Bioactive Edible Films from Pomegranate Peel: A Circular Strategy for Sustainable Food Packaging

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The packaging plays a fundamental role in the storage, transportation, and preservation of food products. Recently, numerous studies have highlighted the potential of natural biopolymers, such as proteins and carbohydrates, as sustainable packaging materials. These biopolymers provide good barriers against oxygen but are generally poor barriers to water vapor. However, they offer the advantage of being functionalizable, enabling the development of active, antimicrobial, and intelligent packaging systems. In this context, the present work aimed to extract bioactive compounds from the waste generated by pomegranate juice processing, mainly the peel, quantify these compounds, and incorporate the extract into films based on gelatin and starch. The films were produced by using the extract as a solvent for both gelatin (10%) and starch (3%), with glycerol used as a plasticizer at 5% and 20%, respectively. The aqueous-based extracts, diluted at ratios of 1:100 and 1:150, showed values of 5556.32 and 6512,89 umol FeSO4 / g amostra, respectively. The last sample showed values of 5313.78 in the ABTS assay and 268.04 mg GAE/g dry matter of total phenolics. The films were homogeneous and transparent, without rupture zones or imperfections. Thinner films were observed for those based on starch. Results for the films indicated higher antioxidant activity in films made solely with starch, reaching 2,067.4 µmol $FeSO_4$/g of sample. By recovering and applying these compounds in the development of edible films or coatings, we not only reduce the environmental impact associated with fruit waste disposal, but also contribute to the creation of functional packaging solutions aligned with eco-design principles.