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Editorial

Fruit and Vegetable Derived Waste as a Sustainable Alternative Source of Nutraceutical Compounds

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Dietary phytochemicals are widely investigated in the field of chemistry, biology, nutrition, and medicine for their potential health-promoting effects. Indeed, many *in vitro* and *in vivo* studies provide evidence that a number of these compounds are involved in the prevention and/or control of chronic disorders such as cancer and cardiovascular diseases. The exponential growth of plant waste production from the agrofood industry is a critical global issue, considering its storage, disposal, environmental impact, and potential health risks. However, the exploitation of plant wastes/by-products for the recovery of added-value compounds offers new avenue for industrial growth and waste management. Indeed, the research and development of new functional foods and health products from low-cost raw materials is of great importance in nutraceutical, cosmetic, pharmaceutical, and agribusiness sectors. Besides, optimizing the processing methods of waste products in order to reduce biomass utilization and environmental risks, as well as to improve recovery of added-value compounds, represents an urgent and necessary technological innovation for the benefit of mankind. In an industrial point of view, moreover, the utilization of food waste for recovering nutraceuticals is economical not only in production line but also in their disposal.

The purpose of this special issue is to feature the scientific knowledge on the nutraceuticals associated with plant waste products derived from fruits and vegetables and their *in vivo* and *in vitro* bioactivities. The information disseminated through this issue is hoped to serve as an interdisciplinary link between biochemistry of nutrition, functional foods, and food technologies. Knowledge of not only quantity and quality of nutrients and nonnutrients present in such functional foods but also their bioactivity may provide broader and valuable information on the food quality field of research.

This special issue about "Fruit and vegetable derived waste as a sustainable alternative source of nutraceutical compounds" covers research articles from different perspectives. Overall, most of the papers have been related to (i) extraction and characterization of bioactive compounds from plant by-products as sources of health-related beneficial compounds; (ii) process optimization; (iii) development of new products and functional foods; and (iv) *in vitro* and *in vivo* bioactivities of nutraceutical components present or extracted from plant food wastes.

Among the submitted manuscripts, five papers have been selected to be part of this special issue. The paper authored by V. Lele et al. deals with the development of chewing candy (CC)—nutraceutical formulations from juices and by-products of juices of the fruits sea buckthorn (*Hippophae rhamnoides* L.) and quince (*Cydonia oblonga* L.) with antimicrobial properties against a panel of pathogenic bacteria strains. Two texture-forming agents (agar and gelatin) were tested for CC formulation. The results obtained in this study indicated that all samples (juices and juice by-products) displayed antimicrobial activity against all the

pathogens tested, and the largest inhibition zones against Bacillus and *Proteus mirabilis* were observed for sea buckthorn juice and quince juice, respectively. Moreover, the addition of all samples (sea buckthorn and quince juices and juice by-products) increased the antioxidant activity and total phenolic content of CC. Therefore, taken together all results, not just juice but also juice by-products, have great potential as desirable antimicrobial ingredients for the food industry with the best acceptability values found for CC prepared with agar and sea buckthorn juice by-products and with gelatin and quince juice.

Abundant residues are generated by industrial processing of blackberry in juices and concentrates. The study by Zafra-Rojas et al. analyses chemicals, minerals, organic acids, antioxidants, and dietary fiber of Mexican blackberry (*Rubus fruticosus* cv Tupy) residues and compares it with a prune-based commercial product. The results show that these residues possess bioactive components and functional properties higher than the commercial sample. Indeed, they are a very rich source of malic acid, phenols, and anthocyanins that contribute to a remarkable antioxidant capacity as measured by the ABTS assay. In addition, the residues can reduce iron and contain high amount of dietary fiber with elevated water retention and swelling capacity. Due to these characteristics, this waste matter could be considered as a potential source of useful and healthy components.

The Bigarade is a bitter orange (*Citrus aurantium* L. cv Bigarade) whose unpleasant taste mainly restricts its utilization to industrial extraction of essential oils. The study carried out by Lagha-Benamrouche et al. was aimed at debittering the peel of these fruits to obtain a jam preparation with appreciable sensorial quality. At the same time, a number of analyses have been carried out to check physicochemical characteristics, bioactive components, and reducing power of the jam in comparison with the original bitter fruit. The results show that the debittering process, including treatment with salt (NaCl), heat, and water decreases acidity, sugars, proteins, bioactive compounds, and reducing power, whereas increases the ash rate. Nevertheless, this jam still remains an interesting source of bioactive compounds with antioxidant potential, to be considered for dietary purposes. This may add new interest to the exploitation of this fruit cultivated in Algeria.

Olive tree culture and oil production are of economic significance in Jordan. The paper authored by Al-Widyan et al. faces the interesting problem of treatment and exploitation of olive oil industry by-products and wastes, in particular the solid waste, a lingocellulosic organic material called olive cake. Considering that the processing at the olive mills, usually performed during the cold season, needs large amounts of hot water and then expensive diesel fuel, the authors propose building a system combining a ground well component (receiving water from tankers that bring the water from nearby springs) and a heat recovery component exploiting the aerobic biological fermentation of the olive waste. A number of analyses are performed to assure that the olive cake can be used for extended periods as a source of fermentation. The authors provide evidence that their system can significantly produce raises in the water temperature before entering the fueled-operated boiler, to satisfy much of the mill needs. Souza et al. have reported that custard apple (*Annona squamosa* L.) bagasse flour, a by-product from custard apple processing, could serve as a promising ingredient in cookies enabling good sensory acceptability. The authors have also shown that the flour and the cookies formulations are rich in essential minerals (Cu, Fe, Mn, Zn, Ca, and Mg) and polyphenols (200 to 658 mg GAE/100 g). Overall, the research highlights that the custard apple bagasse pulp flour can be incorporated in food formulations to improve nutritional and functional properties.

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