

Comparative chemical, structural and functional characterization of pectic polysaccharides and polyphenol co-extracted from mangosteen (*Garcinia mangostana* L.) peels using eco-friendly hybrid technologies

Nhu Bich Ma^{a*}, Ngoc Lieu Le^b

^a Faculty of food technology, Saigon Technology University, 180 Cao Lo, Chanh Hung ward, Ho Chi Minh city, Vietnam

^b Department of food technology, International University, Quarter 33, Linh Xuan ward, Ho Chi Minh city, Vietnam

Abstract

This study aimed to compare the characteristics of pectic polysaccharides and phenolics simultaneously isolated from mangosteen (*Garcinia mangostana* L.) peels using two eco-friendly hybrid extraction methods: ultrasound–microwave-assisted extraction (UMAE) and enzyme–ultrasound-assisted extraction (EUAE). The extracted polysaccharides exhibited colors ranging from dark brown to yellow and irregular, rough surface morphologies. They showed high purification yields (92.5–94.8%), a medium degree of esterification (48–53%), and bimodal molecular weight distributions ($0.12\text{--}2.42 \times 10^5$ Da and $11.66\text{--}13.24 \times 10^5$ Da). Thermal analysis revealed two endothermic peaks and one exothermic peak, while monosaccharide composition was dominated by arabinose, glucose, and galactose. Compared to EUAE, UMAE-derived polysaccharides exhibited higher methoxyl content (6.4%) and anhydrouronic acid content (69%), but lower solubility (69%), equivalent weight (540 g/mol), and bioactive compound contents, including total phenolics (25.9 mg GAE/g DW), anthocyanins (37.5 mg C3G/100 g DW), and antioxidant activity (24.9 mg TE/g DW). In contrast, EUAE polysaccharides showed significantly higher solubility (91%), equivalent weight (2300 g/mol), total phenolic content (42.1 mg GAE/g DW), anthocyanin content (65.3 mg C3G/100 g DW), and antioxidant activity (44.64 mg TE/g DW). For phenolic extracts, both methods yielded comparable levels of total phenolics (222.7–230 mg GAE/g DW), total flavonoids (62–78 mg rutin equivalent/g DW), and anthocyanins (95–108 mg C3G/100 g DW). However, EUAE extracts contained substantially higher levels of α -mangostin and γ -mangostin (approximately 50% higher), resulting in enhanced antioxidant activity. Overall, both UMAE and EUAE are effective eco-friendly approaches for the simultaneous recovery of valuable bioactive compounds from mangosteen peels, with EUAE showing superior performance in enhancing bioactive content and antioxidant capacity.

Key words: eco-friendly extraction, antioxidant properties, mangosteen peel. Phenolic, polysaccharide, structural profiles.

* Corresponding author E-mail address: wjs3@cam.ac.uk