STIR BAR SORPTIVE-DISPERSIVE MICROEXTRACTION BY A POLY(METHACRYLIC ACID-CO-ETHYLENE GLYCOL DIMETHACRYLATE)-BASED MAGNETIC SORBENT FOR THE DETERMINATION OF TRICYCLIC ANTIDEPRESSANTS AND THEIR MAIN ACTIVE METABOLITES IN HUMAN URINE

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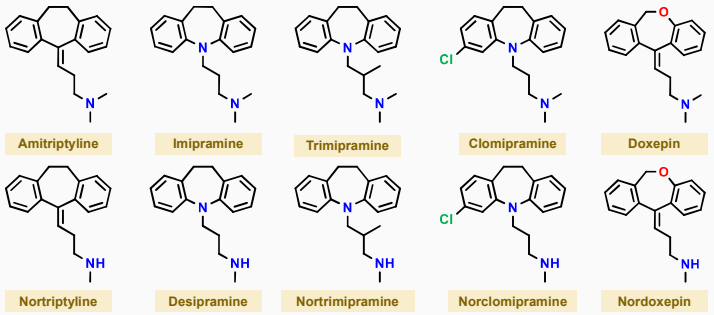
INTRODUCTION

Tricyclic antidepressants (TCAs) are widely used to treat depression, anxiety reaction and recently neuropathic pain. In cases of suspect overdose or pain management, urine immunoassays are performed. However, these assays sometimes cause false-positive results, and they do not have a high sensitivity.

Stir bar sorptive dispersive microextraction (SBSDME) [1] emerged as a hybrid microextraction technique that combines the principles of stir bar sorptive extraction (SBSE) and dispersive solid-phase microextraction (DSPE). In this case, the **magnetic sorbent $CoFe_2O_4$@SiO_2@MPS@EGDMA-co-MAA copolymer** is dispersed by magnetic stirring and retrieved onto NdFeB stir bar surface due to its magnetic properties.

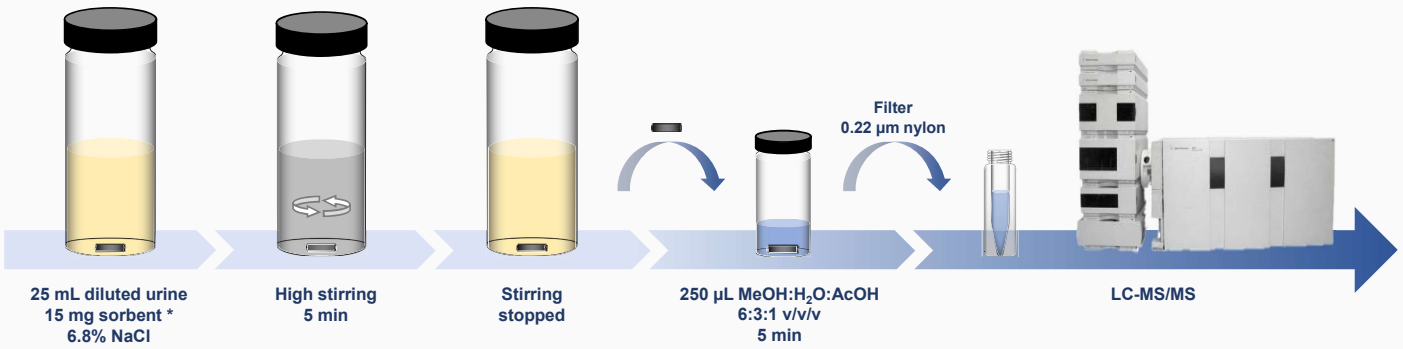
The **aim** of this work is to develop a new method that provides analytical improvements in the determination of TCAs and their active metabolites by means of SBSDME and liquid chromatography-tandem mass spectrometry (LC-MS/MS) [2].

ANALYTES



EXPERIMENTAL

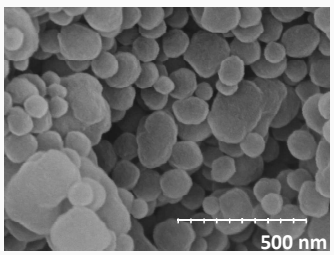
EXTRACTION | LIQUID DESORPTION | ANALYSIS



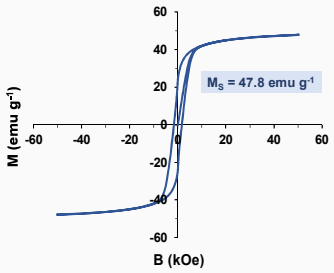
* $CoFe_2O_4$@SiO_2@MPS@EGDMA-co-MAA

RESULTS AND DISCUSSION

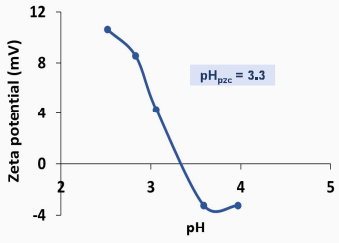
Characterization of the magnetic sorbent



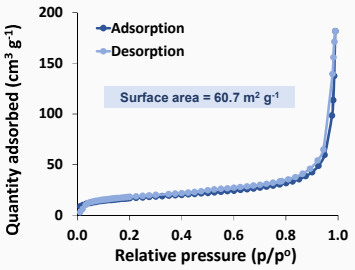
Scanning Electron Microscopy



Magnetization curve



Point of zero charge



Adsorption properties

Figures of merit

TCA	R^2	EF	LOD (ng L^{-1})	LOQ (ng L^{-1})	MLOD (ng L^{-1})	MLOQ (ng L^{-1})	Repeatability (%RSD)						Relative Recovery (%)
							Intra-day			Inter-day			
							50 ng L^{-1}	250 ng L^{-1}	1000 ng L^{-1}	50 ng L^{-1}	250 ng L^{-1}	1000 ng L^{-1}	
Doxepin	0.9990	22	7.0	23.1	14.0	46.1	6.9	2.7	5.1	10.6	13.3	5.5	83 – 100
Nordoxepin	0.9993	13	5.3	17.6	10.6	35.1	7.3	4.3	6.5	0.7	9.6	10.4	81 – 92
Imipramine	0.9994	16	2.3	7.7	4.7	15.4	9.3	2.1	7.0	12.8	12.5	4.7	80 – 103
Desipramine	0.9992	16	1.4	4.7	2.9	9.4	4.0	1.9	5.0	7.0	14.7	2.0	82 – 108
Amitriptyline	0.9998	19	6.2	20.4	12.4	40.8	5.9	1.3	4.7	12.4	6.0	2.1	81 – 106
Trimipramine	0.9994	17	2.7	8.9	5.4	17.7	4.2	1.0	5.3	14.7	14.2	6.1	83 – 107
Nortriptyline	0.9996	18	2.2	7.3	4.4	14.5	2.2	2.0	5.3	12.9	9.1	1.4	83 – 100
Nortrimipramine	0.9997	19	3.0	9.9	6.0	19.7	1.4	2.4	5.2	3.2	15.4	4.4	83 – 95
Clomipramine	0.9998	21	2.5	8.3	5.0	16.5	9.8	2.7	5.3	9.5	14.1	12.5	81 – 113
Norclomipramine	0.997	21	2.0	6.6	4.0	13.2	3.3	3.4	3.0	6.8	8.5	7.6	83 – 102

CONCLUSIONS

- A fully optimized SBSDME-LC-MS/MS method that contributes to the development of sensitive methods for the determination of five TCAs and their main metabolites in urine samples has been presented.
- The use of $CoFe_2O_4$@SiO_2@MPS@EGDMA-co-MAA copolymer as sorbent provides good extraction of the proposed TCAs, through both hydrophobic and electrostatic interactions.
- The proposed method was applied to three real samples, one of them from a patient taking a prescribed drug, which contained 25 mg of clomipramine per tablet, three times per day. As expected, only this sample contained clomipramine and its main metabolite (i.e., norclomipramine).

REFERENCES

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[2] V.Vállez-Gomis, S. Exojo-Trujillo, J. L. Benedé, A. Chisvert, A. Salvador, Microchim. Acta 189 (2022) 52

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ONLINE VERSION

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Stir bar sorptive-dispersive microextraction by a poly(methacrylic acid-co-ethylene glycol dimethacrylate)-based magnetic sorbent for the determination of tricyclic antidepressants and their main active metabolites in human urine

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Abstract

A poly(methacrylic acid-co-ethylene glycol dimethacrylate)-based magnetic sorbent was used for the rapid and sensitive determination of tricyclic antidepressants and their main active metabolites in human urine. This material was characterized by magnetism measurements, zeta potential, scanning electron microscopy, nitrogen adsorption–desorption isotherms, and thermogravimetric analysis. The proposed analytical method is based on stir bar sorptive-dispersive microextraction (SBSDME) followed by liquid chromatography–tandem mass spectrometry. The main parameters involved in the extraction step were optimized by using the response surface methodology as a multivariate optimization method, whereas a univariate approach was employed to study the desorption parameters. Under the optimized conditions, the proposed method was properly validated showing good linearity (at least up to 50 ng mL^{-1}) and enrichment factors (13–22), limits of detection and quantification in the low ng L^{-1} range (1.4–7.0 ng L^{-1}), and good intra- and inter-day repeatability (relative standard deviations below 15%). Matrix effects were observed for the direct analysis of urine samples, but they were negligible when a 1:1 v/v dilution with deionized water was performed. Finally, the method was successfully applied to human urine samples from three volunteers, one of them consuming a prescribed drug for depression that tested positive for clomipramine and its main active metabolite. Quantitative relative recoveries (80–113%) were obtained by external calibration. The present work expands the applicability of the SBSDME to new analytes and new types of magnetic sorbents.

Keywords Active metabolites · Human urine · Magnetic nanoparticles · Polymeric sorbent · Stir bar sorptive-dispersive microextraction · Tricyclic antidepressants

Ver Publicación

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