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Topic of Research: **Aggregation, Physicochemical and Thermodynamic Studies of Amphiphilic Systems with and without Ionic Liquid**

Findings

My research focuses on the interactions of the amino acids DL-Valine/DL-Serine with the conventional surfactants CTAB/SDS and the surface-active ionic liquid (SAIL) [C_{12}mim][I], utilising volumetric, conductometric, and UV-Visible spectroscopy. Overall, DL-Valine/DL-Serine significantly promotes micellization, as evidenced by reduced CMC values and favourable thermodynamic parameters, indicating strengthened interactions between amino acids with CTAB/SDS and [C_{12}mim][I] in both pre- and post-micellar regions.

The micellization and thermodynamics study of different cationic surfactants, DTAB, CTAB, and CPC, with amphiphilic drug AMT in the presence of ILs [C_4mim][Br], [C_4C_1pip][Cl], [C_4C_1pip][Br] was investigated. Results indicate that ILs significantly lower the CMC of cationic surfactants, suggesting facilitation of the micellization process via electrostatic and hydrophobic interactions, with parameters indicating strong synergistic interactions in the cationic surfactants-AMT mixed systems, as quantified by negative interaction parameters (β^m). The antibacterial activity of the pure compound, as well as its binary and ternary mixtures, was evaluated against the Gram-negative bacterium *Escherichia coli* (*E. Coli*) and the Gram-positive bacterium *Staphylococcus aureus* (*S. aureus*).

Formation of IL-based microemulsions (IL/W and W/IL), oil-based microemulsion (Lav/W) using different non-ionic surfactants and characterised through spectroscopic (UV-Visible and fluorescence), DLS, Zeta potential, microscopy (confocal and fluorescence), electrical conductance, and rheology. Quantum calculations were performed to elucidate the molecular stabilisation and provide key information about the microstructural organisation of these IL-based microemulsions. W/IL microemulsions were explored for biomolecule (riboflavin) solubilization, while IL/W and Lav/W microemulsions were utilised for drug release through dialysis membranes.