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Development of a *β*-Cyclodextrins/Cationic Surfactants Based Supramolecular System: Interactions with a Phenothiazinyl Drug

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Extended Abstract

The combination of *β*-cyclodextrins (*β*-CDs) and cationic surfactants has been studied for their formation of inclusion complex. This research examined interactions between *β*-CDs and four surfactants (C_nTAB; n=12, 14, 16, 18) has been investigated using various experimental techniques, including surface tension measurements, UV-Vis spectroscopy, fluorescence spectroscopy, conductivity measurements, and cyclic voltammetry (CV). Longer alkyl chains strengthen hydrophobic interactions, with C_{18}TAB having the highest binding constant (1840 M^{-1}) and C_{12}TAB the lowest (100 M^{-1}). Phenothiazine (PTZ) and chlorpromazine (CPZ) also formed stable complexes, with CPZ displaying a higher binding constant due to its longer chain. The study also highlights the potential of *β*-CD-based systems for controlled drug delivery, especially for CPZ. The study demonstrates how *β*-CDs and cationic surfactants can form effective supramolecular systems for controlled drug delivery, with C_{14}TAB showing enhanced drug release for CPZ in aqueous *β*-CD solutions. Finally, this work lays the foundation for the design of *β*-CD-based nanocarriers for drug delivery applications.

Supramolecular systems, known for their reversible and non-covalent interactions, provide a versatile platform for crafting functional materials with tailored properties [1]. Numerous interaction mechanisms, such as non-specific electrostatic contacts, *π*-*π* interactions, dispersion forces, hydrophobic forces, or more particular binds like host-guest complex formation or "lock-and-key" binding, contribute to this process of supramolecular interactions [2]. CDs are cyclic oligosaccharides with hydrophobic interiors that can encapsulate various guest molecules, making them valuable in drug delivery systems. Common CDs like *α*-, *β*-, and *γ*-CDs consist of 6, 7, and 8 glucose units, with *β*-CDs being particularly useful due to their large cavity and low cost. CDs can form inclusion

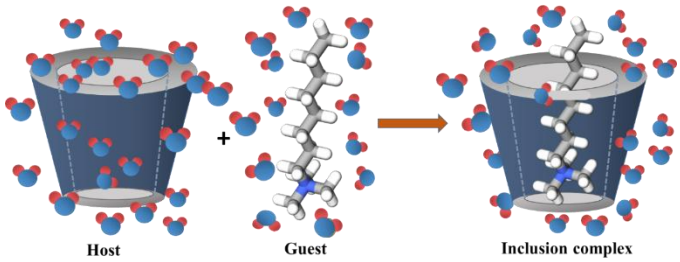

Figure 1: A schematic representation of host guest complex formed using hydrophobic interactions.

complexes with hydrophobic drugs, such as PTZ, improving solubility, stability, and bioavailability (Fig. 1). This research explores the interaction of β-CDs with cationic surfactants to enhance PTZ drug delivery [3]. By studying the thermodynamic parameters and binding constants, it was found that longer alkyl chains in surfactants exhibit stronger hydrophobic interactions.

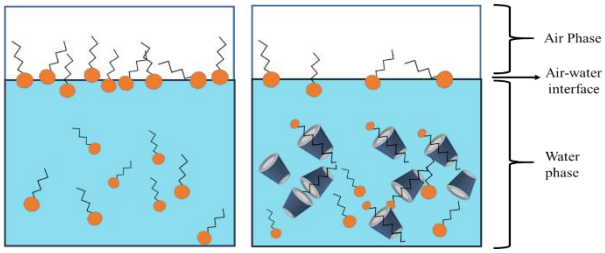

Figure 2: Behavior of surfactants (a) in absence of β-CDs and (b) in presense of β-CDs.

It is observed that the surface tension of C_nTAB decreases in all cases, indicating their adsorption at air-water interface. However, β-CDs are surface inactive; the surface tension values of C_nTAB in the presence of β -CD are significantly different from the values obtained in absence of β -CD. This indicates the presence of inclusion complex between C_nTAB and β-CD in the aqueous solution according to the mechanism shown in Fig. 2. Based on all the observations obtained from different experiments, binding constants has been calculated and it has been found that longer alkyl chains in surfactants exhibit stronger hydrophobic interactions.

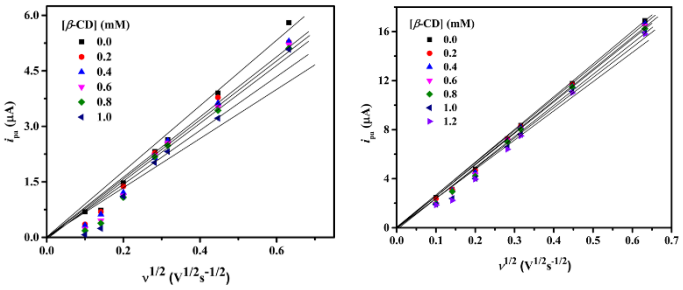

Figure 3: Anodic peak current vs. square root of scan rate of 0.5 mM PTZ and CPZ in 0.10 M KCl aqueous solution at different concentration of β-CDs.

CV measurements show that adding cationic surfactants to an aqueous solution of PTZ and β-CDs increases the peak current intensity [Fig. 3]. This is due to the hydrophobic surfactants displacing PTZ from the β-CD cavity, enhancing its diffusion. Focusing on CPZ, electrochemical analysis identified $C_{14}TAB$ as the most effective surfactant for controlled release, with the release adjustable by varying surfactant concentrations. The study concludes that β-CD-cationic surfactant systems hold great potential for improving the delivery and efficacy of phenothiazinyl drugs, paving the way for optimized pharmaceutical formulations.

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