

Surface-active properties of cationic and neutral amphiphilic β -cyclodextrins substituted with one or seven alkylamino chains

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New aminoalkyl derivatives of β -cyclodextrin (β -CD), in their cationic and neutral forms, were investigated for their surface-active properties, self-association as micelles, and properties as emulsifiers. β -cyclodextrin was mono- or per-substituted at its narrow rim by short (butyl) or long (dodecyl) aliphatic chains. The mono-substituted β -CDs are classical surfactants having a single hydrophobic tail and a single hydrophilic head; the per-substituted β -CDs have seven hydrophobic tails and seven hydrophilic heads. The cationic form is soluble in water and the neutral form is not. The measured solubility of the neutral form was very low. Stable nanoparticles were prepared by dispersion by ultrasound, yielding polydisperse nanoparticles of 500 nm, or by the nanoprecipitation method yielding nanoparticles of 100-200 nm with a narrow size distribution. All cationic β -CD surfactants show surface activity and self-assemble as micelles above a well-defined *cmc* because of the interactions between their hydrophobic tails. Though the main features of the surface-activity look similar to classical surfactants, such amphiphilic β -CDs show several specificities. The short-chained butyl derivatives behave as classical long-chained surfactant do. The head-tail interaction between the long dodecyl chain and the β -CD cavity of mono-substituted β -CD causes the formation of an intramolecular inclusion complex that weakens its hydrophobic character. The seven dodecyl chains of per-substituted β -CD tightly pack together such as lowering the contact area with water and weakening their hydrophobic character. Part of the counterions of multi-charged per-substituted β -CD is associated as ion pairs with the cationic amphiphilic β -CD. A close analogy with the behavior of gemini surfactants is worth noticing.

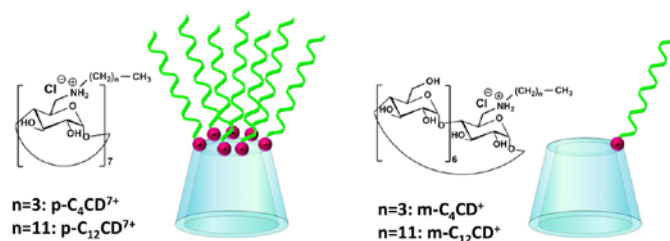


Figure 1 Chemical formulae, abbreviations and schematic representation of cationic amphiphilic β -cyclodextrins.

[1] Preparation and characterization of nanoparticles made from amphiphilic mono and per-aminoalkyl- β -cyclodextrins.

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