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PII: S1350-4177(16)30155-9
DOI: http://dx.doi.org/10.1016/j.ultsonch.2016.05.013
Reference: ULTSON 3223

To appear in: *Ultrasonics Sonochemistry*

Received Date: 1 February 2016
Revised Date: 8 May 2016
Accepted Date: 9 May 2016

Please cite this article as: E. Alipanahpour Dil, M. Ghaedi, A. Asfaram, Optimization and modelling of preconcentration and determination of dyes based on ultrasound assisted-dispersive liquid–liquid microextraction coupled with derivative spectrophotometry, *Ultrasonics Sonochemistry* (2016), doi: http://dx.doi.org/10.1016/j.ultsonch.2016.05.013

Optimization and modelling of preconcentration and determination of dyes based on ultrasound assisted-dispersive liquid–liquid microextraction coupled with derivative spectrophotometry

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Abstract

Present study is based on describing an ultrasound-assisted dispersive liquid–liquid microextraction coupled with derivative spectrophotometry (UAS-DLLME-UV-Vis) as useful technique for selective determination of crystal violet (CV) and azure b (Az-B). The significant factors like pH, extractor volume, disperser value and extraction time contribution and their numerical coefficient in quadratic model were calculated according to central composite design (CCD). According to desirability function (DF) as good criterion the best experimental conditions was adjusted and selected at pH of 7.0, 170 µL of chloroform, 800 µL of ethanol that strongly mixed with the aqueous phase via 4 min sonication. Additionally, under study system was modeled by trained artificial neural networks (ANNs) as fitness function with acceptable error of MSE 2.97×10^{-06} and 1.15×10^{-05} with R^2: 0.9999 and 0.9997 for CV and Az-B, respectively. The optimum conditions by using genetic algorithm (GA) method was pH of 6.3, 160 µL of chloroform, 740 µL of ethanol and 4.5 min sonication. Under above specified and optimize conditions, the predicted extraction percentage were 99.80 and 102.20% for CV and Az-B, respectively. The present UAS-DLLME-UV-Vis procedure has minimum interference from other substances assign to the matrix, which candidate this method as good alternative to quantify under study dyes content with recoveries in the range of 86 to 100% for dyes. The detection limits were 2.043 ng mL^{-1} and 1.72 ng mL^{-1}, and limits of quantitation were 6.81 ng mL^{-1} and 5.727 ng mL^{-1} for CV and Az-B, respectively. The proposed methodology was successfully applied for quantification of under study analytes at different media.

Keywords: Azure B; Binary systems; Crystal violet; derivative spectrophotometry; Dispersive liquid–liquid microextraction; Ultrasound-assisted.

1. Introduction

The major environmental difficulty is related to presence of contaminates like dyes and heavy metals in water ecosystem viz. source and ground water and also marine [1]. Generally organic pollutants are often toxic to aquatic organisms and dyes as most abundant pollutant arrived to the aqueous system as a consequence of activities like textile, plastic, leather, paints, paper, tanning and pharmaceutical industries [2]. Crystal violet (CV) and azure b (Az-B) are highly dissolve in water media as cationic dyes, which have more ability and potential to be harmful for human [3].

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