

Raspberry seeds as a promising source of bioactives

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Around 97% of harvested raspberries are processed into foodstuffs like jams, juices, and sauces due to their high perishability. However, this processing generates significant amounts of discarded raspberry seeds (RS, ca. 110k ton), raising environmental concerns. Raspberry seed oil (RSO) is a known extractable fraction from this byproduct and is highly valued due to its richness in polyunsaturated fatty acids (PUFAs, ca. 86%), renowned for their human health outcomes. Despite that, commercial RSO applications have predominantly been confined to the cosmetic field³, with limited exploration in food-related sectors. Furthermore, the composition of the remaining seed materials, particularly its polymeric constituents like polysaccharides and proteins, remains underexplored¹. In this work, RSO was recovered using Soxhlet extraction with *n*-hexane, while the polymeric material was recovered by microwave-assisted extraction (MAE)², employing a design of experiments to optimize the temperature (T), operation time (t), and solvent quantity (0-0.6% acetic acid aqueous solution) parameters. Chemical characterization confirmed RSO as a specialty oil, rich in PUFAs (92%) with antioxidant (IC₅₀ 139 µg/mL) and hypocholesterolemic (up to 80% increase in cholesterol insolubility) effects. Meanwhile, the defatted RS yielded up to 14% of carbohydrates (w/w) being rich in arabinose-, glucose-, and xylose-rich polysaccharides (up to 45%). MAE allowed to enhance up to fourfold the original RS protein content (up to 31%). These MAE soluble extracts showed antioxidant (up to IC₅₀ 65 µg/mL) and antidiabetic (up to 84% α-glucosidase inhibition) activity. The MAE extracts were successfully incorporated into biscuits potentiating their antioxidant activity. Simultaneously, RS biopolymers (carbohydrates and protein) are being used to develop pectin-based oleogels by incorporating RSO, offering a novel approach to simulate the texture of animal fats while delivering health benefits. Overall, both RS-derived biopolymers and RSO represent a promising renewable source of biomolecules for innovative food applications, adding value to this agri-food byproduct.

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References:

1. Lopes, P., Ferreira, I. M. P. L. V. O., Petronilho, S., & Passos, C. P., *Food Chem.*, 2025, 486, 144658.
2. Passos, C. P., & Coimbra, M. A., *Carbohydr. Polym.*, 2013, 94(1), 626–633.