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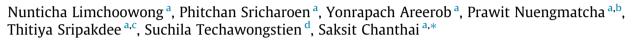
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Analytical Methods

Preconcentration and trace determination of copper (II) in Thai food recipes using $Fe_3O_4@Chi-GQDs$ nanocomposites as a new magnetic adsorbent



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Chemical compounds studied in this article: Chitosan (Pubchem CID: 21896651) Citric acid (Pubchem CID: 311) Copper(II) chloride (Pubchem CID: 24014) Ferric chloride hexahydrate (Pubchem CID: 24810) Iron(II) sulphate heptahydrate (Pubchem CID: 62662)

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ABSTRACT

This study describes the preparation, characterization, and application of a new magnetic chitosan–graphene quantum dots (Fe₃O₄@Chi–GQDs) nanocomposite as an adsorbent for the preconcentration of Cu (II) in Thai food recipes or the so-called "Som Tam" (green papaya salad) prior to determination by inductively coupled plasma–optical emission spectrometry. The spectroscopic and magnetic properties along with the morphology and thermal property were analyzed using FTIR, EDX, XRD, TGA, VSM, and TEM. Preconcentration optimizations including pH, dosage of adsorbent, adsorption–desorption time, concentration and volume of elution solvent, sample volume and enrichment factor, and reusing time were investigated. Good linearity was obtained ranging from 0.05 to $1500 \,\mu g \, L^{-1}$ with correlation coefficient of 0.999. Limit of detection was $0.015 \,\mu g \, L^{-1}$. Relative recoveries of 85.4-107.5% were satisfactorily obtained. This Fe₃O₄@Chi–GQDs has high potential to be used as preconcentration method and can be reused 7 times with high extraction efficiency.

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1. Introduction

Copper is a well-known inorganic element and possesses many biological characteristics as an essential element as well as a toxic substance. It is one of the most important heavy metals that is broadly used in industrial applications. It is also found as a residual contaminant in agricultural products (Rohani Moghadam, Poorakbarian Jahromi, & Darehkordi, 2016). Based on its widespread applications, Cu(II) can be leached out into the environment from several sources. As a result, it may directly or indirectly enter the food chains and in turn affects human health. Numerous serious diseases caused by its higher doses include an intestinal distress; bladder, brain, liver, and kidney damage; and Alzheimer's, Wilson's, and Menkes and Parkinson's diseases (Karadaş & Kara, 2017). Therefore, the determination of Cu(II) at trace concentration becomes increasingly essential because the heavy-metal contaminants in food products have posed a serious threat to public health and biological systems. The trace amount of Cu in food products must be controlled on a daily basis and the maximum allowable level of 30 mg kg⁻¹ Cu is recommended internationally (Sricharoen et al., 2017). Consequently, to ensure the public health, the preconcentration and determination of Cu(II) are required to meet its detection limit as well as the trace-to-ultratrace levels. Numerous techniques, such as solid phase extraction (SPE) (Yavuz, Tokalıoğlu, Şahan, &





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