



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: Development of Unnatural Lipids for the Delivery of DNA and Drug Molecules

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Thesis Submitted to the Department (✓)/ : Chemistry
Center

Date of completion of Thesis Viva-Voce Exam : 28/11/2022

Key words for description of Thesis Work : Synthetic lipids, DNA/drug delivery, stimuli-responsive drug delivery, image guided drug delivery.

SHORT ABSTRACT

The thesis entitled "Development of Unnatural Lipids for the Delivery of DNA and drug Molecules" demonstrates the synthesis, characterization, and biophysical studies of the functionalized unnatural lipid molecules and their applications in delivering DNA and drug molecules to the mammalian cells. The thesis has been arranged into five chapters based on their development and experimental results, which were carried out during the research period. Chapter 1 describes the necessity for the development of drug delivery systems (DDSs) and how synthetic lipid-based DDSs showed great potential in overcoming the low bioavailability of poorly aqueous soluble anticancer drugs and in vitro cellular studies of the drug to the undesired sites. This chapter also discusses how lipid or amphiphilic molecules can be tuned with different active and passive targetable functional groups for the delivery of bioactive components to the targeted sites. Chapter 2 demonstrate the development of the synthetic method for thiol-ene/yne click reaction under sunlight conditions in the aqueous medium to synthesize a series of β -hydroxy ammonium head groups containing amphiphilic molecules. The synthesized cationic lipid's detailed biophysical characterization and in vitro DNA transfection efficiency were also documented. Chapter 3 describes the development of a novel class of stimuli-sensitive sulfonium-based synthetic amphiphiles, which exhibit several favorable biophysical properties of natural lipids. The anticancer drug (doxorubicin (DOX)) delivery efficacy of the potent amphiphiles and its inherent antibacterial activities were also discussed. Chapter 4 reports a smart approach to delivering the anticancer drug. Here, developed NIR-light-responsive macrocyclic cationic Gemini amphiphiles and examined the light-triggered DOX delivery efficacy to cancerous cells. Chapter 5 elaborates on developing a cyanine-3 (Cy3) dye-based fluorescent macrocyclic targetable amphiphile with NIR-light mediate cleavable property. The image-guided DOX delivery to the cancer cell has been reflected in this chapter.

Overall, this thesis focused on the development of novel synthetic amphiphiles, which in the presence of internal or external stimuli, can deliver the DNA/drug molecules in a controlled manner to the targeted cells.