Exploring the valorisation potential of Tomato cultivation by-products in the frame of Circular Economy

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Abstract

Purpose: In this study tomato waste (TW), consisting of leaves, stems, red and green tomato fruit, was used for the receipt of valuable bioactive compounds that were encapsulated for the potential development of innovative industrial materials.

Methods: The extraction methods for the recovery of TW extracts, were Ultrasound Assisted Extraction (UAE) and Ultrasound -Microwave Assisted Extraction (UAE-MAE). The efficiency of these processes was evaluated by their extraction yield. The total phenolic (TPC) and total flavonoid content (TFC) as well as the antioxidant activity of the extracts was evaluated using protocols of several analytical methods. Subsequently, the electrospinning process was used, for encapsulating the extracts into final polymeric films. The films' properties were evaluated by Scanning Electron Microscopy (SEM), Attenuated Total Reflectance Infrared spectroscopy (ATR-FTIR) and Differential Scanning Calorimetry (DSC).

Results: The analysis showed that stem followed by leaves had the highest bioactive content compared to the fruit for the same extraction methods, while UAE for 20 min with previous 72 h stirring in the extraction solvent was the most effective method. Specifically, high TPC (604.7 mg GAE/g d.e., 270.5 mg GAE/g d.e.) and TFC (150.6 mg QE/g d.e., 144.6 mg QE/g d.e.) were measured in the stem and leaves extracts respectively, as well as significant antioxidant activity in stem (73.54 mg TE/ g d.e.). Finally, electrospinning led to thermally stable nanofibers with physical encapsulation.

Conclusions: TW proved to be an important source of bioactive compounds that could be exploited with novel technologies for use in numerous applications i.e., active packaging.

Keywords

Encapsulation, ultrasound and/or microwave assisted extraction, stable formulations of bioactive extracts, added value applications.