World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:17, No:08, 2023

Encapsulated Bioflavonoids: Nanotechnology Driven Food Waste Utilization

Authors : Niharika Kaushal, Minni Singh

Abstract : Citrus fruits fall into the category of those commercially grown fruits that constitute an excellent repository of phytochemicals with health-promoting properties. Fruits belonging to the citrus family, when processed by industries, produce tons of agriculture by-products in the form of peels, pulp, and seeds, which normally have no further usage and are commonly discarded. In spite of this, such residues are of paramount importance due to their richness in valuable compounds; therefore, agro-waste is considered a valuable bioresource for various purposes in the food sector. A range of biological properties, including anti-oxidative, anti-cancerous, anti-inflammatory, anti-allergenicity, and anti-aging activity, have been reported for these bioactive compounds. Taking advantage of these inexpensive residual sources requires special attention to extract bioactive compounds. Mandarin (Citrus nobilis X Citrus deliciosa) is a potential source of bioflavonoids with antioxidant properties, and it is increasingly regarded as a functional food. Despite these benefits, flavonoids suffer from a barrier of pre-systemic metabolism in gastric fluid, which impedes their effectiveness. Therefore, colloidal delivery systems can completely overcome the barrier in question. This study involved the extraction and identification of key flavonoids from mandarin biomass. Using a green chemistry approach, supercritical fluid extraction at 330 bar, temperature 40C, and co-solvent 10% ethanol was employed for extraction, and the identification of flavonoids was made by mass spectrometry. As flavonoids are concerned with a limitation, the obtained extract was encapsulated in polylactic-co-glycolic acid (PLGA) matrix using a solvent evaporation method. Additionally, the antioxidant potential was evaluated by the 2,2-diphenylpicrylhydrazyl (DPPH) assay. A release pattern of flavonoids was observed over time using simulated gastrointestinal fluids. From the results, it was observed that the total flavonoids extracted from the mandarin biomass were estimated to be 47.3 ±1.06 mg/ml rutin equivalents as total flavonoids. In the extract, significantly, polymethoxyflavones (PMFs), tangeretin and nobiletin were identified, followed by hesperetin and naringin. The designed flavonoid-PLGA nanoparticles exhibited a particle size between 200-250nm. In addition, the bioengineered nanoparticles had a high entrapment efficiency of nearly 80.0% and maintained stability for more than a year. Flavonoid nanoparticles showed excellent antioxidant activity with an IC50 of 0.55µg/ml. Morphological studies revealed the smooth and spherical shape of nanoparticles as visualized by Field emission scanning electron microscopy (FE-SEM). Simulated gastrointestinal studies of free extract and nanoencapsulation revealed the degradation of nearly half of the flavonoids under harsh acidic conditions in the case of free extract. After encapsulation, flavonoids exhibited sustained release properties, suggesting that polymeric encapsulates are efficient carriers of flavonoids. Thus, such technology-driven and biomass-derived products form the basis for their use in the development of functional foods with improved therapeutic potential and antioxidant properties. As a result, citrus processing waste can be considered a new resource that has high value and can be used for promoting its utilization.

Keywords : citrus, agrowaste, flavonoids, nanoparticles
Conference Title : ICWM 2023 : International Conference on Waste Management
Conference Location : Sydney, Australia
Conference Dates : August 24-25, 2023