Cyclic peptide-inorganic nanoparticles as co-assembled hydrogels for drug delivery

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Abstract

Nanocomposite hydrogels are gaining attention for their versatile applications. These materials can be fabricated from the co-assembly between peptides and inorganic nanoparticles resulting in hydrogels with enhanced mechanical and functional properties. A recent study has shown the co-assembly between laponite and linear peptide amphiphiles, resulting in hydrogels for potential applications in neovascularization and hierarchical mineralization.[1] The latter provides the basis for further exploration of nanosilicate-peptide interactions, paving the way for the development of hydrogels tailored for various biomedical applications.

This study introduces a nanocomposite hydrogel formed by the co-assembly of cyclic octapeptide nanomaterials and nanosilicates (**nSi**). Cyclic peptide **CP1** (cyclo-(D-Leu-Lys-D-Leu-Tyr)$_2$) self-assembled into elongated nanostructures under a pH-triggered mechanism and high peptide concentrations (1 - 2 %wt). Field emission SEM confirmed the formation of **CP1** nanostructures, while FTIR validated the integration of **CP1** and **nSi** within the hydrogel. CD spectroscopy indicated that the ß-sheet structure of **CP1** was preserved upon nSi incorporation. Rheological analysis demonstrated enhanced elasticity compared to a nonpeptide control. Drug release studies showed a 40% release of vancomycin over 24 hours, sufficient to eradicate *E. coli* DH5-α. This novel organic-inorganic nanocomposite hydrogel has the potential to be used for diverse drug delivery and therapeutics applications.

References:

1. Okesola, B. O. *et al.* ACS Nano (2021). https://doi.org/10.1021/acsnano.0c09814