Abstract

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Project Title: A new polypyrrole/Fe_3O_4/alginate sorbent for the extraction and preconcentration of endocrine disrupting compounds in water sample

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Abstract:

Magnetite nanoparticles incorporated into alginate bead and coated with a polypyrrole adsorbent were prepared (polypyrrole/Fe_3O_4/alginate bead) and used as an effective magnetic solid phase extraction sorbent for the extraction and enrichment of endocrine disrupting compounds (estriol, β-estradiol and bisphenol A) in water samples. The determination of the extracted endocrine disrupting compounds was performed using a high performance liquid chromatography with a fluorescence detector. The effect of various parameters on the extraction efficiency of endocrine disrupting compounds were investigated and optimized including the type and amount of sorbent, sample pH, extraction time, stirring speed and desorption conditions. Under optimum conditions, the calibration curves were linear in the concentration range of 0.5-100.0 μg L^{-1} and the limit of detection was 0.5 μg L^{-1}. The developed method showed high extraction efficiency, the recoveries were in the range of 90.5 ± 4.1 to 98.2 ± 5.5 %. The developed sorbent was easy to prepare, was cost-effective, robust and provided a good reproducibility (RSDs < 5%) and could be reused 16 times. The developed method was successfully applied for the determination of endocrine disrupting compounds in water samples

Keywords: Polypyrrole, Alginate, Sorbent, Extraction, endocrine disrupting compounds

Executive summary

Endocrine disrupting compounds (EDCs) are substances that interfere with the synthesis, secretion, transport, binding, activity, or elimination of natural hormones in the body that are responsible for the development, behavior, fertility, and maintenance of homeostasis, and consequently can cause adverse health effects in humans and other living organisms. EDCs are introduced into the aquatic environment by human activity, both domestic and industrial. They can enter the food chain and adversely affect humans. Although the concentration of these compounds is normally relatively low in water supplies involved in human activities, a continuous release and chronic exposure to these substances can result in adverse effects on aquatic life, which can be a potential risk to human health. Therefore, it is necessary to develop reliable, simple and highly sensitive methods for the monitoring of EDCs in environmental samples. However, the concentration of EDCs in water samples is relatively low and the matrices are often complex, thus, a sample concentration and preparation is required prior to instrumental analysis. Recently, magnetic solid phase extraction (MSPE) has attracted much attention for its application for sorbents due to the separation process of a sorbent from a sample solution that can be performed using an external magnetic field, which makes the separation easier and faster.

In this work, a magnetic solid phase extraction (MSPE) sorbent of polypyrrole/magnetite nanoparticles/alginate (polypyrrole/Fe3O4/alginate) was synthesized and applied to extract and preconcentration endocrine disrupting compounds (EDCs) in water samples. The Fe_3O_4 nanoparticles were entrapped in porous alginate beads then coated with polypyrrole. The Fe_3O_4 nanoparticles provided a simple and fast separation of the analytes from the water samples. The alginate helped to prevent oxidation of the magnetic nanoparticles and increase the amount of polypyrrole (in the pore and on the surface), while, the polypyrrole coated Fe_3O_4/alginate beads provided high extraction efficiency due to the π-π and the hydrophobic interactions between the polypyrrole and the EDCs. Several parameters that might affect the extraction efficiencies were investigated, i.e., the amount of sorbent, pH of the sample, extraction time, ionic strength, stirring speed and desorption conditions. The analytical performances of the proposed sorbent coupled with high performance liquid chromatography were evaluated such as its linearity, limit of detection (LOD), limit of quantification (LOQ), recovery, accuracy, precision, reproducibility, reusability. The developed sorbent was applied to extract EDCs in real water samples such as tap water, river water and wastewater. The advantages of the proposed sorbent are that it is simple to prepare, easy to use, convenient and cost-effective