Nanobioconjugates for Targeted Delivery of Antigenic and Therapeutic Peptides in Colorectal Cancer

Introduction

Colorectal cancer (CRC) is a significant global health challenge, ranking third in cancer-related mortality. To address this, nanobioconjugates, specifically poly(lactic-co-glycolic acid) (PLGA) nanoparticles (NPs), have emerged as a versatile platform for advanced CRC treatment. Peptides, known for potent chemotherapeutic and vaccine antigen capabilities, play a vital role in CRC therapy. This study employs peptide-loaded PLGA NPs to confront current CRC therapy challenges. Through nano-level encapsulation, exploring the physicochemical properties of peptides and PLGA, the research aims for enhanced stability and precise controlled release. Surface modification of PLGA NPs enhances therapeutic efficacy while minimizing side effects, promising to reshape CRC therapy by leveraging nanobioconjugate attributes and the synergistic potential of peptide therapeutics.

Materials and methods

In this study, two strategies are employed for potential CRC approaches. Firstly, CDC25B-II peptide, inhibiting CRC tumor growth via CD8+ T-cell activation, is encapsulated in PLGA-COOH. Surface modification with D-mannosamine targets antigen-presenting cells for a specific immune response against CRC cells. Secondly, the GILGFVFTL peptide, inhibiting CRC cell proliferation, is encapsulated in PLGA-PEG-Mal NPs. Functionalized with the G3 peptide, specific to CRC cells, these NPs are designed for targeted delivery to the CRC tumor microenvironment. Both strategies use D-α-Tocopherol as surfactant and are achieved through the emulsion-evaporation method.

Results

The PLGA-CDC25B-II-loaded NPs exhibited a mean particle size of 240 ± nm, a polydispersity index of 0.24 ± 0.02, and a ζ-potential of -61.6 ± 1.2 mV. Quantification of CDC25B-II involved constructing a calibration curve with an R^2 value of 0.9905. The encapsulation efficiency was 26.3 ± 15.7%, and the drug-loading capacity was 0.24 ± 0.14%.

Conclusion

Encapsulation of CDC25B-II in PLGA NPs was successful, as indicated by the observed mean particle size, polydispersity index, and ζ-potential. The encapsulation efficiency and drug-loading capacity fall within the reported range for peptide encapsulation in PLGA NPs, affirming the effectiveness of the chosen formulation. The interplay between physicochemical properties of PLGA and CDC25B-II is evident in the particle size, suggesting a balanced influence of molecular weight and lactic acid:glycolic acid ratio, and the strong negative ζ-potential indicates the stability of the NPs.

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