

¹Department of Pharmacy, Faculty of Medicine, University of Nis, Serbia

²Department of Mechanic, Faculty of Mechanic, University of Nis, Serbia

³Department of Physiology, Faculty of Medicine, University of Nis, Serbia

Impact of COVID pandemic on attitude and prevalence of plant-based food products consumption in Serbia

Dragana Pavlovic^{1*}, Jelena Matejic¹, Ivan Pavlovic², Milica Veljkovic³

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Summary

COVID pandemic influence on eating behavior and dietary habits with respect to various plant-based foods in Serbia were estimated by an anonymous questionnaire. Most examinees agree that fruits and vegetables contribute to strengthening immunity and that herbal medicines and natural products have beneficial effects on health. Around 55% of examinees consider their diet balanced, and 4% have started to drink herbal teas more often when the pandemic started. Garlic and ginger were the most frequently reported newly included plants in examinees' diet. The attitudes toward plant-based food products are not strongly dependent on the education level. The age and previous dietary habits of examinees have great influence in the current frequency of consuming fruits, vegetables, herbal teas, spices, and dietary supplements. There was a significant shift toward greater use of herbal teas and dietary supplements, especially among the population that has already consumed them occasionally. Somewhat concerning is the fact that around half of respondents use dietary supplements without the recommendation of an expert. People with good dietary habits and the elderly were most prone to improving their diet. Roughly 15% of all respondents now have the same habits as before the pandemic, although they improved their diets temporarily at the beginning of COVID pandemic.

Keywords: dietary style, fresh and processed, plant-based products, winter food, self-reported data.

Introduction

The COVID (SARS-CoV-2 coronavirus) pandemic presents a global issue – a great threat to global public health that affects almost every segment of human life. Apart from the quarantine and self-isolation of many individuals that promoted unhealthy behavior, pandemic has affected dietary habits and eating behavior alongside personal attitudes and food preferences (RUIZ-ROSO et al., 2020; SIDOR and RZYMSKI, 2020; CHAARI et al., 2020).

A balanced, optimal diet supports and enhances the immune system function both by providing an effective response against pathogens and by resolving infections in a shorter time, avoiding any further complications (CHILDS et al., 2019). The intake of plant-based foods may also enhance the diversity of nutrients that reach the gut and support the gut microbiome (CHILDS et al., 2019). Nutrition and proper diet can promote the functioning of the immune system as a preventive measure by reducing both inflammation and oxidative stress, as well ensuring that the body is in the strongest possible state to battle the virus (CHAARI et al., 2020; AMAN et al., 2020). World Health Organization (WHO) especially encourages consumption of fresh fruits and vegetables through general nutrition advice for adults during the COVID outbreak: to eat fresh and unprocessed foods, moderate amounts of fat and oil, less salt and sugar, and to drink

enough water every day (WHO, 2021). Thus, one of the main solutions to promote health should be through healthy eating (SHI and YAN, 2020). Some people are prone to including herbal teas, spices, and dietary supplements both as a replacement or in addition to their regular diet (HAMULKA et al., 2020).

Traditionally, pickled vegetables have played a significant role in the dietary habits of the European population, especially during the winter (JELOČNIK et al., 2019). Processed fruits and vegetables are convenient because they are available throughout the year regardless of the season and could supply consumers' needs for all nutrients since they have a similar concentration of those compounds as fresh equivalents. In some cases, the nutrients from canned food are more readily digestible than those of the fresh equivalents. Also, processed plant-based food can be stored for extended periods of time without the need for refrigeration and presents useful pantry food to stock in case people cannot go grocery shopping for various reasons (FEATHERSTONE, 2016). The last fact was very important during the quarantine and self-isolation due to the COVID-19 pandemic.

In the light of these considerations and the general impressions of dietary changes during the past period, this study aims to highlight the influence of the COVID-19 pandemic on: i) eating behavior and dietary habits changes with respect to various plant-based foods; ii) frequency of consumption of herbal teas and dietary supplements; iii) quantity of traditionally pickled plant-based food prepared for winter period, and iiiii) the general attitude toward diet, plant-based food, natural products, and dietary supplements.

Materials and methods

A cross-sectional study was performed using an anonymous online questionnaire that contained 16 open-ended and closed-ended questions. In addition to fresh, frozen, and processed fruits and vegetables, herbal spices and herbal teas are also considered plant-based food products for the purposes of this research. The questions in the survey were related to the general attitude towards these products, and the frequency of their use before and during the COVID pandemic in the region of Serbia. Most of the questions were multiple-choice, allowing respondents to select a pre-specified answer. Self-perception on diet and lifestyle changes from the beginning of the pandemic was also recorded, and in the last question, examinees had to specify how much they agree/disagree with some claims.

Data collection was carried out through a structured questionnaire in Serbian created in Microsoft Forms (Microsoft 365). The original questionnaire in Serbian, the English translation and the results are available as data set at PAVLOVIC et al. (2021). The questionnaire was modeled based on our previous survey on attitude and prevalence of bee product usage in pediatric pulmonology patients (ŽIVANOVIĆ et al., 2019). The study was conducted by the ethical principles of the Helsinki declaration. Ethical Committee of the Faculty of Medicine, University of Nis, Serbia, approved the investigation. The invitation to participate in the survey was shared by e-mail, Viber, or by social

* Corresponding author

networks such as Facebook, and Instagram. The first few invitations were given to the people authors knew personally, with a request to share this questionnaire with wider potential respondents. The survey was available for completion in January 2021. Participation was completed anonymously, voluntarily, and individual responses were not linked to a specific participant. Data obtained by filling out the questionnaire were statistically analyzed by MATHLAB R2017 software. The data were shown in frequency distribution tables expressed as percentages, which were further analyzed using Pearson's Chi-square test. A probability value of $p < 0.05$ was considered of significance.

Results and discussion

The COVID-19 pandemic is impacting not only people's lives and longevity but also global food trade, food supply chains, and food security and consequently people's nutrition (FAO, 2021). The containment measures adopted by national governments to limit the spread of the coronavirus have caused harmful disruptions throughout all elements of the supply chain, from production to processing to distribution (FAO, 2021). The current coronavirus pandemic is special compared to the other infectious disease epidemics: since its beginning people had to stay at home or work at home for an extended periods, schools, restaurants, stores, and markets were closed for months, and public transport was restricted. Thus, the changes in eating habits could not be attributed only to the knowledge of strengthening immune defenses but also must be perceived in terms of all factors related to the coronavirus pandemic. The government of Serbia has enacted series of laws, decrees, orders, decisions, and solutions from the beginning of the pandemic till today (MINISTRY OF HEALTH AND INSTITUTE OF PUBLIC HEALTH OF SERBIA, 2021). The most severe measurement against the global pandemic was lockdown that was 52 days in duration (from 3/15/2020 till 5/6/2020). Our anonymous online questionnaire estimated the COVID-19 pandemic influence on eating behavior and dietary habits in Serbia, alongside preference and personal attitudes toward fruits, vegetables, herbal teas, and spices. Dietary supplements were also considered through 3 questions since they have been the focus of public interest since last year (AMAN et al., 2020; SHI and YAN, 2020; HAMULKA et al., 2020).

The complete answers of the questionnaires are available as data set at PAVLOVIC et al. (2021). The total number of completed questionnaires was 408. The average age of the respondents is 27.5 ± 6.6 years, most of them are employed ($N=261$), followed by students ($N=64$), unemployed ($N=62$), and retired citizens ($N=21$). Around a fifth of respondents were males (20.1%). The highest level of education was college/postgraduate training and high school, 278 and 128, respectively. Only 2 reported basic level of education.

Change in eating behavior and dietary habits toward fruits, vegetables, herbal teas, and spices

Previously published data reported insufficient fruit and vegetable consumption in Serbia (RODIĆ-TRMČIĆ et al., 2015). Almost all examinees in our survey agreed that fruits and vegetables contribute to strengthening immunity although 24% and 14.5% of them, included greater amounts of fruit and vegetables, respectively, into their diet compared to the amount before the COVID pandemic. Education level influenced the tendency to use the same amounts of fruits or vegetables in combination with dietary supplements ($p=0.0163$, and $p=0.0117$, respectively), while the most used vegetables were roots and tubers (potatoes, carrots, beets), followed by vegetables from legume (beans, peas, green beans), cabbage (cabbage, cauliflower, broccoli) and onion family (onion, garlic). Regarding fruits, the most popular are southern fruits (oranges, lemons, bananas), followed by

seasonally grown (apples, pears, plums) and wild seasonal fruits (wild strawberries, raspberries, blackberries). The increased intake of vitamin C could be an explanation for such agrums popularity.

On the other hand, nutritional value of wild-growing fruits was mentioned in 2% of responses, overall interest in edible wild plants seems low. The study conducted in Central Italy shows that knowledge of wild plants use is principally concentrated in the elderly, alongside the lack of interest of younger generations for such kind of information (RANFA and BODESMO, 2017). Recent work of MATEJIĆ et al. (2020) documents that the use of medicinal plants for eating, cooking, and compote in addition to treating health complaints is widespread in some parts of Serbia.

Fruits and vegetables that are most frequently newly included in examinees' diet since the beginning of the pandemic were: garlic, beets, horseradish, celery, pomelo, avocados, mango, and pineapple. Ginger, thyme, ribwort plantain, parsley, nettle, turmeric, and wild oregano were reported as recently introduced medicinal plants/spices. Garlic and ginger were highest ranked from all listed plants.

Considering the growing popularity of garlic, WHO pointed out that, while garlic is a healthy food that may have some antimicrobial properties, there is no evidence from the current outbreak that eating garlic has provided protection from the new coronavirus (WHO, 2021). Garlic antimicrobial properties have been well documented in many references in literature and the Committee on Herbal Medicinal Products of the European Medicines Agency (EMA/HMPC) recommend it as a traditional herbal medicinal product used for the relief of the symptoms of the common cold (EMA/HMPC/7686/2013).

According to EMA/HMPC ginger rhizome (*Zingiber officinale* Roscoe) is a herbal medicinal product for the prevention of nausea and vomiting in motion sickness, and a traditional herbal medicinal product for the symptomatic treatment of mild, spasmodic gastrointestinal complaints including bloating and flatulence (EMA/HMPC/577856/2010). Still aqueous and organic extracts of ginger root have repeatedly been shown to possess broad anti-infectious (antibacterial, antifungal, antiviral, and anthelmintic) properties, and ginger is one of the favorite folk remedies for infectious diseases (EMA/HMPC/749154/2010). According to a survey conducted among pediatric pulmonary patients' parents/guardians, one of the most popular homemade bee product blends applied to the child for respiratory problems consisted of honey and ginger (ŽIVANOVIĆ et al., 2019).

Change in the frequency of herbal teas and dietary supplement consumption

Significant number of respondents of lower education level (completed elementary and high school) tend to use a smaller quantity of fruits and vegetables in combination with dietary supplements ($p=0.0235$, and $p=0.0234$, respectively). Compared to women, men were prone to use the same quantity of fruits now as before the pandemic ($p=0.0335$), while women use the same quantities of fruits and vegetables but with the addition of dietary supplements ($p=0.0180$, and $p=0.0042$, respectively). Around one-third of all respondents reported regular use of dietary supplements since the beginning of the pandemic, although only 5% and 2.5% of them admitted to lower amounts of fruits and vegetables in the diet, respectively (Fig. 1).

The sales of dietary supplements on the global market had increased dynamically in the wake of COVID-19 in most of the countries, and at the beginning of the pandemic, some types of supplements recorded even triple-digit growth rates (HAMULKA et al., 2020). Over the counter (OTC) market in Serbia has increased by 15% compared to the prior (pre-pandemic) year with additional 43 m EUR in sales. The highest contributor of the increase was vitamins and minerals, along with other dietary supplements. In retail, OTC segment of the Serbian pharma market represented 34% of sales. Regardless of the

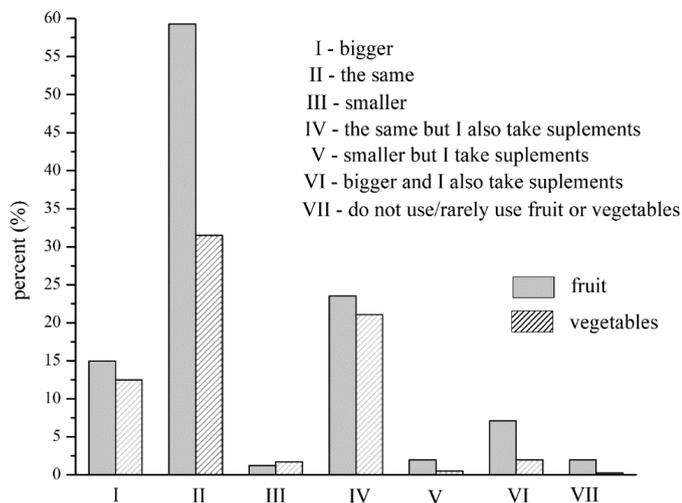


Fig. 1: Comparison of the amounts of (fresh, frozen, and processed) fruit/vegetable respondents declared to eat now vs. before the COVID-19 pandemic. *denotes the significant difference in fruit and vegetable consumption in the selected category.

OTC market's constant annual growth (for example, there was an increase from 2018 to 2019 by about 12%), the exceptional impact of COVID on the OTC market cannot be ignored. In 2020 vitamins and minerals overtook the leading market position from cough and cold products on the Serbian OTC market (CHAMBER OF COMMERCE OF SERBIA, 2021).

Around half of our respondents use dietary supplements without the recommendation of an expert. Bearing in mind potential interaction, overdosage, and side effects of prolonged uncontrolled dietary supplements application (RONIS et al., 2018), especially when polypharmacy takes place, it is worrisome that a great number of consumers do not discuss the use of supplements with healthcare professionals. Our survey revealed that 43% of respondents support the statement that vitamins, minerals, and dietary supplements are necessary for maintaining good health in current times while around 38% disagree with that conclusion.

According to the opinion of most respondents (87%), herbal medicines and natural products (teas, balms, bee products, etc.) have a beneficial effect on health. Such a high percentage was not a surprise since almost every home in Serbia possesses a copy of „Lečenje biljem“ (HERBAL THERAPY, 1973). This book (written by a university professor, dr. Jovan Tucakov) systematizes ethnopharmacological knowledge herbal products and their specific uses, and self-medication practice based on the book's contents or related ethnopharmacological experience within the family is very common (STOJANOVIĆ et al., 2017). Herbal teas are the most popular type of tea and could be noticed that individuals that used to drink herbal tea occasionally moved toward the regular use with the COVID-19 pandemic (Tab. 1). Yet only 4% of examinees went from no use to regular consumption of herbal teas with the start of the pandemic. The influence of education level on the frequency of tea consumption was not statistically significant. Female gender and advanced age (50+) significantly increase the probability of regular and frequent tea usage ($p=0.0291$, and $p=0.0041$, respectively).

As it could be seen from Tab. 1, both herbal teas and dietary supplements gained popularity from the beginning of the pandemic, although a greater shift toward more frequent use is achieved in supplement application. Dietary supplements should not and cannot be used to treat the problems caused by an unhealthy diet (SHI and YAN, 2020). The caution towards supplement use, especially among vulnerable populations (e.g., people with chronic conditions), is a wise approach (SHI and YAN, 2020).

Tab. 1: Frequency of use of herbal teas and dietary supplements before and during COVID pandemic.

Frequency of use	Herbal teas (%)		Dietary supplements (%)	
	before COVID	during COVID	before COVID	during COVID
regularly	20.6	24.8	8.8	22.1
often	15.9	21.6	7.1	15.4
periodically	35	31.1	32.1	27
when I am ill	9.6	6.4	9.1	6.1
really rare	11.3	10	18.9	12.3
only in winter	3.2	1.2	2.2	1
never	4.4	4.9	21.8	16.1

Variation in the quantity of traditional plant-based food left for winter

Food preparation is a strong part of the Serbian family tradition. Seasonal vegetables are traditionally fermented, and pickles generally consumed during the wintertime (UBIPARIP SAMEK et al. 2021). The most consumed processed vegetables in Serbia are ajvar, cabbage, and turshiya, while the fruit is processed to different sweet preserves. They are often made at home in the autumn, even in cities, but are also sold in supermarkets and served in restaurants. Turshiya is made with green peppers, green tomatoes, carrots, cauliflower, cabbage, and celery. The vegetables are put in a large, covered container, pressed down with some twigs and a stone, and a marinade made of salt, vinegar, and water is poured over. The pickles are left to ferment and are commonly consumed till early summer. Pickled cabbage (sauerkraut) is made separately in a barrel with whole cabbages and marinade of only with salt and water afterward. Pickled cabbage is used both as a winter salad and as an important ingredient of some dishes (JELOCNIK et al. 2019). Ajvar (pepper-based pate made from red bell peppers) and its variations (which also include carrots, eggplant, onion, garlic, and tomatoes) are a regular part of the table spread during the winter. Sweet fruit preserves such as jams, jellies, marmalades, and compote (MATEJIĆ et al., 2020) are often eaten for breakfast as spread on bread or as an ingredient of a pastry or dessert. The winter food left for 2019/2020 winter was an excellent source of processed vegetables and fruits during the lockdown in spring of 2020. Recommendations of the Institute of Public Health on proper nutrition during COVID-19 pandemics among others are: „To reduce the number of trips to the market or supermarket, in addition to fresh, you can also buy frozen or canned fruits and vegetables that also contain vitamins and minerals.“ (INSTITUTE OF PUBLIC HEALTH NIŠ, 2020). Accordingly, one of the questions of our survey dealt with the quantity of „winter food“ prepared for the pandemic 2020/2021 winter.

Compared to last year, many respondents reported the same amount of frozen and processed fruits and vegetables prepared for winter (73%); significantly greater or greater amounts were declared by 11%, somewhat or much smaller amounts by around 10% and 5%, respectively, while 1% of examinees did not prepare at all. These results could either be caused by fear of new quarantine and food shortage or by the worsening economic situation. Besides the constant growth of fruits and vegetable prices in recent years (INSTITUTE OF PUBLIC HEALTH OF SERBIA 2020), COVID-19 has magnified social inequalities and made the poorest families struggling to put food on the table (FAO, 2020).

The general attitude toward diet, plant-based food, natural products, dietary supplements, and teas

Although most respondents in our survey have the attitude that fruits and vegetables contribute to strengthening immunity, 3% of exa-

minees do not believe in the health benefits of everyday fruit and vegetable consumption. Regarding the quality of plant-based food, around 70% of respondents connect the excellent appearance of vegetables and fruits (seemingly the most appealing ones) with over-treatment with different chemicals, and more than half of examinees prefer moderate price and appearance of herbal food. Accordingly, fruits and vegetables are most commonly bought at the open marketplace, followed by supermarkets and groceries although similar numbers of respondents declared each of these three places for purchase. It is interesting to mention a fast reaction of a new generation of producers and consumers that have made a Facebook group in response to the closing of marketplaces during the lockdown and the need of citizens to supply food. The largest such group in the capital of South Serbia (Niškafriška – eng. Fresh in Niš) has grown to an online platform that provides complete technical support to both customers and manufacturers. The group offers fresh and processed fruits and vegetables, honey, dairy products, nuts, etc. (NISKAFRIŠKA MARKET, 2021).

The conclusions of some recent studies (RUIZ-ROSO et al., 2020; SIDOR and RZYMSKI, 2020) pointed out diet impairment due to the COVID-19 pandemic while some others reported its improvement (RODRÍGUEZ-PÉREZ et al., 2020). According to surveys conducted in Spain, Italy, Brazil, Colombia, and Chile, the COVID-19 pandemic modified dietary trends of adolescents, seemingly because families had more time to cook and improve eating habits by increasing legume, fruit, and vegetable intake. This change did not increase the overall diet quality (RUIZ-ROSO et al., 2020). This group of authors pointed out also that females living in Europe and those who reported a higher maternal education had the highest rates of adherence to the weekly food intake recommendation (RUIZ-ROSO et al., 2020).

Our finding that people with good dietary habits are most prone to improve eating behavior is following the conclusions of SIDOR and RZYMSKI (2020). They concluded that overweight and obese subjects are most prone to quarantine-related adverse dietary modification resulting in lower daily frequency of fruit, vegetable, and legume consumption, increased food consumption and snacking, and the greatest tendency to consume meat, sweets, salty snacks, and fast foods daily (SIDOR and RZYMSKI, 2020). A cross-sectional study on the eating behavior changes of the adult population due to the COVID-19 confinement pointed out a significantly higher adherence to the Mediterranean diet during the confinement across all 16 European countries included. Also, stricter contingency restrictions seemed to lead to a significantly higher increase in adherence to a healthy diet (RODRÍGUEZ-PÉREZ et al., 2020).

Although there were no statistically significant differences between fruits, vegetables, and herbal tea consumption before and during the COVID-19 pandemic, a great number of respondents in our study noted a shift toward greater use of plant-based food (Fig. 1). Indeed, around half of the examinees pointed out that their diet slightly moved toward a „healthy“ one since the beginning of the pandemic (among them near 14% significantly approved their dietary practice) while 4% reported a negative impact of the pandemic on their diet style. 15% of all respondents now have the same habits as before the pandemic although they improved their diets at the beginning of the COVID-19 issue (Fig. 2). Old habits appear hard to change even when motivation and some initial improvement exist. According to self-assessment more than a quarter (26.2%) of respondents absolutely consider their diet balanced with a sufficient intake of fruits and vegetables, and around 30% consider it strongly balanced. Yet, 10% admitted to poor dietary habits.

There was a significant shift toward greater use of herbal teas and dietary supplements (with p values 0.0391 and 0.0002, respectively) especially among the population that had already used them occasionally. The number of respondents who regularly take dietary supplements and herbal teas significantly increased while the ones

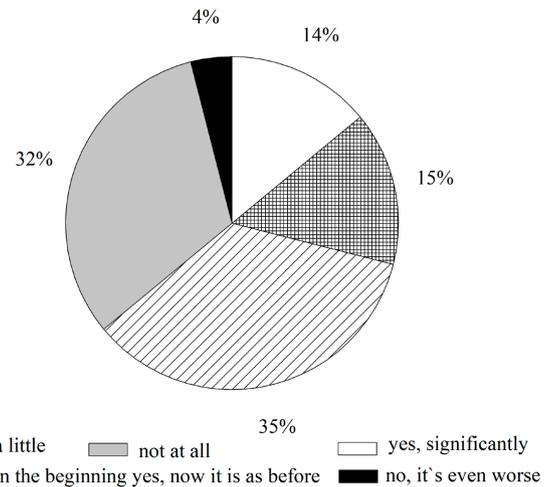


Fig. 2: Self-perception on diet change since the beginning of COVID pandemic.

that use them never or very rarely significantly decreased (Pearson's χ^2 , $p < 0.05$). The strongest statistical significance was noticed for the shift toward regular dietary supplements intake ($p=0.0000017$, $\chi^2=27.3689$). According to our results, the attitudes toward plant-based food are not dependent on the education level while the age of examinees and their previous dietary habits influence greatly the frequency of consuming fruits, vegetables, herbal teas, and dietary supplements. The older respondents are, the they are more likely to improve their lifestyle according to self-evaluation.

Our survey has shown that pandemic did not much affect dietary habits except greater vitamins, minerals, and supplements usage and moderate shift toward larger consumption of different plant-based food products. Yet this cross-sectional study has given indications that a modest shift toward greater use of plant-based food in everyday diet and awareness of its importance in the COVID pandemic exist.

Strengths and limitations of the study

Our study group included respondents that filled out an online questionnaire in Serbian language during the month of January 2021. Since examinees from different age groups and from the different geographical locations were invited to participate in the survey, we can say that the sample of 408 completed questionnaires could be adequate in size for this type of study and deduced conclusions. Only a quarter of the examinees were male, since women are more likely to participate in various questionnaires. This is the first study conducted on the use of plant-based food products and dietary supplements before and during the COVID pandemic in the Serbian-speaking area. One of the limitations of this study is the self-reported data, where one can only rely on the memory from the time of fruits, vegetables, teas, spices, and dietary supplements consumption before the pandemic and its readiness to honestly report the usage of such products.

Conclusion

Having in mind that the current pandemic impacted, among other things, eating behavior and dietary habits, dietary changes from the beginning of the pandemic are in the focus of today's research. The COVID-19 pandemic influenced consumption and attitude toward fruits, vegetables, teas, spices, and dietary supplements in Serbia. The self-perception of personal diet changes revealed shift toward a healthier lifestyle in around half of respondents, although 4% reported worsening dietary habits in comparison to the period before

the new corona SARS-CoV-2 pandemic. An interesting observation is that 15% of all respondents improved their diets at first but have since returned to the same habits as before the pandemic. Also, a greater use of herbal teas and dietary supplements was noticed especially among the people who already have used them from time to time. Yet, dietary supplements are often used without consultation with health professionals. Since plant-based food besides nutritive possesses numerous health-promoting effects, its consumption should be constantly pointed to the global population, especially in the time of highly processed food in which we are living.

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Conflict of interest

No potential conflict of interest was reported by the authors.

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ORCID:

Dragana Pavlovic  <https://orcid.org/0000-0001-6048-4834>

Jelena Matejic  <https://orcid.org/0000-0001-6410-4296>

Ivan Pavlovic  <https://orcid.org/0000-0003-0062-4342>

Milica Veljkovic  <https://orcid.org/0000-0001-6705-4706>

Address of the corresponding author:

Dragana Pavlovic, Department of Pharmacy, Faculty of Medicine, University of Nis, Serbia

E-mail: dragana.pavlovic@medfak.ni.ac.rs

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