

Source: Sadeghi, M., Shiri, F., Kordestani, D., Mohammadi, P. & [Alizadeh, A.](#) (2018). SBA-15/Metformin as a novel sorbent combined with surfactant-assisted dispersive liquid–liquid microextraction (SA-DLLME) for highly sensitive determination of Pb, Cd and Ni in food and environmental samples. *Journal of the Iranian Chemical Society*, 15, 753–768. <https://doi.org/10.1007/s13738-017-1272-0>. [10.1007/s13738-017-1272-0](https://doi.org/10.1007/s13738-017-1272-0).

SBA-15/Metformin as a novel sorbent combined with surfactant-assisted dispersive liquid–liquid microextraction (SA-DLLME) for highly sensitive determination of Pb, Cd and Ni in food and environmental samples

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Abstract

This paper established a new, rapid and sensitive method for the ultra-trace determination of lead, cadmium and nickel in food and environmental samples preconcentrated by dispersive solid-phase extraction (DSPE) combined with surfactant-assisted dispersive liquid–liquid microextraction (SA-DLLME) prior to graphite furnace atomic absorption spectrometry. SBA-15/Met was synthesized and used as a new efficient sorbent for the extraction of metal ions in DSPE. It was characterized by TEM and TGA techniques. After DSPE step, stripped metal elements were complexed with dithizone, and then, the complexes were extracted into carbon tetrachloride by using SA-DLLME. A conventional nonionic surfactant, triton X-100 was used as a disperser agent. Under the optimized conditions, the limit of quantifications was found to be 2.5 ng L⁻¹ for Pb²⁺, Cd²⁺ and 5.0 ng L⁻¹ for Ni²⁺. The limits of detection were 1.5 ng L⁻¹ for Ni²⁺ and 0.75 ng L⁻¹ for Pb²⁺ and Cd²⁺, with enrichment factor of 1650. The optimized method exhibited a good precision level with relative standard deviations (RSDs%) values of 4.9, 5.2 and 5.0% for 1 µg L⁻¹ Pb²⁺, Cd²⁺ and Ni²⁺, respectively (n = 7). Application of the proposed method to the analysis of fish-certified reference material produced results that were in good agreement with the certified values.

Keywords: Biguanide-functionalized SBA-15, Surfactant-assisted dispersive liquid–liquid microextraction, Heavy metals, Food samples.