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Polymeric nanoparticles mediated delivery of nucleic acid for targeted gene therapy

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Gene therapy refers to the introduction of a therapeutic gene or nucleic acid to modify and regulate the expression of a target gene. This is emerging as a promising and alternative strategy against drug treatment, surgical approach and enzyme/protein therapy for the treatment of various deadly diseases. According to a fact sheet of World Health Organization (WHO), cardiovascular diseases are causing the highest percent of death rate all over the world. Despite of implementation of many diagnostic techniques and remedies, the success rate against diseases is very low. Gene therapy is come up as a better way to surmount this problem. Further, the therapeutic potential of a gene relies upon its safe and targeted site delivery. For this, several delivery systems have been explored, however limited success has achieved. In current study, we have designed chitosan nanoparticles, a biocompatible and biodegradable polymer based delivery vectors for siRNA delivery to target cardiovascular diseases. Chitosan would be modified with suitable ligands for targeted delivery of siRNA to mammalian cells, HepG2. The modification would be evaluated by Fourier transform infrared spectroscopy (FT-IR) and nuclear magnetic resonance (NMR). Nanoparticles thus prepared would be characterized for size, shape, surface morphology by DLS, SEM and TEM, respectively. Entrapment efficiency and *in vitro* gene expression was evaluated by fluorescence microscopy. Further, quantitative analysis of gene expression would be analyzed and this study could be used for the development of an efficient delivery system.

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Model biomimetic lipid membranes based on quaternary lipid-water systems for encapsulation of bioactive molecules

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The cell membrane environment, which is ubiquitous in biological systems, provides an exceptional model to devise smart nanostructures based on the molecular self-assembly of biological macromolecules such as carbohydrates, lipids, nucleic acids, and proteins. Amphiphilic biomolecules such as lipids can self-assemble into nanostructures of well-defined geometry. The most common of these nanostructures is the lamellar phase which is analogous to the lipid bilayer structure of the cell membrane. Other, more complex architectures may also self-assemble including the lipidic cubic phase, which retains the fundamental lipid bilayer structure. Proteins, especially membrane proteins, and peptides, are very fragile when removed from their native cell membrane environment. An appropriate biomimetic environment is required for long-term storage, as well as for various applications of protein-based systems including in meso crystallization, delivery of therapeutic proteins and peptides, biosensors and cosmeceuticals. To date, synthetic lipid nanomaterials have lacked the complexity of the biological cell membrane, which is composed of hundreds of different lipids. In this work, we investigate the phase behavior of quaternary lipid systems, based on the lipid monoolein, with two additional lipid additives and water. The investigated additives are mainly endogenous and include phospholipids, sphingomyelin and cholesterol. A systematic variation of lipid composition has allowed us to extract the effect of different physiologically relevant lipids on bilayer properties and the nanostructure of the lipidic cubic phase.

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