



Research article

Exploration of supramolecular solvent-based microextraction for crystal violet detecting in water samples

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ABSTRACT

This approach highlights the advantages of supramolecular solvents in a new microextraction model. The distinct properties and behavior of this supramolecular solvent provide enhanced extraction capabilities for detecting crystal violet (CV) in water samples. The methodical experimentation was executed to optimize the critical process parameters, providing maximum efficiency of crystal violet extraction at optimal conditions with pH set at 2.7, 186 μL of extraction solvent, extraction time of 3.5 min, and a salt amount of 3.1 % w/v, yielding the best results. Analytical data from extraction experiments under these optimal conditions demonstrated a high extraction percentage. The extraction model exhibited a linear response within the range of 10–800 ng mL^{-1} of crystal violet, with a detection limit of 2 ng mL^{-1} . This model enables the measurement of CV in water samples with recovery rates exceeding 97 %, offering a straightforward and accessible approach for analysis.

1. Introduction

Crystal violet is a triphenylmethane dye commonly used in histology, bacteriology, biological staining, medical, and industrial [1–3]. In aquaculture, crystal violet has been employed as a fungicide and antiseptic for treating fish diseases. However, its use raises concerns due to its toxicity and potential environmental impact [4,5]. Crystal violet is known to be toxic, with potential carcinogenic, mutagenic, and teratogenic effects. It can cause skin and eye irritation and has harmful effects if ingested or inhaled [6–9]. Therefore, detecting crystal violet in water is crucial due to its persistence and potential to cause long-term environmental and health effects. Accurate measurement helps in managing pollution and ensuring water safety [10–12]. To enhance the sensitivity of analyte measurement, advanced analytical tools such as high-performance liquid chromatography (HPLC) coupled with mass spectrometry (MS) [13], capillary electrophoresis [14], and pre-concentration techniques like cloud point extraction (CPE) [15–17], solid-phase extraction (SPE) [18], solid-phase microextraction (SPME) [19], and liquid-phase microextraction methods (LPME) [20–27] are utilized. Dispersive Liquid-Liquid Microextraction (DLLME) is characterized by its use of a small volume of organic solvent, high pre-concentration factor, simplicity, speed, cost-effectiveness, and environmental friendliness [28].

Ionic Liquids (ILs) are organic salts, typically composed of an organic cation and an organic or inorganic anion [29]. They have gained significant attention in various fields of chemistry, particularly in analytical chemistry, due to their advantageous properties. ILs exhibit properties such as high thermal stability, low vapor pressure, non-flammability, various viscosities, conductivity, and miscibility with different solvents [30]. These properties stem from the electrostatic interactions within ILs and their unique

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