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Preconcentration Of Persistent Organic Pollutants in Aqueous Sample by Alginate Natural Deep Eutectic Solvent Assisted Microextraction Technique

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Structured Abstract

Background: Pesticides have positively impacted crop yield and quality, but their chemical properties pose environmental and health risks, leading to their persistence in water bodies, soils, and biological tissues. To address this, rapid and environmentally friendly detection methods, such as Micro Solid Phase Extraction (μ -SPE), are studied. Utilising green sorbents like Alg-NADES, this method employs Natural Deep Eutectic Solvent encapsulated in Alginate (Alg-NADES) to efficiently capture organophosphate pesticides (OPPs) and organochlorine pesticides (OCPs). This eco-friendly approach aligns with the principles of green chemistry, offering an improved and sustainable alternative to conventional extraction methodologies.

Methods: Synthesised Alg-NADES beads were employed for the extraction of targeted organophosphate pesticides (OPPs) and organochlorine pesticides (OCPs), including diazinon, chlorpyrifos, p,p-DDE, and dieldrin from paddy water. Prepared through an encapsulation method, the Alg-NADES beads underwent characterisation via ATR-FTIR and FESEM analysis. These beads were then utilised as solid sorbents in Micro Solid Phase Extraction (μ -SPE) of the pesticides. Parameters such as extraction time, desorption time, and mass sorbent were systematically evaluated and optimised using Box-Behnken Design (BBD) before GC-MS analysis. The optimized conditions resulted in favourable analytical figures of merit for μ -SPE.

Results: FTIR analysis indicates Alg-NADES matrix interaction via π - π stacking, while FESEM results show porous, unsymmetrical beads with a distinct spherical shape and rough surfaces. Upon optimisation, the limit of detection (LOD) were obtained to be in the range of 0.003-0.024 mg/L and percent recoveries of 88-110%. Calibration curves were linear over wide ranges, with coefficients of determination ranging from 0.9867 to 0.9994. Relative standard deviations were in the range of 5.10-11.90% and 2.17-12.84% for intra-day and inter-day precision respectively.

Conclusion: In conclusion, the findings of this study indicated that there are promising results in extracting pesticides using Alg-NADES beads due to its porosity. It offers an eco-friendly alternative, help to reduce the use of harmful solvents, and to achieve SDG 6 of 2030 Agenda for Sustainable Development.

Keywords: Micro solid phase extraction, NADES, Box Behnken Design, Organochlorine Pesticides, Organophosphate Pesticides

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