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Aqueous biphasic systems composed of ionic liquids: one-step extraction/concentration techniques for water pollution tracers

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PURPOSE OF THE ABSTRACT
Emergent micropollutants have become a serious global problem with a large impact in the environment and human health, while their presence in aquatic systems has been registered as ranging from ng/L-1 to ug/L-1 [1]. Pharmaceuticals are ubiquitous micropollutants since their continuous consumption and consequent release via human excretions into aqueous systems are inevitable [2]. Due to their usually low concentrations in aqueous samples, the development of a pre-concentration technique in order to continuously quantify and to monitor these components in aqueous streams is of major relevance.
Aqueous biphasic systems (ABS) composed of ionic liquids (ILs) can be seen as more sustainable separation processes since they avoid the use of volatile and hazardous organic solvents (VOCs) [3]. As liquid-liquid systems, ABS can be used as extraction, purification and concentration platforms. Due to the outstanding tunable properties of ILs, IL-based ABS provide higher and more selective extraction efficiencies for a wide range of compounds when compared to traditional polymer-based ABS [3]. IL-based ABS were already employed and adequately characterized for the extraction and concentration of endocrine disruptors, either from biological fluids or aqueous matrices [4, 5]. The aim of this work is to demonstrate the applicability of IL-based ABS to completely extract and concentrate, in one-step, two different and representative pharmaceutical pollution tracers, namely caffeine (CAF) and carbamazepine (CBZ). The low concentration of these persistent pollutants (usually found in ug/L-1 and ng/L-1 levels) does not allow a proper detection and quantification by conventional analytical equipment without a previous concentration step. However, pre-concentration methods commonly applied are costly, time-consuming, provide irregular recoveries and/or use VOCs. In this work, ABS composed of the IL tetrabutylammonium chloride ([N4444]Cl) and the salt K3C6H5O7 was investigated, demonstrating to be able to completely extract and concentrate CAF and CBZ in a single-step. Moreover, with this pre-treatment step it was demonstrated to be possible to overcome the detection limits of a high performance liquid chromatography coupled to an UV-Vis detector equipment (Fig. 1). The results obtained demonstrate that IL-based ABS are versatile pre-concentration techniques, and can be used for the extraction and concentration of a large plethora of other micropollutants from environmental aqueous matrices.

FIGURES

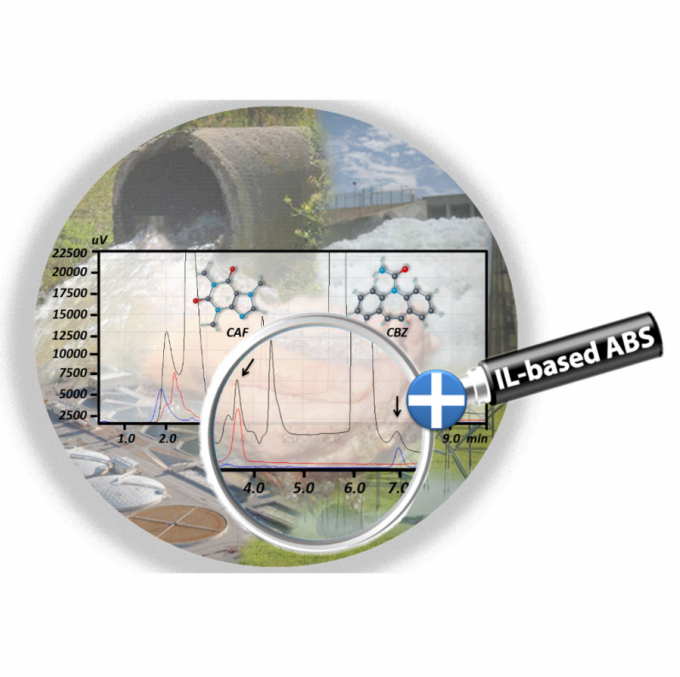

FIGURE 1

Illustration on the use of ionic liquid-based ABS as concentration platforms to overcome the detection limits of analytical equipment.

CAF - caffeine; CBZ - carbamazepine; Black lined chromatogram represents CAF and CBZ simultaneously extracted in aqueous solutions; Red and blue lined chromatograms represent CAF and CBZ standard solutions, respectively.

FIGURE 2

KEYWORDS

Micropollutants | Concentration | Ionic liquid | Aqueous biphasic system

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