

Editorial

Beverage Industry By-Products as Bio-Resources of Functional Compounds

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To produce sufficient food for the expanding global population, natural resources are constantly being overused, and at the same time, wastes are being produced at an ever-increasing rate. The waste biomass generated by the food industry sector is primarily dumped in sanitary landfills, but such an option limits the amount of land that can be used for agriculture, while being highly harmful for eco-systems. As opposed to linear models of development, circular economy techniques are focused on valorizing food wastes, to lessen or eliminate their generation and resource misuse. This limits the inefficient use of energy and minimizes waste formation by directing food production into sustainable systems of resource restoration and regeneration. The guiding principles of green chemistry are primarily concerned with reducing waste and encouraging resource and energy efficiency. These principles may apply to extraction processes in a variety of ways, such as the targeted production of extracts with improved/increased biological activities, the use of alternative solvents such as water or other bio-based solvents, the reduction in energy consumption through the implementation of cutting-edge technologies, and the reduction in unit operations for safer and more robust processes.

This Special Issue addressed the concept of innovative and emerging strategies that aim at effectively implementing green technologies for the extraction of bioactive compounds from beverage industry wastes.

Kalompatsios et al. [1] examined the extraction of bioactive polyphenols from waste orange peels (WOP), using a batch stirred-tank mode and water as a solvent. Under optimized settings, the extraction afforded a total yield of polyphenols of 26.13 ± 0.78 mg gallic acid equivalents per gram of dry mass. The use of aqueous solutions of citric, tartaric, and lactic acid revealed that either 1% tartaric acid or 2.5% citric acid can greatly improve total polyphenol recovery. High-performance liquid chromatography analyses showed that the impact on specific polyphenolic compounds, however, was fairly minimal. The differences in the polyphenolic composition were putatively responsible for the differences in antioxidant capabilities between the extracts obtained with water and acidified water. The suggested extraction method may be employed as an efficient way to recover WOP polyphenols and was touted as being low-cost and ecologically friendly.

Tsoupras [2] examined the anti-inflammatory and antithrombotic properties of vitamin C and freshly squeezed juices and their lipid bioactives from the Navalina and Sanguine orange varieties and the Clementine variety of mandarins, and their processing by-products. It was shown that through their general antioxidant effect in platelets, the non-oxidized juices of citrus fruits and a vitamin C supplement exhibited stronger anti-PAF and anti-thrombin effects than their oxidized versions. Total lipids (TLs), the HPLC-derived fractions of phenolic compounds and polar lipid bioactives from juices and their by-products showed a stronger inhibitory effect against the inflammatory and thrombotic pathways of PAF and thrombin in platelets, while also strongly inhibiting specific enzyme activities of the main biosynthetic enzymes of PAF in leukocytes. The stronger bioactivity of the dietary bioactives found in juices of these citrus fruits against specific biochemical pathways of inflammation and thrombosis likely acted in synergy with vitamin C, which further



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supported the notion that these juices may be functional foods with anti-inflammatory properties. The author proposed that the presence of these dietary bioactive phenolic compounds and polar lipid bioactives in waste peels further enhance the valorization of such food industry by-products as potential sources of anti-inflammatory agents, to be used as ingredients for novel functional products.

Vriesekoop et al. [3] presented a study on yeast spreads. According to this study, large amounts of spent brewers' yeast are being used for both food and feed purposes, due to the high nutritional value of spent yeast. Spent brewers' yeast for human consumption in the form of yeast spreads came onto the market in the early 20th century, first in the United Kingdom and shortly thereafter in the commonwealth dominions, especially Australia and New Zealand. In the study, the status of yeast spreads in the UK, Australia, and New Zealand were examined. It was demonstrated that a brewery by-product such as spent brewers' yeast is more than just the creative use of a waste stream; rather, it has become intrinsically linked to the national identities of these nations to the point where some brands have become iconicized.

Alibante et al. [4] studied the development of an integrated green process for the extraction of red grape pomace antioxidant polyphenols using ultrasound-assisted pretreatment and β -cyclodextrin. These substances are primarily extracted from vinification side streams using solvent–liquid extraction techniques; in this context, the investigation's goal was to develop an alternative, environmentally friendly method for extracting polyphenols by incorporating ultrasonication as a pretreatment step and aqueous β -cyclodextrin as the extraction solvent. Pretreatment with ultrasonication was found to significantly improve the recovery of polyphenols from red grape pomace (RGP), and the addition of β -cyclodextrin significantly improved the aqueous extraction. The maximum yield in total polyphenols under optimized conditions, as determined by response surface methodology, was 57.47 mg GAE g⁻¹ dry mass. Comparing the produced extract to the aqueous extract, it showed a significant increase in catechin and quercetin content, as well as increased antiradical activity. These results demonstrated the worth of the method created for the selective recovery of particular polyphenols and the generation of task-specific extracts.

As a promising alternative in the fight against bovine tuberculosis, Blaxland et al. [5] published a study on the antibacterial effect of *Humulus lupulus* (hops) against *Mycobacterium bovis* BCG. In the study, the antibacterial efficacy of 50 hop extracts (45 different variants) against *M. bovis* BCG was examined using an aqueous extraction method. The authors discovered that all hops displayed a level of inhibitory activity using an agar well diffusion assay. This level ranged from 1.2 mm (+/– 0.08 mm) for the hop variant Target to 15.7 mm (+/– 0.45 mm) for the hop variant Citra. The minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) of the Citra variant were both 16% v/v. It was suggested that additional research be focused on other *Mycobacteria* spp., the potential for antimicrobial synergy, and the antibacterial effect of individual components. This was the first study to analyze a wide variety of hops for their antimicrobial potential against *M. bovis* BCG.

Conflicts of Interest: The author declare no conflict of interest.

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