



Trends in food bioactives in the COVID-19 pandemic year—JFB audience

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Abstract

The World Health Organization (WHO) stated that COVID-19 could be characterized as a pandemic in March 11, 2020. As for the food industry and related sectors, food safety and security were the first subject of concern. Since there was no evidence that COVID-19 had any effect on food safety and security, the attention was changed to the potential of nutraceuticals and functional foods in positively affecting immunity in the context COVID-19. As for the feedstocks, our readership has shown a great deal of interest in fruits (e.g. pomegranate, grapes, berries, mushrooms, and soybean) and the industrial products thereof (e.g. wine, smoothies, miso), while lipids, peptides, and phenolic compounds were in the spotlight among the bioactive compounds. Considering the number of downloads of each paper, this report provides a cursory account of selected examples to illustrate the trends in food bioactives in the COVID-19 Pandemic Year.

Keywords: Coronavirus; SARS-CoV-2; Functional foods; Nutraceuticals.

1. The audience of Journal of Food Bioactives in in the COVID-19 Pandemic Year

The 9th volume was published on March 31, 2020. Therefore, 20 days after the World Health Organization (WHO) stated that COVID-19 could be characterized as a pandemic. According to the Summary Report on the Extraordinary Scientific Roundtable of IUFOST-CIFST on March 21, 2020, it was stated that there was no evidence that COVID-19 has any effect on food safety and security as well as on food bioactives (Shahidi, 2020). This report (Table 1) was downloaded almost four thousand times and, according to researchgate, has received 25 citations thus far. The phenolic antioxidants of pomegranate were addressed by de Oliveira et al (2020). Their review presented the main antioxidant compounds in pomegranate (e.g. ellagic and gallic acids, anthocyanins, ellagitannins, and procyanidins) and their biological effects, the antioxidant activity of pomegranate-based foods, the application of pomegranate as a natural antioxidant food additive,

the role of pomegranate in the prevention and management of chronic diseases, as well as the trends and prospects regarding the application of pomegranate in innovative food and health. Finally, the original paper by de Carvalho et al. (2020) studied the effects of vineyard management practices in terms of physicochemical characteristics, phenolic profile, and antioxidant capacity of Syrah tropical wines from São Francisco Valley in Brazil. The interaction between the espalier training system and the rootstock IAC 766 resulted in higher flavonol contents, phenolic acids, and malvidin-3-*O*-glucoside, which was detected as the major phenolic as quantified by HPLC. This wine also presented significant levels of procyanidins A2 and B2, which showed a positive correlation with the antioxidant activity.

COVID-19 also received much attention in the volume 10 of the journal. Adequate nutrition is a prerequisite of an optimally functioning immune system. Accordingly, the potential immunomodulatory effects of dietary sources of micronutrients and food bioactives in the context COVID-19 was discussed by Lange and Nakamura (2020). The supplementation of micronutrients,

Table 1. Most downloaded articles from April 2019 to March 2021

Section	Title	Keywords
Volume 9		
Meeting Report	Does COVID-19 affect food safety and security?	Coronavirus; SARS-CoV-2
Review	Pomegranate as a natural source of phenolic antioxidants: a review	Ellagitannins; Anthocyanin; Antioxidant; Polyphenols
Original	Physicochemical characteristics, phenolic profile, and antioxidant capacity, of Syrah tropical wines: effects of vineyard management practices	São Francisco Valley; Vitis vinifera L; Phenolic compounds; Antioxidant activity; Physicochemical composition
Volume 10		
Perspective	Food bioactives, micronutrients, immune function and COVID-19	Food bioactives; Micronutrients; Diet; Immune function; Coronavirus; COVID-19
Original	An overview of Brazilian smoothies: from consumer profile to evaluation of their physicochemical composition, bioactive compounds, antioxidant activity and sensory description	Smoothies consumption; Bioactive compounds; Antioxidant activity; Sensory description
Review	Lipid-derived flavor and off-flavor of traditional and functional foods: an overview	Maillard reaction; Volatiles and non-volatiles; Lipid fatty acids; Oxidation; Flavor and off-flavor
Volume 11		
Opinion	Do natural antioxidants play a role in Alzheimer's disease?	Alzheimer's disease; Antioxidants; Oxidative stress; Prevention; Prooxidant activity
Review	Composition, polyphenol bioavailability, and health benefits of aronia berry: a review	Aronia berry; Anthocyanin; Chronic disease; Composition; Polyphenol
Original	Amber, red and blue LEDs modulate phenolic contents and antioxidant activities in eight Cruciferous microgreens	Amber light; Antioxidants; Light-emitting diodes; Microgreens; Phytochemicals; Secondary metabolites
Volume 12		
Opinion	Food processing and effects on bioactive constituents: an opinion piece	Food processing; Bioactive compounds; Ultra-processing; Junk food; Controversies
Review	Bioactive compounds and bioactive properties of chaga (<i>Inonotus obliquus</i>) mushroom: a review	Phenolics; Terpenoids; Polysaccharides; Alkaloids; Nutraceutical/medicinal properties; Bioactives and bioactivities; Toxicity/safety concerns
Original	Identification of short-chain pyroglutamyl peptides in Japanese salted fermented soy paste (miso) and their anti-obesity effect	Fermented food; Miso; Pyroglutamyl peptide; Pyroglutamyl leucine; Obesity

including vitamins and trace elements, and food bioactives, such as carotenoids and polyphenols, has been shown to be beneficial in enhancing immunity in viral infections. However, the authors highlight that the significance of these compounds in naturally occurring infections derives primarily from studies using animal models while the findings of human studies are inconsistent. According to these authors, nutritional approaches, including administration of food bioactives and micronutrients, may therefore have the potential to augment immune function and defend against COVID-19. Nevertheless, evidence evaluating dietary supplementation in COVID-19 is lacking. At that moment the authors concluded that a reliance on supplements to prevent or treat COVID-19 would be premature. A cursory account of the role of lipids in flavor formation was provided by [Shahidi and Oh \(2020\)](#). Lipid, as a major food component, contributes to the food flavor formation via both interactions with other components and/or due to its own degradation during food processing, cooking, and storage. According to the authors, this is particularly important when dealing with functional foods that may contain a high proportion

of highly unsaturated oils. Consumer's preference and sensory science were also in the spotlight in the last year. [Yassin et al. \(2020\)](#) worked with Brazilian smoothies and pointed out that of the 500 volunteers who participated in the evaluation work, 30% had never heard of smoothies. The regular consumers of smoothies were young student and single women residing in the southern region of Brazil. The strawberry, banana and pineapple were the preferred smoothie flavors. The flavor, residual taste, odor, color intensity, particle presence, homogeneity, turbidity and viscosity were the main terms generated in the sensory description. Additionally, the samples showed significant differences in the analytical parameters evaluated (e.g., phenols, ascorbic acid, and carotenoids), resulting in differences of 4.9, 5.4, 11.3 and 7.6 times on the antioxidant activity as evaluated by DPPH, ABTS, FRAP and CUPRAC assays, respectively.

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by globally impaired cognitive functions. The perspective paper by [Lange et al. \(2020\)](#) focused on a very important question "Do natural antioxidants play a role in Alzhei-

mer's disease?" and the audience of JFB has shown that COVID-19 was not the only subject of interest during 2020. The authors highlight that, since it may influence inflammation and oxidative stress in the brain, diet has been recognized as a modifiable lifestyle factor capable of affecting the risk of developing AD. Dietary intake of natural antioxidants, such as polyphenols, carotenoids and vitamins C and E, is thought to reduce oxidative stress and to have preventive or therapeutic potential in AD. Several antioxidants have shown promise in animal models of AD. However, there is no evidence of clinical efficacy of natural antioxidants in people with AD. Therefore, the authors conclude that the assessment of the effectiveness of antioxidant-rich diets in AD deserves further investigation. This is actually similar to the findings of [Lange and Nakamura \(2020\)](#) when talking about the potential of supplementation with micronutrients and food bioactives in enhancing immunity in viral infections. Aronia berries have abundant levels of anthocyanins, proanthocyanidins, flavonols, and phenolic acids that may reduce the risk of non-communicable diseases. [King and Bolling \(2020\)](#) reported that aronia polyphenols are bioavailable, but the majority are transformed into low molecular-weight phenolics. The authors summarized recent preclinical and clinical studies on the polyphenol bioavailability and health benefits upon aronia berry consumption to better understand its potential as a functional food. [Alrifai et al. \(2020\)](#) investigated different ratios of amber, blue and red LEDs on the synthesis of antioxidant phytochemicals in 8 species of the Brassica genus of microgreens. Their findings suggest the microgreens can be clustered into 3 groups based on phytochemical contents and sensitivity to the lighting: (i) high blue and amber dose-dependence producing high total phenolics and flavonoids content and DPPH antioxidant activity in radish, red Rambo microgreens; (ii) moderate to high sensitivity to overall lighting but no clear dose-dependence to the light in mustards Barbarossa and red kingdom; and (iii) mizunas, pac choi and other microgreens with various responses to lighting.

Food processing and effects on bioactive constituents ([Shahidi, 2020](#)) was addressed in the opinion piece published in the 12th volume. This manuscript highlights that while, palatability and wholesomeness of food are most important, over processing and inclusion of excessive amount of salt, sugar and solid fat with high content of trans isomers must be avoided. Additionally, while preservatives and additives are essential for safety of products and shelf-life extension, when and where possible natural products with established safety records should be used. The so-called, ultra-processed food (UPF) that may refer to products that do not follow these criteria are often associated with a myriad of diseases, but again here, caution must be exercised to avoid misuse of terminologies that may create misconception. Various nutraceutical and pharmaceutical potential, including antioxidant, anti-inflammatory, anti-tumor, immunomodulatory, antimutagenic activity, anti-virus, analgesic, antibacterial, antifungal, anti-hyperglycemic, and anti-hyperuricemia activities/effects, as well as main bioactive compounds including phenolics, terpenoids, polysaccharides, fatty acids, and alkaloids of chaga mushroom have been thoroughly reviewed by [Peng and Shahidi \(2020\)](#), and tabulated using a total 171 original articles. Besides, the up-to-date toxicity concerns and risk assessment about the misuse of chaga, which limit its acceptance and use as medicinal/nutraceutical products, have also been clarified. Miso, a paste of salted fermented soybean, which is a seasoning used extensively in traditional Japanese cuisine was studied by [Shirako et al. \(2020\)](#). Their results suggest that the short-chain

hydrophobic pyroglutamyl peptides present in miso are effective in suppressing high fat diet-induced obesity in rats.

2. Concluding remarks and future trends

The COVID-19 Pandemic Year was marked by uncertainties in many areas. As for the food industry, the concern was initially related to the probable existence of SARS-CoV-2 contaminated food and if such contamination could be dangerous to the consumer. After one year, still there is no evidence that COVID-19 had any effect on food safety and security. Considering that immune function and inflammation are of great importance and that some nutraceuticals and functional foods present the potential to improve health, some authors have speculated that bioactive compounds present in these feedstocks would be of great importance in the context of COVID-19. This relates mainly to the expectation that immune-enhancing effect of certain foods/food ingredients may provide some level of protection in fighting viral infections. However, it is too early to have strong evidences in this direction. Future research in this area is expected to shed some light in terms of the potential of the nutraceuticals and functional foods to contribute in this and in future cases.

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