Abstract

Synthesis and Morphological Elucidation of Cysteine Based Short Peptide Nanostructures and Their Efficacy Studies

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Short peptide based supramolecular nanostructures and nanomaterials have gained significant interest due to their potential application in various fields such as biomaterials, biosensors, drug delivery, tissue engineering, wound healing, cell proliferation, wastewater management, oil spillage recovery, etc. due to their extreme biocompatibility. Because of their huge importance in various fields, it is always very demanding to design new low molecular-weight peptides which can self-assemble in different nanostructures. In view of that efforts were made to synthesize different types of self-assembling short peptides for different applications.

In **chapter 1**, brief introductions to nanotechnology, nanoscience, short peptide-based self-assembled nanostructures, organogel, hydrogel-like soft nanomaterials, and their potential uses in various fields were discussed. Self-assembly of peptide molecules and the possibility of tuning their physicochemical properties by minor changes in the amino acids that make them up for certain applications were also discussed in this chapter.

In **chapter 2**, a cyclic dipeptide (CDP) consisting of L-leucine and S-benzyl protected L-cysteine was designed and synthesized which formed hydrogel in 1% DMSO-PBS buffer at physiological pH and temperature. Sustainable drug delivery from this CDP gel matrix was studied using anticancer drug 5-Fluorouracil. Hydrogel-drug co-assembly on the human cancer cell line HCT116 showed better anticancer activity than the drug itself.

In **chapter 3**, a series of six cyclic dipeptides (CDPs) having S-benzyl-L-cysteine as a common partner were synthesized in order to establish a structure-morphology or structure-gelation relationship as a factor of the hydrophobicity of other constituent amino acid partners. Small variations of the constituting amino acids in the peptide moieties caused significant differences in their morphology as well as in gelation properties. These CDPs had no significant cytotoxicity and one of the peptide hydrogels efficiently adsorbed toxic dyes from contaminated water.

In **chapter 4**, two sets of total four quinazolinone capped hybrid peptides were designed and synthesized where one set of peptides exhibited fibrillar nanostructure and another set of peptides produced spherical nanostructure after self assembly in aqueous solvent. The morphological and structural insights into the self-assembly pattern of these peptides were discussed using AFM, FESEM, and crystallographic studies. Two of the peptides formed thermoreversible, thixotropic hydrogels in aqueous solvent. These peptides did not induce any acute toxicity in Hela cells which made them suitable for cellular applications in future.

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