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Ultrasound-assisted solvent extraction of porous membrane packed solid samples: a new approach for extraction of target analytes from solid samples

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Abstract

For the first time, a porous membrane-based method is proposed for the extraction of target analytes directly from the solid samples. This method involves the packing of solid sample inside a porous polypropylene membrane sheet whose edges are heat-sealed to fabricate a bag. This bag is immersed in a suitable solvent and the analytes are extracted by the application of ultrasound energy. The various factors that affect the extraction performance such as extraction solvent, ultrasonication time, and ultrasound power are suitably optimized. The scope of this extraction method is very general, it can be used for the extraction of different classes of analytes from a variety of solid samples using suitable extraction solvents. The beauty of this method lies in the fact that only the small molecules such as analytes can pass through the membrane while the interfering or complex matrix species cannot pass through the membrane bag to the extraction solvent. Previously, the solid samples were first digested/dissolved into liquid medium and then analytes were extracted by membrane-protected adsorbents involving adsorption and desorption steps. With the proposed procedure, the steps of digestion/dissolution and the adsorption of analytes onto a suitable adsorbent are eliminated. Likewise, the steps of filtration, and centrifugation are not required as the solid is effectively packed inside the membrane bag. Moreover, the extraction device is low cost, portable, easy to fabricate, and simple to use in extraction process. In this work, proof of the concept is demonstrated by the extraction of polyaromatic hydrocarbons from the soil samples using GC-MS. This method provided reasonably low LODs ranging from 0.19 to 0.93 ng/mg. The inter-day precision ranged from 87.5 to 109%, while recoveries varied from 75.1 ± 4.9 to 106.0 ± 4.5 %.

Keywords

Solvent extraction; membrane-packed solid samples; microextraction; environmental analysis; sample preparation