



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
PhD-17 SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

This thesis is divided into five chapters. Chapter 1 highlights the growing demand for biopolymer-derived materials in biomedical and environmental applications, including drug delivery, wound healing, and biosensing, and reviews the synthesis and emerging applications of carbon dots. Chapter 2 reports the synthesis of lysine-doped κ -carrageenan-derived carbon dots and their application in folic acid detection and targeted cancer drug delivery. Chapter 3 describes the preparation of casein- and thymine-derived carbon dots for the selective detection of Hg^{2+} ions and tetracycline antibiotics in water. Chapter 4 presents κ -carrageenan/casein-derived carbon dots (CasK@CDs) as precursors and stabilizing agents for silver nanoparticles, enhancing their fluorescence, stability, water solubility, and antibacterial activity against *E. coli* and *S. aureus*. Chapter 5 focuses on a hydrocaffeic acid-modified chitosan hydrogel with improved mechanical strength, antibacterial, and antioxidant properties. Incorporation of CasK@CDs-capped silver nanoparticles further enhanced antimicrobial activity and ROS scavenging. Cell studies confirmed excellent biocompatibility, hemocompatibility, and wound healing performance, demonstrating the hydrogel's strong potential as an advanced wound dressing material.