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**INSTITUTE
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IN NOVI SAD**

BOOK OF PROGRAMME AND ABSTRACTS



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food security for a better tomorrow"*

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Smart NADES for Solvent Reuse: Astaxanthin Extraction from *Haematococcus pluvialis* Using Fatty Acid-Based Systems

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Abstract: Various health issues, closely associated with excessive oxidative stress, have created an increasing demand for efficient natural antioxidants such as astaxanthin. However, the extraction of this potent lipophilic compound from natural sources typically relies on toxic and volatile organic solvents, which limits process sustainability and safety. In addition, once extracted, the separation of the compound from the solvent phase remains a major challenge due to strong analyte-solvent interactions. To overcome these limitations, a fatty acid-based natural deep eutectic solvent was developed and evaluated as a green alternative that enables both efficient astaxanthin extraction and its subsequent recovery. The eutectic mixture, composed of mid-chain fatty acids, octanoic and nonanoic acid, was selected due to their lipophilic character and strong affinity toward the lipophilic astaxanthin. The solvent exhibits tunable polarity, which allows controlled separation of astaxanthin from the obtained extract. The extraction procedure was conducted under mild thermal and mechanical conditions, using solid-liquid extraction with magnetic stirring, and the process was optimized using response surface methodology and the Box- Behnken design to achieve maximal astaxanthin yield from the algal biomass (*Haematococcus pluvialis*). Polarity switching was induced by the controlled addition of a hydrogen bond-accepting amine, resulting in rapid carotenoid crystallization and solvent regeneration. The obtained results demonstrated that the fatty acid-based eutectic solvent achieved extraction efficiency comparable to conventional organic solvents such as acetone and ethanol, with the added benefit of simple astaxanthin recovery and solvent reuse through polarity switching. This dual functionality highlights the potential of such natural deep eutectic solvents as sustainable and versatile alternatives for the valorization of natural bioactive compounds. The presented approach supports the transition toward environmentally responsible extraction practices aligned with the principles of green chemistry and circular bioeconomy, contributing to the development of safer and more sustainable food and nutraceutical products.

Keywords: Natural deep eutectic solvents (NADES); astaxanthin; switchable NADES; carotenoids; green extraction