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Interaction, thermodynamic, and solubilisation study of amino acid-tyrosine in aqueous anionic and cationic amphiphiles: electrical conductance and spectroscopic studies

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ABSTRACT

Spectroscopic and conductometric approach was employed to study the effect of aromatic amino acid-tyrosine on the micellisation of hexadecyltrimethylammonium bromide and sodium dodecyl sulphate in aqueous medium. Tyrosine was used as an additive as well as a probe while recording the UV-visible spectrum. A simple experiment was performed were the conductivity and UV-visible spectrum of amino acid was utilised to determine the effect of increasing amphiphile concentration. The critical micelle concentration and various thermodynamic parameters such as Gibbs free energy of micellisation, ΔG_m^0, enthalpy of micellisation, ΔH_m^0, entropy, ΔS_m^0, Gibbs free energy of transfer values, $\Delta G_{m,trans}^0$, hydrophobic free energy, ΔG_{HP}^0, free energy associated with surface contribution, ΔG_S^0, etc. were calculated to find the effect of this amino acid on the solubilisation, interaction, and aggregation process in aqueous medium.

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Tyrosine; thermodynamic parameters; amphiphile–biomolecule interactions; conductometry; UV-visible spectroscopy

1. Introduction

Various studies dealing with the effect of amino acids on the surfactant assemblies are well reported [1–20]. Studies on using amino acid itself as a probing tool to determine the effect and its solubilisation in micellar media are lacking. A simple experiment was performed where the conductivity and UV-visible spectrum of amino acid were utilised to determine the effect of increasing amphiphile concentration. In this study, aromatic amino acid-tyrosine was utilised as a probe and as an additive to determine the effect of this amino acid on the critical micelle concentration (CMC). To support our findings, side by side conductometry was also done to find the CMC, additive effect on CMC, and various thermodynamic parameters; and how these parameters change on adding the additive amino acid. The micelle shows different physicochemical properties owing to the presence of different regions to solubilise different substances. Head group region which is highly polar if the amphiphile is ionic, palisade layer starts from hydrophilic groups and the first few carbon atoms of the hydrophobic tail, and the core formed by inner hydrophobic tail [19,20].

Hexadecyltrimethylammonium bromide (HTAB) is effective against bacteria and fungi due to its antiseptic properties [21]. Its role in the synthesis of gold nanoparticles has also been established [22]. It is also present in many industrial preparations and in domestic products [23]. Sodium dodecyl sulphate (SDS) on the other hand acts as a potent denaturant of proteins than urea and guanidine hydrochloride [24]. Its role in solubilising biological membranes, in isolating, and purifying the proteins and lipids of membranes is previously studied [25,26].

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