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Mixtures of polymers and cholinium-based ionic liquids to tailor the phase diagrams and extraction efficiency of aqueous biphasic systems

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PURPOSE OF THE ABSTRACT

Aqueous biphasic systems (ABS) are outstanding alternatives over conventional liquid-liquid extraction processes since it is avoided the use of volatile and hazardous organic solvents (VOCs). ABS are more biocompatible systems formed by two aqueous-rich phases that can be designed by combining different pairs of solutes (polymer-polymer, polymer-salt or salt-salt) above specific concentrations [1]. In the past years, ABS have been studied as powerful techniques for purification, separation and extraction purposes [1].

Ionic liquids (ILs) have been described as interesting fluids towards the development of more sustainable processes [1]. Due to the ILs unique properties, their introduction in ABS led to systems with higher selectivity and extraction performance for a wide plethora of compounds [1]. In fact, it was already shown that ILs allow to overcome the low hydrophilic-hydrophobic range of ABS composed of two polymers or one polymer and one inorganic salt [1]. IL-based ABS formed with polyethylene glycol (PEG) polymers were recently introduced and a successful control of the phase polarities, through the manipulation of the IL chemical structure, was demonstrated [2]. Lately, it was also demonstrated that a new class of natural-derived cholinium-based ILs are capable of undergoing two phase separation by the addition of PEGs with different molecular weights [3]. In the present work, mixtures of PEGs with different molecular weights (400 and 2000 g/mol) were used to ascertain on the formation ability of ABS composed of water and cholinium-based ILs or salts. The results obtained indicate that the formation ability of these ABS increase with the content of PEG2000 over PEG400 (and follow a continuous increase), meaning that a close-fitting control on their phase?s polarity can be attained. These systems were then evaluated on their performance for extracting a series of alkaloids with different polarities, namely caffeine, theophylline, theobromine and nicotine. In general, the alkaloids partition extent to the most hydrophobic phase (PEG-rich) follows their polarity/hydrophobicity. In summary, it is here demonstrated that mixtures of polymers as phase-forming components of ABS allow to tailor the partition coefficients of different alkaloids and their use in the purification of added-value compounds from biomass extracts is straightforwardly foreseen.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Selective extraction | Polymers mixture | Bio-based ionic liquids | Aqueous biphasic system

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