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## **Fabricated Alginate Beads With a Polymeric Natural Deep Eutectic Solvent For Green Micro-Solid Phase Extraction ( $\mu$ -SPE) Of Pesticide in Tea Leave Sample**

Syifa' Amerah Fauzey<sup>a</sup>, Wan Nazihah Wan Ibrahim<sup>a\*</sup>

### **Structured Abstract**

**Background:** The background of the study delves into the investigation of alginate beads manufactured with a polymeric natural deep eutectic solvent (NADES) for eco-friendly micro-solid phase extraction ( $\mu$ -SPE) of pesticides from tea leaves. This environmentally conscious approach targets the extraction of specific pesticides like diazinon, chlorpyrifos, p,p-DDE, and dieldrin. The study underscores the green and sustainable nature of pesticide extraction, emphasizing the enhanced selectivity and efficiency achieved with alg-NADES beads. The synthesis of these beads employs an encapsulation method, and their characteristics are analyzed using ATR-FTIR and FESEM analyses.

**Methods:** In the method section, the encapsulated alg-NADES beads are utilized as solid sorbents in micro-solid phase extraction ( $\mu$ -SPE) of pesticides. The extraction process is optimized by evaluating factors such as extraction time, desorption solvent, desorption time, and mass sorbent. A detailed examination is conducted using GC-MS analysis under optimized conditions. The study emphasizes the controlled release of NADES through the encapsulation technique, contributing to the overall efficiency of the extraction process.

**Results:** Results indicate the successful implementation of the alg-NADES beads in micro-solid phase extraction. Analytical figures of merit for  $\mu$ -SPE, including linear ranges, limits of detection, and extraction recoveries, are assessed under optimized conditions. The efficiency of the prepared sorbent is confirmed through the extraction of pesticides from real tea samples. Calibration curves show linearity in wide ranges with coefficients of determination. Intra-day and inter-day precision are measured through relative standard deviations. Overall, the results affirm the viability and effectiveness of the proposed green and sustainable approach for pesticide extraction.

**Conclusion:** To sum it up, our findings suggest that using these alginate-NADES beads is a good and environmentally friendly way to extract pesticides from tea. We see potential for using these beads in other areas too. The study also considers the environmental impact and rates our approach as quite green.

**Keywords:** Alginate, Natural Deep Eutectic Solvent, Gas-Chromatography,  $\mu$ -SPE, Pesticide

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\*Correspondence: [wannazihah@uitm.edu.my](mailto:wannazihah@uitm.edu.my)

<sup>a</sup> School of Chemistry & Environment, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia