SPECTROSCOPIC AND STRUCTURAL STUDIES OF INTERACTIONS BETWEEN GEMINI SURFACTANTS AND PHOSPHATIDYLOCHOLINE DERIVATIVES

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Gemini surfactants are amphiphilic compounds which consist of two hydrophilic groups ("heads") connected with a spacer group and two hydrophobic chains. The molecules of gemini surfactants above critical micellar concentration (CMC) can form aggregates or lamellar structures, which are packed in a certain way in the space [1]. Phosphatidylcholine derivatives are also amphiphilic molecules. They are built of a large polar head group and two hydrophobic chains. Phospholipids aggregate usually into a lamellar phase. The mixtures of phospholipids and surfactants are currently tested as delivery agents for gene therapy [2, 3].

The aim of this work was to investigate the influence of the spacer group length of cationic gemini surfactants: 1, 1'-(1, 4 hexane)bis3-dodecyloxymethyl-imidazolium chloride (C6) and 1, 1'-(1, 4 butane)bis3-dodecyloxymethylimidazolium chloride (C4) on the phase transitions of two derivatives of phosphatidylcholine - dimirystoyl- phosphatidylcholine (DMPC) and dipalmitoyl- phosphatidylcholine (DPPC) in the aquatic environment.

Infrared spectra were recorded by means of a BRUKER IFS 66 FTIR-RAMAN Spectrometer and DSC measurements were performed using a DSC-204 Phoenix Netzsch system equipped with high sensitivity μ-sensor.

A series of the SAXS data sets were collected in MaxLab, at Beam Line 7-11 and 9-11-4 (Lund, Sweden) [4]. The data were collected at temperatures from 6 to 30°C for DMPC and from 10 to 45°C for DPPC using the synchrotron radiation ($\lambda = 0.107$ nm and $\lambda = 0.091$ nm respectively) and a Mar 165 CCD detector. The scattering vector range was $0.05 < s < 3.42$ nm^{-1}. All data sets were processed (normalized to the incident beam intensity, corrected for detector response and the scattering of the buffer was subtracted) using the computer programs BLI7-11 [4] and PRIMUS [5].

The analysis of FTIR and DSC results showed that the addition of surfactant affects the phase transition by shifting it towards lower temperatures. It is caused by formation of hydrogen bonds between the polar heads of lipids and surfactants as well as the interaction of surfactants with phospholipid acyl chains in the bilayer. It leads to changes in the trans-gauche conformation of phospholipids and the transition from rippled gel phase to lamellar liquid crystalline phase. The SAXS results implied a gradual disappearance of the lamellar phase typical of DMPC and DPPC and a probable formation of the mixed liposomes.

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