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Co-Extraction of Bioactives from *Rosa canina* Flowers for Oleolite Production Using Supercritical CO_2: Focus on Oxidative Stability Enhancement

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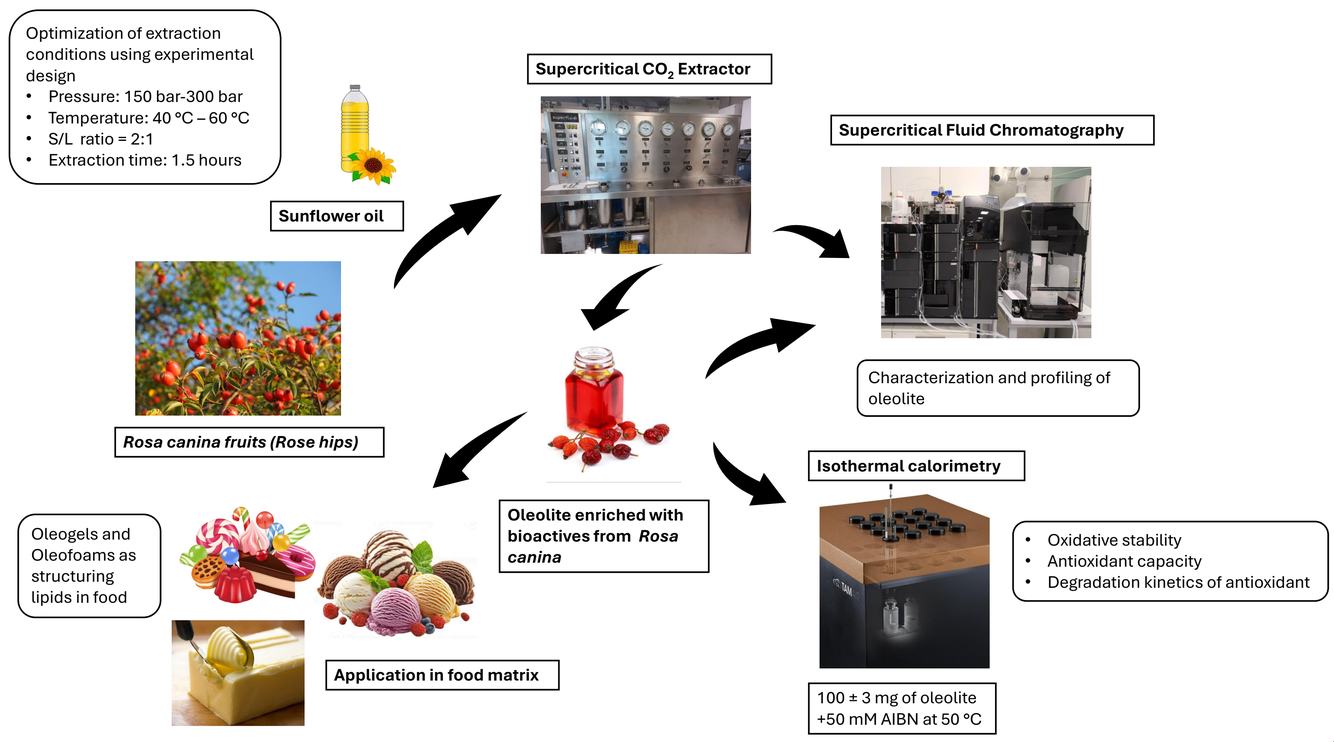
Introduction

- The growing demand for natural antioxidants and clean-label lipid formulations has driven interest in sustainable extraction strategies. This study explores the co-extraction of bioactive compounds from *Rosa canina* flowers into sunflower oil using supercritical CO_2 (SC-CO_2) to develop oleolites with enhanced oxidative stability.
- The SC-CO_2 processing variables (pressure and temperature) were optimized using a Central Composite Design to obtain oleolites with enhanced bioactive compounds.
- Sunflower oil was employed as a food-grade co-solvent under optimized SC-CO_2 conditions, and the resulting extracts were analyzed for oxidative stability (isothermal calorimetry), antioxidant activity (DPPH assay), and bioactive profile (supercritical fluid chromatography).
- The enriched oleolites exhibited significantly improved oxidative stability reflected by longer induction times and delayed lipid oxidation which attributed to the transfer of lipophilic antioxidants such as tocopherols and carotenoids into the oil matrix.
- This work demonstrates the potential of SC-CO_2 co-extraction as a green and efficient strategy for producing functional lipid-based systems, offering oxidative protection and bioactive enrichment suitable for nutraceutical, food, and cosmetic applications.

Materials and Method



Results and Discussion

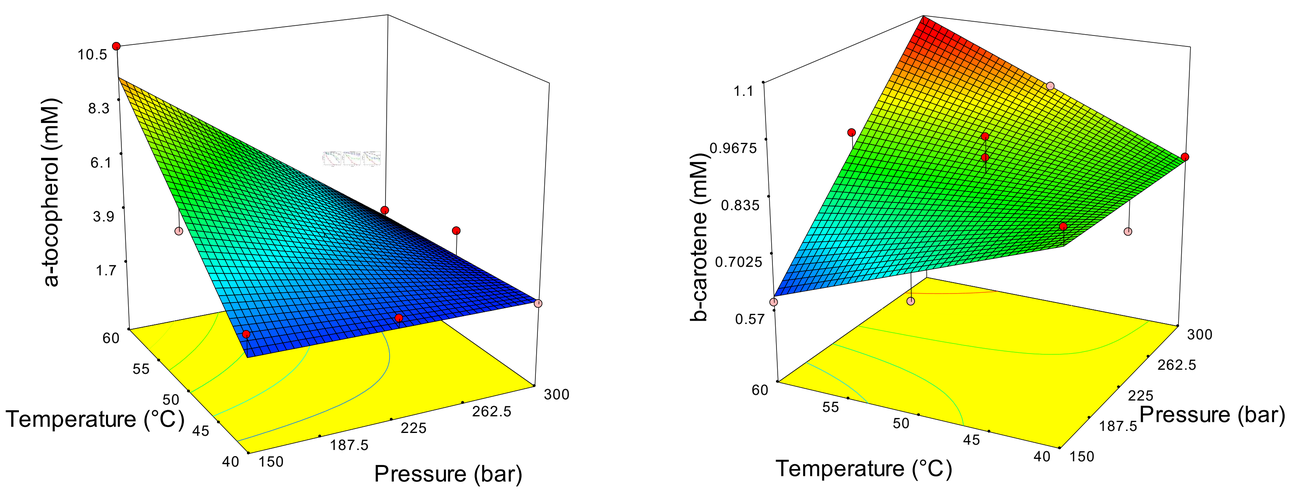


Fig. 1. Pressure and Temperature correlation of α–tocopherol (mM) and β-carotene content in oleolites.

- Across the experimental design, α-tocopherol was the most abundant antioxidant, with concentrations peaking at 15.25 mM under the low-pressure and high-temperature condition of 150 bar and 60 °C.
- By contrast, β-carotene concentrations were markedly lower, reaching their maximum of 1.05 mM only at higher pressure at 300 bar and 60 °C.
- It was possible to identify two distinct optimal conditions clusters. The first one being a tocopherol-rich condition at 150 bar and 60 °C, characterised by high antioxidant power and strong correlation with DPPH activity, and secondly a carotenoid-rich condition at 300 bar and 60 °C.

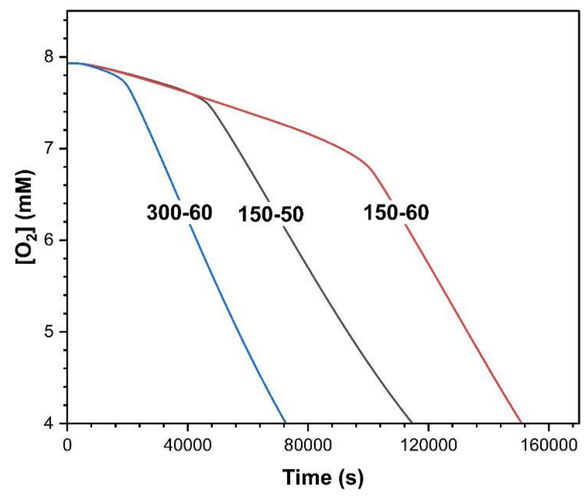


Fig 2. Rate of Oxygen consumption against Time for the oleolites obtained at different extraction conditions: 300 bar and 60 °C (300-60), 150 bar and 50 °C (150-50) and 150 bar and 60 °C (150-60).

- The results demonstrated a significant dependence of the oleolites oxidative stability on the extraction conditions.
- Oleolites with higher content of α-tocopherol obtained at 150 bar and 60 °C reported the highest induction time.

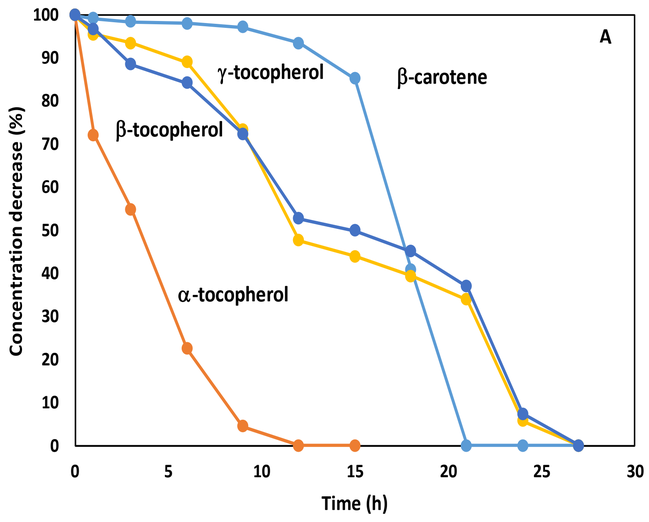


Fig 3. Dynamic consumption curves of antioxidants compounds over time for oleolites extracted at 150 bar and 50 °C measured by supercritical fluid chromatography.

- The depletion of α-tocopherol closely correlated with the induction times obtained calorimetrically, within experimental error.
- This correlation highlights α-tocopherol as the major chain-breaking antioxidant controlling the inhibited period, in agreement with mechanistic studies on lipid oxidation kinetics that identify tocopherols as the primary peroxyl radical scavengers in lipid systems.
- In contrast, β-carotene exhibited a lower consumption rate and a weaker correlation with induction time, suggesting that its antioxidant role under these conditions was limited.

Conclusions and Future work

- Co-extraction from *Rosa canina* with sunflower oil using supercritical CO_2 produced **bioactive-rich oleolites**, with pressure and temperature strongly influencing yield and antioxidant composition.
- **α-tocopherol** was the **key contributor** to antioxidant activity and oxidative stability.
- Future work will focus on **sustainable oleolite production**, enhancing oxidative stability, and evaluating **physicochemical properties** (stability, color, viscosity, texture, functionality, shelf-life).
- Application studies will explore the **incorporation of oleolites into real food matrices** through structured lipids (oleogels, oleofoams), aiming to establish them as **clean-label, sustainable functional ingredients** for food and nutraceuticals.

References

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