Green synthesis of magnetic iron nanoparticles coated by olive oil and verifying its efficiency in extraction of nickel from environmental samples via UV-Vis spectrophotometry

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Background: Recently, iron oxide nanomaterials have gained much attention due to their properties, such as extremely small size, cheap, non-toxic, excellent magnetic properties, high surface area, great biocompatibility and high level of reactivity with metal which makes them worthwhile in the removal of these heavy metals.This paper reports dispersive solid-liquid phase microextraction (DSLME) method using superparamagnetic iron oxide nanoparticles based on $FeCl_2$ and $FeCl_3$ using coprecipitation method coated with olive oil followed by spectrophotometric determination of nickel in soil, potato, red tea, white tea, mushroom, lettuce, cabbage, apple, urban water, water from household water treatment device and pacifier samples [1,2].

Methods: Magnetic nanoparticles were synthesized using co-precipitation method. First, $FeCl_3$ and $FeCl_2$ were mixed and dissolved in deionized water. Then NaOH was added and the pH value was maintained between 10-11 by continuous stirring using a magnetic stirrer for 1 hour. Olive oil was heated to 80C in hot air oven. Then this oil was added slowly to sample and stirred continuously for 48 h. After that they were washed several times and then filtered. Finally it was dried at 100C for 3 h [3]. After synthesis of magnetic nanoparticles (MNPs), 0.1 g of them in 1 mL of ethanol, as the disperser solvent, was stirred for 20 min. Then the mixture was injected rapidly into 15 mL of the nickel complex (with DMG & GLY). A magnet placed at the bottom of the beaker, particles separated quickly from solution. Then they were desorbed by adding 3 mL of HNO_3 as our desorption solvent followed by stirring for 30 min. Again precipitation was done using a magnet and finally the absorbance of the desorbed solution was reported using UV-Vis spectrophotometry.

Results: Under the optimal experimental conditions for this method maximum adsorption occurred at 15 ml of aqueous solution of analyte, pH 7, ethanol as a dispersive solvent, adsorption time of 20 min, HNO_3 as desorption solvent and 30 min as desorption time. SEM and FT-IR spectrum were used for characterization of the synthesized magnetic nanoparticles. Detection limit, linear range and relative standard deviation (RSD) were 0.821 ng/ml, 1-5000 ng/ml and 0.196 %, respectively.

Conclusion: A biocompatible and efficient sorbent was applied for fast extraction of Ni from environmental samples by DSLME method. The advantages of this method include rapidity and simplicity with good extraction efficiency, environment-friendly because of no use of toxic organic solvent and low cost.

Keywords: Green synthesis, Nickel, Microextraction, Olive oil, Magnetic iron nanoparticles, UV-Vis spectrophotometry.

References:

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