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Influence of the length and type of spacer group of gemini surfactants on their ability to form stable complexes with nucleic acids in a presence of helper lipid

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Keywords: gene therapy, gemini surfactant, small angle X-ray scattering

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A promising alternative to virus-based vectors, currently used in gene therapy appear to be amphiphilic compounds, especially gemini surfactants which have been tested for possible applications in this field [1,2].

This work was performed on alcoxyderivatives of bis-imidazolium quaternary salts with three different spacer groups. Additionally, to enhance the biocompatibility of the tested lipoplexes, a helper phospholipid – DMPC was used.

The SAXS data were collected at the Beam Line I911-4 at the MAXII storage ring (Lund, Sweden) and BM29 BioSAXS line in ESRF Grenoble (France) using the MarCCD 165 mm and PILATUS 1M detector, correspondingly. Synchrotron radiation wavelength was 0.091 nm and 0.15 nm, respectively. The scattering vector range was $0.1< s <4$ nm^{-1}. All data were analyzed using program PRIMUS [3].

SAXS data have indicated that the addition of surfactants cause a gradual perturbation of the lamellar phase typical for DMPC and eventually, the formation of different structural phases.

The longer spacer group of surfactant has stronger influence on the structural behaviour of the system. Moreover for certain values of charge ratio, the studied systems form stable complexes with DNA of low molecular weight..

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Modifications of structures formed by phosphatidylcholine by gemini surfactants with cyclic side chains as a key to successful DNA transportation

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Extremely important in gene therapy is a delivery system (also known as a vector), which improves the delivery of the therapeutic DNA into cells and protects genetic material from damage. Especially desirable are nonviral delivery systems, for example systems based on amphiphilic compounds [1].

All studied gemini surfactants possess aliphatic side chains with the same length but differ in the type (linear or cyclic). This study comprises of characterization of three types of mixed systems: phoshpolipid/surfactant, surfactant/DNA and phospholipid/surfactant/DNA. These systems were thoroughly characterised by small angle scattering of synchrotron radiation (SAXS), differential scanning calorimetry (DSC), Fourier transform infrared spectroscopy (FTIR), circular dichroism spectroscopy (CD) and agarose gel electrophoresis.

The series of the SAXS data sets were collected at the Beam Line I911-4 at the MAXII storage ring (Lund, Sweden) and BM29 BioSAXS line in ESRF Grenoble (France) using the MarCCD 165 mm and PILATUS 1M detector, respectively. The scattering vector range was $0.1<s<4$ nm^{-1}. All data were analyzed using the program PRIMUS [2].

Studied surfactants show strong influence on conformational and structural behaviour and thermodynamic parameters of formed systems. Obtained results therefore enabled us to choose the most suitable candidates for DNA transportation.

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