Ligandless Extraction and Determination of Trace Amounts of Lead in Pomegranate, Zucchini and Lettuce Samples after Dispersive Liquid-Liquid Microextraction with Ultrasonic Bath and Optimization of Extraction Condition with RSM Design

Authors : Fariba Tadayon, Elmira Hassanlou, Hasan Bagheri, Mostafa Jafarian

Abstract : Heavy metals are released into water, plants, soil, and food by natural and human activities. Lead has toxic roles in the human body and may cause serious problems even in low concentrations, since it may have several adverse effects on human. Therefore, determination of lead in different samples is an important procedure in the studies of environmental pollution. In this work, an ultrasonic assisted-ionic liquid based-liquid-liquid microextraction (UA-IL-DLLME) procedure for the determination of lead in zucchini, pomegranate, and lettuce has been established and developed by using flame atomic absorption spectrometer (FAAS). For UA-IL-DLLME procedure, 10 mL of the sample solution containing Pb^{2+} was adjusted to pH=5 in a glass test tube with a conical bottom; then, 120 µL of 1-Hexyl-3-methylimidazolium hexafluoro phosphate (CMIM)(PF6) was rapidly injected into the sample solution with a microsyringe. After that, the resulting cloudy mixture was treated by ultrasonic for 5 min, then the separation of two phases was obtained by centrifugation for 5 min at 3000 rpm and IL-phase diluted with 1 cc ethanol, and the analytes were determined by FAAS. The effect of different experimental parameters in the extraction step including: ionic liquid volume, sonication time and pH was studied and optimized simultaneously by using Response Surface Methodology (RSM) employing a central composite design (CCD). The optimal conditions were determined to be an ionic liquid volume of 120 µL, sonication time of 5 min, and pH=5. The linear ranges of the calibration curve for the determination by FAAS of lead were 0.1-4 ppm with R^2=0.992. Under optimized conditions, the limit of detection (LOD) for lead was 0.062 µg.mL-1, the enrichment factor (EF) was 93, and the relative standard deviation (RSD) for lead was calculated as 2.29%. The levels of lead for pomegranate, zucchini, and lettuce were calculated as 2.88 µg.g-1, 1.54 µg.g-1, 2.18 µg.g-1, respectively. Therefore, this method has been successfully applied for the analysis of the content of lead in different food samples by FAAS.
Keywords : Dispersive liquid-liquid microextraction, Central composite design, Food samples, Flame atomic absorption spectrometry.

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