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Author: Fernando Maya, Burkhard Horstkotte, José M. Estela, Víctor Cerdà

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# Automated in-syringe dispersive liquid-liquid microextraction

Fernando Maya <sup>a</sup>, Burkhard Horstkotte <sup>b</sup>, José M. Estela <sup>a</sup>, Víctor Cerdà <sup>a,\*</sup>

<sup>a</sup> *Department of Chemistry, University of the Balearic Islands, Cra. Valldemossa km 7.5, 07122 Palma de Mallorca, Spain*

<sup>b</sup> *Department of Analytical Chemistry, Faculty of Pharmacy, Charles University in Prague, Heyrovského 1203, CZ-50005 Hradec Králové, Czech Republic*

## HIGHLIGHTS

- Automation of the dispersive liquid-liquid microextraction technique (DLLME)
- Automated in-syringe-DLLME
- In-syringe-DLLME with “on-drop” integrated detection
- In-syringe-DLLME-multi-syringe flow-injection analysis
- In-syringe magnetic stirring-assisted liquid-phase microextraction

## ABSTRACT

The dispersive liquid-liquid microextraction (DLLME) technique is simple, efficient and environment friendly. One of the main limitations to its further development is the lack of approaches to its automation.

In this work, we describe and review recent applications of a novel approach to performing fully-automated in-syringe DLLME based on the use of computer-controlled bi-directional syringe pumps. The in-syringe-DLLME technique enables precise flow control of the extractant and the concomitant detection of the analytes “in-syringe”, within a peripheral flow network, or by introduction into coupled detectors.

### *Keywords:*

Automated sample treatment  
Dispersive liquid-liquid microextraction (DLLME)  
Flow-injection technique  
Green analytical chemistry  
In-syringe DLLME  
Liquid-phase microextraction  
Magnetic stirring  
Miniaturization  
Multi-syringe flow-injection analysis  
Stirring-assisted extraction

*Abbreviations:* AAS, Atomic absorption spectrometry; DLLME, Dispersive liquid-liquid microextraction; ETAAS, Electrothermal atomic absorption spectrometry; FAAS, Flame atomic absorption spectrometry; FIA, Flow-injection analysis; GC, Gas chromatography; GC-MS, Gas chromatography-mass spectrometry; HF-LPME, Hollow-fiber liquid-phase microextraction; ICP, Inductively-coupled plasma; IV, Injection valve; LC, Liquid chromatography; LLE, Liquid-liquid extraction; LPME, Liquid-phase microextraction; MC, Monolithic column; MSFIA, Multi-syringe flow-injection analysis; PTFE, Polytetrafluoroethylene; SDME, Single-drop microextraction; SIA, Sequential injection analysis; SPE, Solid-phase extraction; SPM, UV-Vis spectrophotometry; SV, Selection valve

Corresponding author.

*E-mail address:* victor.cerda@uib.es (V. Cerda)

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