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Extraction of carotenoids from cantaloupe waste and determination of its mineral composition

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ABSTRACT

The carotenoid and mineral levels as well as the *in vitro* antioxidant capacity, using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay, of waste from cantaloupe was assessed. Then the matrix was subjected to ultrasound-assisted extraction (UAE) and response surface methodology (RSM) was used for the optimization of the extraction of carotenoids. The effect of the extraction procedure on the microstructure of the powder was assessed by scanning electron microscopy (SEM) analysis. The major carotenoids identified were lutein (63.24 ± 0.73 μg βCE/g dw) and β-carotene (56.43 ± 0.11 μg βCE/g dw). Several mineral elements (K, Na, P, Mg, Ca, Fe, Cu, Mn and Zn) were identified, potassium being the major one.The extract exhibited *in vitro* antioxidant activity (IC_{50} = 7.33 ± 0.22 μg/mL). The RSM results showed that an amplitude of 100%, extraction time of 10 min, hexane percentage of 80% in hexane/acetone solvent, and solvent-to-solid ratio of 55 mL/g were the optimal conditions for the extraction of carotenoids. Under these conditions, the carotenoid content of the extract was 124.61 ± 3.82 μg/g.The microscopic analysis revealed the effectiveness of the ultrasound treatment that results in noticeable physical changes, like microscopic perforations and breakages.

1. Introduction

Colorants are extensively used in food industry as they are much related to the sensory quality and therefore to food choice and preference, hence the production of colorants continues to increase (Martins, Roriz, Morales, Barros, & Ferreira, 2016). Synthetic colorants are perceived as potentially harmful for many consumers, therefore, there is a constant trend to try to replace them with natural pigments (Zhang, Yin, Kong, & Jiang, 2011).

Plant or natural pigments are important in signalling, they attract pollinators and seed dispersal agents and repel herbivores (Eldahshan & Singab, 2013). They are also important for humans, because colour is one of the attributes of appearance related to food acceptability (Meléndez-Martínez, Britton, Vicario, & Heredia, 2007). In addition to their role in providing colour, natural pigments such as carotenoids can be involved in a wide variety of health-promoting biological functions (Saini, Nile, & Park, 2015).

Fruits and vegetables are rich in carotenoids and are the most important contributors to these compounds in the typical human diet. During the treatments applied on these foods, large amounts of waste were occured. It is estimated that about 1.3 billion of food wastes are produced per year (Arshadi et al., 2016; Matharu, de Melo, & Houghton, 2016), which poses important problems for the industry and the environment. Fruits and vegetables waste might be rich sources of bioactive compounds and can be used to obtain products with high added-value for the agro-food, cosmetic or pharmaceutical industry.

Currently there is a trend to extract such compounds not only from foods but also from by-products and wastes by means of green extraction. This consists in the extraction procedures design that use environmental friendly solvents and renewable products, reduce the consumption of energy and have a suitable extract in terms of safety and other quality parameters as result (Chemat, Vian, & Cravotto, 2012).

Recently, different novel and emerging technologies for green extraction such as High Hydrostatic Pressures (HHP), Ultrasound (US), Pulsed electric fields (PEF) and Microwaves (MW) are being increasingly used (Barba, Galanakis, Esteve, Frigola, & Vorobiev, 2015; Deng et al., 2014; Kyriakopoulou, Papadaki, & Krokida, 2015). In this regard,

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