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Valorization of Allium Ampeloprasum Propagation Organ (Japanese Garlic) Byproducts for Phenolic Compounds Recovery: A Circular Approach

Ana Montserrat Corona-España[1,*], Mario Alberto Garcia-Ramirez[1], Jorge Iván Delgado-Saucedo[1], Francisco Misael Gómez-Villegas[2], Orfil González -Reynoso[1] and Ingrid Mayanin Rodriguez-Buenfil[2]

[1]*University of Guadalajara, University Center of Applied Sciences and Engineering, Guadalajara Jalisco, Mexico*
[2]*Center for Research and Assistance in Technology and Design of the State of Jalisco. A.C Southeast Sub-Headquarters, Mérida Yucatán, Mexico*

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Abstract

The *genus Allium* comprises more than 1,100 species, among which *Allium cepa* and *Allium sativum* stand out for their nutritional and medicinal relevance. However, species such as *Allium ampeloprasum* as well as its propagation organ, also known as Japanese garlic, remain relatively unexplored, despite their increasing cultivation in Mexico and their recent promotion as a substitute for common garlic due to their similar flavor, better digestibility, and less unpleasant breath effects (Kurnia et. al., 2023, Zhu et. al., 2025, Baños et. al., 2022). Nevertheless, the industry generates large volumes of byproducts, such as the skin shells of the propagating organ, that represent up to 30% of total production and constitute a potential source of bioactive compounds (Hitlamani et. al., 2024). The aim of this study was to evaluate the phenolic profile, total polyphenol content by Folin-Ciocalteu method, and the antioxidant capacity by the DPPH assay of different *A. ampeloprasum propagation organ* raw materials (Skin shells, peeled, and complete) extracts, subjected to different drying processes (Freeze-drying as well as oven drying) using hydrophilic natural eutectic solvents (NADES) based on choline/glucose (0.8:1 molar ratio), hydrated to 60% and 68%, in order to be compared to conventional methanol extraction. Individual polyphenols quantification was performed by ultra-high-performance liquid chromatography (UHPLC) using two phenolic standards mixtures. While methanolic extractions yielded a higher total phenolic content, NADES extracts exhibited a more selective extraction profile for molecules with established antioxidant and anti-inflammatory activities. This positions NADES as a biocompatible and sustainable alternative for targeted byproduct valorization. The highest total polyphenol content was obtained in freeze-dried skin shells extracted with 60% hydrated NADES (384.81 ± 15.38 mg GAE/100 g). The greatest DPPH radical inhibition was observed in freeze-dried skin shells with 68% hydrated NADES (93.08 ± 0.58%), followed by the complete propagation organ under the same extraction conditions with NADES and hydration, where polyphenols like: Catequin, Chlorogenic acid, Rutin, Quercetin + Luteolin, Kaempferol, Hesperidin, stand out. These values highlight the *A. ampeloprasum* potential as an alternative source of phenolic compounds as the results exceed those previously reported on *Allium sativum*'s variety. This study demonstrates the valorizing A. ampeloprasum agro-industrial byproducts using NADES feasibility, contributing to the crop's comprehensive application in the food, nutraceutical, and

pharmaceutical industries, as an important antioxidant and anti-inflammatory option.

Keywords: Allium ampeloprasum, Japanese garlic, polyphenol and antioxidant

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