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Soluting-out effect of amino acids on aqueous solutions of tetraalkylammonium salts revealed by isopiestic measurements

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Tetraalkylammonium (TAA) salts are used in many environmental and biological processes because of possessing both ionic and hydrophobic properties [1]. The possibility of evaluating the effects of TAA salt's alkyl chain length and anion type on the interactions governing the solution behavior causes TAA salts to be a good choice for investigating the soluting effects occurring in aqueous solutions containing another solute [2,3].

In order to expand the knowledge of the soluting-out/in phenomena occurring in aqueous solutions, in this work, several ternary systems of {water + amino acid + quaternary ammonium salt} were subjected to isopiestic (vapor-liquid equilibrium (VLE)) measurements at 298.1 K. The amino acids used are glycine, DL-alanine, S(+)-serine, and S(-)-proline and the tetraalkylammonium salts are tetramethylammonium bromide (TMAB), tetrapropylammonium bromide (TPAB), tetra-n-butylammonium bromide (TBAB), tetra-n-butylammonium chloride (TBAC), and tetra-n-butylammonium hydrogen sulfate (TBAH). The deviations of water iso-activity curves from the semi-ideal behavior have been taken as a criterion to determine the soluting-out/in effect occurring in the investigated systems. The VLE results generally showed negative deviations from the semi-ideality, indicating that there are no favorable interactions between amino acids and quaternary ammonium salts in aqueous media, and aqueous solutions composed of these solutes undergo the soluting-out phenomenon (except for DL-alanine/S(-)-proline-TBAH aqueous ternary systems that show small positive deviation from the semi-ideality). For a given amino acid, the magnitude of negative deviations and the strength of the soluting-out effect increase with increasing the cation alkyl chain length (TBAB > TPAB > TMAB) and the hydrophobic character of the anion of the quaternary ammonium salts (TBAB > TBAC > TBAH). Amino acids act as the soluting-ou agent, and their soluting-out ability follows the order S(+)-serine > glycine > DL-alanine > S(-)-proline.

Keywords: Amino Acids, Tetraalkylammonium Salts, Isopiestic, Soluting-Out

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