

Correlations Between Antioxidant Activity and Bioactive Compounds in Ethanolic Extracts of Pomegranate Peels and Seeds and Their Physicochemical Composition

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Abstract

Pomegranate by-products have been widely studied for their bioactive and antimicrobial potential. Managing waste from pomegranate peel and seeds can lead to large reductions in environmental burdens. Its valorisation is of utmost relevance and requires preserving its biological properties. However, there is a lack of information regarding its composition and physicochemical characteristics, which correlate with its biological potential. This study aims to characterize the peels and seeds of three cultivars (Acco, Big Full and Wonderful) grown in Alentejo Region of Portugal, in terms of moisture, ash, volatile solids, protein and lignin content, pH, titratable acidity (TA), electrical conductivity and elementary composition (C, N, S). In addition, the bioactive potential of the peels and seeds extracts produced under sonication-assisted extraction was evaluated in relation to total phenolic compounds, total flavonoids and antioxidant activity. The effect of different ethanol/water solvents (water; EtOH25%; EtOH50% and EtOH75%) was also evaluated. Significant differences were observed between the composition of pomegranate by-products, as well as between cultivars. In terms of pH and titratable acidity, the peels (pH = 3.55-3.96; TA = 5.38-6.21 g citric acid/100 g (db)) were more acidic than the seeds (pH = 3.77-5.31; TA = 1.86-5.07 g citric acid/100 g (db)). However, seeds had the highest moisture content (14.06-21.15%), protein (9.25-15.83%, db), nitrogen (1.48-2.53%, db) and insoluble lignin (22.76-29.80%, db). The EtOH25% and EtOH50% mixtures proved to be the best solvents to improve the extraction yield and increase the content of bioactive compounds. Regardless of the cultivars, the peels gave the best results. Peel from Big Full had the highest extraction yield (56.41%) and

antioxidant activity (0.009 mg/mL IC₅₀) with EtOH25%, but higher total phenolic content (0.499 mg GAE/mg extract) was obtained with EtOH50%. The highest content of total flavonoids was obtained for seeds of the Wonderful cultivar with EtOH25%. Negative significant correlations were found between phenolic compounds and total Kjeldahl nitrogen and the protein content of the by-products. The main conclusions were that more acidic matrices, with less nitrogen content, lead to greater antioxidant activity of the extracts. It was also observed stronger correlations for solvents with a higher ethanol content. Among the cultivars studied, Big Full proved to be the most differentiated, either in the composition of the peel or seeds. The results obtained allow to expand the knowledge about the physicochemical composition of the pomegranate by-products of the studied cultivars, besides allowing to establish predictions regarding its bioactive potential.

Keywords: Pomegranate peel and seeds, physicochemical composition, antioxidant activity, Sonication-assisted extraction, *Punica granatum* L.

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