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Facile synthesis of molecularly-imprinted magnetic-MoS_2 nanosheets for selective and sensitive detection of ametryn

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ABSTRACT

In the present study, a novel analytical method was developed for selective and sensitive detection of ametryn in tap and lake water samples based on molecular imprinting technology with high performance liquid chromatography-ultraviolet detection. For this purpose, molecularly-imprinted magnetic MoS_2 (MIP@mag-MoS_2) particles were synthesized via surface initiated reversible addition-fragmentation chain transfer polymerization. The investigation of the rebinding properties, selective recognition ability, and reusability of the MIP@mag-MoS_2 demonstrated their high adsorption capacity, outstanding selectivity, rapid adsorption kinetics, and capability for multiple uses, with an imprinting factor of 4.39. The detection limits for ametryn were 0.031 μ g/L and 0.041 μ g/L in tap water and lake water, respectively. The proposed method also had high recovery percentage and low relative standard deviations for the water samples spiked with ametryn. The results suggest that the combination of mag-MoS_2 with MIP layer is a prospective alternative analytical method for quantification of ametryn.

1. Introduction

Ametryn [2-(ethylamino)-4-isopropylamino-6-methyl-thio-s-triazine], classified as a second-generation herbicide, is employed for the management of broadleaf weeds and annual grasses in diverse agricultural settings [1]. Despite its widespread global distribution in water bodies, it poses a considerable threat to human health, inducing symptoms like nausea, vomiting, diarrhea, muscle weakness, salivation, and even carcinogenic effects [2]. Furthermore, exposure to ametryn can result in skin, eye, and respiratory tract irritation, while also being toxic for both terrestrial and aquatic animals [3]. Despite its practical applications, ametryn was identified as a contaminant in water resources and soils, with numerous instances of groundwater contamination reported globally [4,5]. Consequently, this contamination renders affected water sources unsuitable for drinking, recreational activities, and various other purposes [6]. While pesticides have been in use for many decades, the ongoing emphasis in analytical chemistry revolves around the continual evolution of methods for detection and measurement of these chemicals.

Given the extensive use of ametryn, there is considerable significance in promptly determining its presence in environmental and food samples. Various analytical methods were documented in the literature, employing diverse chromatographic, spectroscopic or electroanalytical techniques such as gas chromatography with mass spectrometric detection (GC–MS) [7], liquid chromatography with mass spectrometric detection (LC-MS) [8], anodic stripping voltammetry [9], surface plasmon resonance (SPR) [10], surface-enhanced Raman spectroscopy [11], micellar electrokinetic capillary chromatography [12], or ion mobility spectrometry [13]. However, these methods typically necessitate complementary sample preparation techniques, essential for minimizing matrix effects and facilitating the extraction of enriched trace analytes [14]. Several sample preparation techniques have been employed, including microwave-assisted solvent extraction[15], solid-phase extraction [16], solid-phase microextraction (SPME) [17] or liquid–liquid extraction [18]. In the current era, SPME has been widely adopted as a sample clean-up technique, due to its inherent advantages, including simplicity, time efficiency, minimal solvent requirements, and cost-effectiveness [19]. Additionally, alongside conventional SPME, magnetic solid-phase extraction (M−SPE) is extensively employed in sample pre-treatment [20]. The integration of magnetic properties into SPME enhances its utility by enabling the easy collection of the sorbent with the help of a magnet, eliminating the need for centrifugation or filtration steps, and reducing amount of solvent and sorbent compared to

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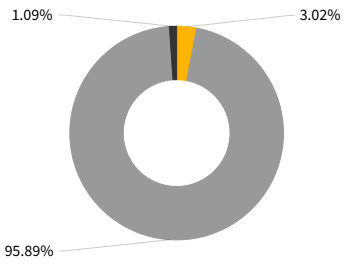
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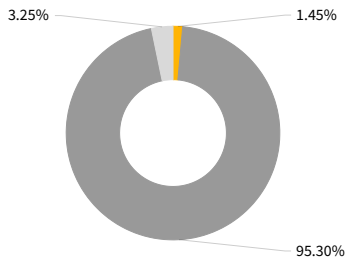
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CATEGORY
PHYSICS, ATOMIC, MOLECULAR & CHEMICAL

17/39

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2023	21/40	Q3	48.8

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2021	114/165	Q3	31.21
2020	113/162	Q3	30.56

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EDITION
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2022	18/35	Q3	50.0
2021	20/36	Q3	45.83
2020	17/37	Q2	55.41