Accepted Manuscript

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Mohammed Taghi Zafarani-Moattar, Hemayat Shekaari, Parisa Jafari

PII:	S0021-9614(18)30480-4
DOI:	https://doi.org/10.1016/j.jct.2018.10.001
Reference:	YJCHT 5567
To appear in:	J. Chem. Thermodynamics
Received Date:	7 May 2018
Revised Date:	30 September 2018
Accepted Date:	1 October 2018



Please cite this article as: M.T. Zafarani-Moattar, H. Shekaari, P. Jafari, Thermodynamic study of aqueous twophase systems containing biocompatible cholinium aminoate ionic-liquids and polyethylene glycol di-methyl ether 250 and their performances for bovine serum albumin separation, *J. Chem. Thermodynamics* (2018), doi: https:// doi.org/10.1016/j.jct.2018.10.001

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Thermodynamic study of aqueous two-phase systems containing biocompatible cholinium aminoate ionic-liquids and polyethylene glycol di-methyl ether 250 and their performances for bovine serum albumin separation

Mohammed Taghi Zafarani-Moattar*, Hemayat Shekaari, Parisa Jafari Physical Chemistry Department, University of Tabriz, Tabriz 51664, Iran

Abstract

Aqueous two-phase systems, ATPSs, are known as an interesting media for the separation and purification of vital biomolecules in biotechnology applications. From this viewpoint, the ambition of this work is investigating ability of cholinium aminoate ([Ch][AA]) as novel, low toxic and high biodegradable ionic liquids, including of cholinium glycinate ([Ch][Gly]), cholinium prolinate ([Ch][L-Pro]) and cholinium valinate ([Ch][L-Val]) for inducing ATPSs with polyethylene glycol di-methyl ether 250, PEGDME₂₅₀, and then evaluating their performances for partitioning of bovine serum albumin, BSA, as a model protein. For achieving this purpose, binodal curves and tie-lines were experimentally measured at T = (298.15, 308.15)and 318.15) K under atmospheric pressure (≈ 85 kPa) for all of the aforementioned systems. The influences of ionic liquid anion and temperature were searched systematically on the binodal curve and tie-lines. The phase splitting ability in these systems was assessed by utilizing the effective exclude volume theory from which the locations of binodals may be predicted and the Setschenow-type equation which provides salting-out coefficients by fitting the experimental tielines to this equation. Two empirical equations including of Merchuk equation were applied in order to represent the binodal data. Moreover, the Othmer-Tobias and Bancraft, Osmotic virial equations and two versions of NRTL models (m- or e-NRTL) were selected to correlate the tielines. In addition, the partition behaviour of BSA was studied by measuring of partition coefficient and extraction efficiency in the mentioned systems. The measured partition coefficients for BSA were discussed on the basis of physiochemical properties of amino acids involved in ionic liquid structure.

Keywords: IL-based ATPS; choline amino acid ionic liquids; PEGDME₂₅₀; bovine serum albumin partition coefficient; effective exclude volume theory; Osmotic viral equation.

^{*}Corresponding author. Fax: +98 413 3340191. E-mail addresses: zafarani47@yahoo.com (M.T. Zafarani-Moattar).

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