Application of Modern Chemical Methods for Detection of Deterioration and Pollution in Foods

A Thesis Presented by

Amira Atef Abdullah Mahmoud

B. Sc. Chemistry Faculty of Science, Zagazig University

M.Sc. Analytical Chemistry, Faculty of Science, Zagazig University

In Partial Fulfillment for the Degree of Ph.D. of Science (Analytical Chemistry)

Submitted to

Chemistry Department

Faculty of Science

Zagazig University

2020

Abstract

A new, green, and simple preconcentration and microextraction methods for preconcentration of trace amount of aluminum (Al(III)), cadmium (Cd(II)) and amaranth dye prior to its determination by spectrophotometry or flame atomic absorption spectroscopy. The first method is based on the complexation reaction of Al(III) with alizarin red S (ARS) at pH 5.0 and micelle-mediated extraction of the complex with nonionic surfactant Triton X-114. The enriched analyte in the surfactant-rich phase was determined spectrophotometrically at 515 nm. The proposed CPE method showed linear calibration within the range 5.0–300 ng mL^{-1} of Al(III) and the limit of detection was 1.0 ng mL^{-1} with a preconcentration factor of ~100. The relative standard deviation (RSD%) and relative error (RE%) were found to be 1.70% and 1.78%, respectively. The method was applied to the determination of Al(III) in real food samples with a recovery for the spiked samples in the range of 95.0–102%. The second technique is vortex-assisted ionic liquid-based dispersive liquid-liquid microextraction technique (VA-IL-DLLME) was developed to preconcentrate and determine trace quantities of Cd(II) ions from real food samples, prior to detection by FAAS. The proposed VA-IL-DLLME method is base on utilization of ionic liquid (IL) (1-hexyl-3-methylimidazolium tris(pentafluoroethyl)trifluorophosphate [HMIM][FAP]) as an extraction solvent for Cd(II) ions after the complexation with 2-(2'-benzothiazolylazo) chromotropic acid (BTANC) at pH 8.0. In the range of 1.0–300 μg L^{-1}, the calibration graph was linear. Limit of detection, preconcentration factor and the relative standard deviation (RSD %, 25, 150 and 250 μg L^{-1}, n=5) were 0.2 μg L^{-1}, 100 and 2.0-3.2%, respectively. The third method is ultrasound-assisted ionic liquid-based dispersive liquid-phase microextraction technique (UA-IL-DLPME) was successfully developed to preconcentrate and determine trace quantities of amaranth dye in food samples. This method based on utilization of ionic liquid (IL) (1-hexyl-3-methylimidazolium tris(pentafluoroethyl)trifluorophosphate [HMIM][FAP]) as an extraction solvent for amaranth from 50 mL sample solution, with the aid of sonication. In the range of 10–800 μg L^{-1}, the calibration graph was linear. Detection limit, and preconcentration factor were 3.0 μg L^{-1} and 100, respectively. The relative standard deviations (RSD %) for 100 and 700 μg L^{-1} of amaranth were 3.0 and 2.3% (n=5), respectively. The impact of different analytical parameters on microextraction efficiency was investigated. The validation of the proposed methods was verified by test of certified reference materials applying the standard addition method.

Contents

List of Figures

List of Tables