.9 and 7.6, respectively (ABTS); and 8.8 and 8.6, respectively (FRAP).

In conclusion, horseradish root juice encapsulated within carbohydrate biopolymers contained significant amounts of phenolic compounds and high antioxidant activity, which makes it a potential replacer for synthetic antioxidants in the food industry and opens the possibility for further research on this topic.

Key words: horseradish root juice; encapsulation; carbohydrate biopolymers; phenolics; antioxidant activity

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THE EFFECT OF USING ALTERNATIVE SOURCES OF PROTEIN FROM ANIMAL SPECIES ON THE PRODUCTION PARAMETERS OF RAINBOW TROUT (*Oncorhynchus mykiss*)

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Fishmeal is dominantly used as a protein source in commercial aquafeed for rearing rainbow trout, due to its favorable amino acid content. However, the use of this component has become unsustainable because of the small stocks of wild fish species used for its production, which directly affects the increase in price. Previous studies have shown that animal protein sources represent a potentially good choice for use in the production of feed for fish due to their high protein and fat content. Worms are used for feeding fish and support the principles of the circular economy. The aim of this research was to compare the possibility of completely replacing fishmeal with alternative protein sources and to investigate their effect on the production parameters of rainbow trout. In this study, four experimental diets were formulated: a diet control with fishmeal (FM) and three diets where fishmeal was replaced with mealworm (MW), earthworm (EW), and zooplankton (ZO). The production parameters were calculated: body weight gain (BWG), feed conversion rate (FCR) and biometric index, i.e. hepatosomatic index (HSI). The results for BWG were from 45.61 g for MW to 6.23 g for ZO. The values for the FCR parameter ranged from 1.48 for MW to 1.59 for FM. As can be seen, rainbow trout fed the diet with MW had the best growth, as well as the best digestibility of the feed, which can be explained by the affinity of rainbow trout to different protein sources, while the HSI value showed that the diets do not negatively affect fish health. In conclusion, mealworms and earthworms used in rainbow trout diets showed high values in production parameters and can be defined as sustainable alternatives for the replacement of fishmeal. Finally, they could be used as a potential functional ingredient in aquafeeds.

Keywords: rainbow trout; fishmeal replacement; mealworm; earthworm; zooplankton

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SENSORY EVALUATION OF BAKED RAINBOW TROUT (*Oncorhynchus mykiss*) FED DIFFERENT NON-CONVENTIONAL PROTEIN SOURCES

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Rainbow trout is one of the most used cold-water fish species in the human diet all over the world, thanks to its rich source of protein, minerals, and omega-3 fatty acids. Fishmeal is used in commercial formulation diets for trout, due to its appropriate nutritional composition. However, due to the high price of fishmeal, there is a tendency to replace it with different plant or animal protein sources. The use of plant protein sources in fish diets is limited because of the presence of anti-nutrients and the lack of essential amino acids, whereas this is not the case with animal protein sources. In addition to a good chemical composition, mealworms (*Tenebrio molitor*), earthworms (*Eisenia fetida*), and zooplankton have a low environmental impact with well-known functional components that have a positive effect on fish health. There is no comparative study that investigated the sensory quality of rainbow trout fed with a diet based on entirely non-conventional protein sources until now. The aim of this study was to evaluate the sensory quality of baked rainbow trout, three diets were formulated, in which mealworm, earthworm, and zooplankton substituted 100% of fishmeal, and their effect on the individual sensory properties. The descriptive sensory analysis and the quality rating method, using a linear and categorical scale, were used. The mean rating scores were within the range of "very good" quality for baked rainbow trout fed the diet based on mealworm and earthworm with noticeable positive properties, except diet based on zooplankton. Negative changes in that sample are associated with a dark appearance and a hard and sticky texture. According to the sensory evaluation performed, the application of non-conventional protein sources as a potential functional feed showed promising results in terms of the overall quality of the baked rainbow trout.

Keywords: rainbow trout; non-conventional protein sources; worms; quality rating method; descriptive sensory analysis

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ENCAPSULATION OF BROCCOLI MICROGREEN JUICE: PHYTOCHEMICAL COMPOSITION AND ANTIOXIDANT ACTIVITY

***Belošević D. Spasoje*[1], *Milinčić D. Danijel*[1], *Salević-Jelić S. Ana*[1], *Marković M. Jovana*[1], *Lević M. Steva*[1], *Pešić B. Mirjana*[1], *Marjanović M. Stefan*[1], *Dorđević B. Verica*[2], *Nedović A. Viktor*[1]**

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Encapsulation is a process that implies the active compounds are enclosed in a wall material using various techniques, creating a barrier that protects the active ingredients from unfavorable environmental conditions. The most commonly encapsulated active compounds derive from plant extracts and juices. Broccoli microgreen juice as a source of active compounds for encapsulation has not been used so far. The aim of this study is the encapsulation of broccoli microgreen juice (BCJ) in maltodextrin as wall material by spray drying technique and the characterization of the obtained powder in terms of phytochemical composition and antioxidant activity. The spectrophotometric assays were used to determine the content of total phenolics (TPC), flavonoids (TFC) and antioxidant activity (AA) ($ABTS^{\cdot+}$, $DPPH^{\cdot}$ and FRAP). The TPC, TFC, and AA were expressed in mg equivalents (gallic acid, quercetin, and Trolox, respectively) per 100 g of the encapsulates. The values determined for TPC were higher than those for TFC. Regarding antioxidant activity, the results followed the order FRAP>$ABTS^{\cdot+}$> $DPPH^{\cdot}$. It should be noted that the antioxidant potential expressed by the encapsulated BCJ varied due to different mechanisms of the employed antioxidant assays. In summary, broccoli microgreen juice encapsulated in maltodextrin showed a high content of phenolic compounds and good antioxidant activity and can be defined as a novel food ingredient. In addition, future studies should focus on the addition of encapsulated broccoli microgreen juice in food products and the characterization of such products.

Keywords: encapsulation; spray drying; microgreen juice; phytochemical composition; antioxidant activity

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THE INFLUENCE OF CARBOHYDRATE CARRIERS ON THE MORPHOLOGY AND PHYSICAL PROPERTIES OF RED BEET MICROGREEN JUICE ENCAPSULATES

***Belošević D. Spasoje*[1], *Milinčić D. Danijel*[1], *Salević-Jelić S. Ana*[1], *Marković M. Jovana*[1], *Pavlović B. Vladimir*[1], *Lević M. Steva*[1], *Pešić B. Mirjana*[1], *Marjanović M. Stefan*[1], *Dorđević B. Verica* [2], *Nedović A. Viktor*[1*]**

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Red beet microgreen juice is considered a novel functional beverage due to its content of bioactive compounds, including the color pigment betalain and flavonoids. Considering the sensitivity of these bioactive compounds, it is necessary to protect them by encapsulation within carriers to extend their shelf life. The aim of this study was to apply the spray drying technique for the encapsulation of red beet microgreen juice in inulin (RIN) and maltodextrin (RMD) carriers and to determine the effects of spray drying on the morphology and physical properties of obtained encapsulates. The morphological properties of the obtained encapsulates were examined by scanning electron microscopy (SEM), while the moisture content, tapped and bulk density and color were determined by standard methods. The RMD was characterized by a small particle size with the presence of typical spherical particles and pseudo-spherical particles with irregular surfaces due to rapid evaporation at high temperatures in the spray drying chamber. In contrast to RMD, RIN had larger particles with a high degree of agglomeration as inulin is a larger molecule and more hygroscopic than maltodextrin. The moisture content of the encapsulates was below 10 %, with the higher bulk density of RIN compared to RMD. Regarding the color of the encapsulates, those in maltodextrin showed a higher brightness and saturation than the encapsulates within inulin. In summary, inulin and maltodextrin provide good morphological and physical properties and can be used for the encapsulation of red beet microgreen juice. However, further studies should include a detailed phytochemical characterization of the encapsulates.

Keywords: red beet microgreen juice, inulin, maltodextrin, scanning electron microscopy, moisture content

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EFFECT OF VARIOUS ALTERNATIVE DIETS ON GROWTH PARAMETERS AND BIOMETRIC INDECES OF COMMON CARP (Cyprinus carpio)

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Fishmeal is used as one of the main protein sources in intensive common carp production. The use of this component makes the production of fish food more expensive, due to the decline of the population of wild fish used for its production, so there is an urgent need to find new sources of protein. Worms and other invertebrates are easy to grow and have minimal negative impact on the environment and as such they are candidates for replacing fishmeal in the fish diet. The experiment was carried out under controlled conditions in the fish nutrition laboratory at the Faculty of Agriculture, University of Belgrade. This study aimed to investigate the effects of a complete fishmeal based diet (IFM) replacement with total inclusion of earthworm diet (IEF), mealworm diet (ITM) and zooplankton diet (IZO). At the beginning and end of the feeding period, fish were weighed to calculate growth performance such as specific growth rate (SGR), body weight gain (BWG) and condition factor (CF), while the liver was weighed to determine hepatosomatic (HSI) index. Values for SGR and BWG had the same trend for all four experimental groups, with the highest values achieved in the group whose diet included mealworms, while the lowest value was achieved in the group in which the diet included fishmeal. Common carp fed ITM achieved similar CF values to the control diet, suggesting that *Tenebrio molitor* based diets can replace fishmeal (IFM) based diets. Also, values for HSI range from 1 to 2%. Finally, based on the results obtained, it can be concluded that alternative protein sources can be used in the common carp diet instead of fishmeal without a potentially negative impact on fish growth and health.

Keywords: fishmeal replacement; hepatosomatic index, condition factor

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FATTY ACID COMPOSITION OF RAINBOW TROUT (ONCORHYNCHUS MYKISS) FED MEALWORM, EARTHWORM, AND ZOOPLANKTON DIETS

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Feeding in aquaculture plays a pivotal role in the successful rearing of fish, with particular emphasis on diets that have a positive effect on the chemical composition of fish fillets. This study aimed to assess the effect of the total replacement of fishmeal with alternative animal protein sources on the fatty acid composition of rainbow trout fillets. The fishmeal diet (FD) was substituted with diets based on earthworms (ED), mealworms (MD), and zooplankton (ZD). The gas chromatography technique with a flame ionization detector was used to determine the fatty acid composition of rainbow trout fillets. The lipids from the fillets were extracted with a mixture of chloroform and methanol (2:1) and prepared for GC analysis according to the EN ISO method. The results of the fatty acid composition of rainbow trout fillets fed with ZD showed a higher content of saturated fatty acids (SFA) compared to the control fillets. However, replacing fishmeal in the rainbow trout diet with mealworm and zooplankton resulted in the increase of monounsaturated fatty acids (MUFA) compared to rainbow trout fed with FD, with the rise in MUFA attributed to elevated oleic acid levels. Fish fillets fed with ED and MD exhibited higher levels of n-6 polyunsaturated fatty acids (PUFA), due to higher linoleic acid (LA) content, but lower levels of n-3 PUFA, which was reflected in the lower n3/n6 ratio compared to the control fillet. In contrast, the replacement of fishmeal with zooplankton had lower n-6 PUFA and n-3 PUFA, but a higher n3/n6 ratio. Despite the change in fatty acid profile, the ratio of n-3 to n-6 PUFA in all fillets remained within the optimal range recommended for human health. In conclusion, rainbow trout fillets fed with alternative protein sources had favorable nutritional characteristics in terms of fatty acids.

Keywords: rainbow trout, polyunsaturated fatty acids, mealworm, earthworm, zooplankton

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ENCAPSULATED HORSERADISH LEAF JUICE: A POTENTIAL ALTERNATIVE TO SYNTHETIC ANTIOXIDANTS IN MAYONNAISE PRODUCTION

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Horseradish leaf is an under-researched source of phenolics with pronounced antioxidant potential. Due to the high biological activity of fresh horseradish juices, it is desirable to encapsulate them by spray-drying, a cost-effective one-step process suitable for scaling up production. The potentially harmful effects of synthetic antioxidants have led to an increasing demand for antioxidants from natural sources to maintain the oxidative stability of lipid-rich products. Therefore, this study aimed to compare the effect of encapsulated, spray-dried horseradish leaf juice within maltodextrin/alginate (MD/AL) and maltodextrin/gum Arabic (MD/GA) with the effect of a conventionally used synthetic antioxidant ethylenediaminetetraacetic acid (EDTA) on the mayonnaise oxidative stability, quality, and sensory properties.

Sunflower oil (75%), egg yolk (3%), vinegar (3%), sugar (3%), and salt (1%) were used for mayonnaise production. The water content (15%) was reduced by adding encapsulates (in an amount to achieve a total phenolic content of 400 mg gallic acid equivalents/kg mayonnaise). The mayonnaise containing EDTA was used as a positive control. Based on an accelerated oxidative stability test, MD/AL and MD/GA were found to be more effective than EDTA in delaying the mayonnaise oxidation, by prolonging the induction period (by 39 and 32%, respectively). The mayonnaise quality during the eight-week storage period was determined by measuring the pH and acid values. The horseradish encapsulates also improved the product quality with a higher pH (by 0.5-1.5%) and lower acidity (by 21.4%) after storage compared to the positive control. A nine-point hedonic scale was used for the sensory analysis of the mayonnaises. The overall acceptability of the mayonnaises followed the order: MD/AL>EDTA>MD/GA, with scores above 7 ("like moderately").

Finally, horseradish leaf juice encapsulates positively affected the oxidative stability, quality, and sensory properties of the mayonnaise, indicating the great potential of these natural antioxidants as a substitute for synthetic ones in the food industry.

Keywords: horseradish leaf juice, encapsulation, antioxidant activity, mayonnaise, oxidative stability

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HORSERADISH LEAF JUICE ENCAPSULATES: PHYSICOCHEMICAL, SPECTROPHOTOMETRIC, AND CHROMATOGRAPHIC CHARACTERIZATION

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Horseradish is mainly used in the food industry for its succulent and spicy roots, while the horseradish leaves are usually disposed of with the above-ground biomass. The cold pressing of horseradish leaves produces a juice that is rich in bioactive compounds with pronounced antioxidant potential. However, due to its high water content and biochemical reactivity, it is prone to degradation. The bioactive compounds of horseradish leaf could be protected from undesirable external factors by spray drying encapsulation within maltodextrin/alginate (MD/AL) and maltodextrin/gum Arabic (MD/GA) carriers. Therefore, the aim of this study was to encapsulate horseradish leaf juice within these carriers and to evaluate the physicochemical, spectrophotometric, and chromatographic properties of the obtained encapsulates. Using standard analytical methods, lower values for moisture content, water activity, solubility, oil holding capacity, and encapsulation yield were obtained for MD/AL than for MD/GA encapsulates. Standard spectrophotometric methods were used to characterize MD/AL and MD/GA encapsulates in terms of total phenolic content (5241.25 and 4849.00 mg gallic acid equivalents/100 g), total flavonoid content (4640.67 and 4159.99 mg catechin equivalents/100 g), total phenolic acid content (5008.34 and 7013.20 mg caffeic acid equivalents/100 g), and antioxidant activity (mmol Trolox equivalents/100 g: 0.88 and 0.44 (DPPH); 58.67 and 63.20 (ABTS); and 15.78 and 13.71 (FRAP), respectively). Using an ultra-high-performance liquid chromatography system, coupled with a quadrupole time-of-flight mass spectrometry, a total of fourteen phenolic compounds were quantified after extraction from the encapsulates. The chromatographic analysis also confirmed the higher total content of all identified phenolic compounds in MD/AL (1896.87 mg/kg) than in MD/GA (1761.27 mg/kg). The obtained results highlight encapsulated horseradish leaf juice as an underestimated and underexplored source of phenolic compounds with high antioxidant potential, whose application in the food industry could valorize crop side streams and reduce synthetic antioxidant usage.

Keywords: horseradish leaf, encapsulation, spray drying, phenolic compounds, antioxidant activity

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