PÔSTER - RESUMO - MATERIAIS E BIOMATERIAIS

ALGINATE/PDDA COACERVATES AS A BIOINSPIRED PLATFORM FOR GOLD NANOROD ENCAPSULATION FOR PHOTOTHERMAL THERAPY IN SKIN CELL MODELS

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Complex coacervation is a colloidal phenomenon in aqueous systems containing oppositely charged macromolecules, resulting in phase separation into a dense, polyelectrolyte-rich coacervate phase and a dilute supernatant. These systems closely mimic cellular compartmentalization processes and are considered bioinspired models with increasing relevance in biotechnology and nanomedicine. Beyond fundamental interest, coacervates have attracted growing attention as versatile platforms for the encapsulation, stabilization, and controlled release of bioactive compounds and functional nanomaterials.

In this study, alginate/poly(diallyldimethylammonium chloride) (SA/PDDA) coacervates (charge ratio, Z-/+ = 0.86) were investigated as a hybrid bioinspired platform for the encapsulation and delivery of gold nanorods (AuNRs) for photothermal therapy applications. AuNRs were synthesized via a controlled chemical route, exhibiting uniform morphology, with average dimensions of 26.66 ± 0.75 nm along the longitudinal axis and 7.65 ± 0.26 nm along the transverse axis, as well as well-defined localized surface plasmon resonance bands with maximum at 776 and 541 nm. Different strategies for nanorod incorporation were evaluated, with the addition of AuNRs during coacervate formation yielding the highest encapsulation efficiency, as confirmed by confocal fluorescence microscopy, zeta potential analysis, and dynamic light scattering measurements.

The biocompatibility and biological activity of the hybrid system were assessed in vitro using murine B16F10 melanoma and Balb/3T3 fibroblast cell lines through neutral red uptake and crystal violet colorimetric assays. The highest non-cytotoxic concentration of SA/PDDA coacervates (0.082 mg mL-1) was first determined and then used for AuNR incorporation at concentrations ranging from 0.53 × 10?4 to 5.3 mg L-1. The results (cells incubated in dark condition – control experiments) showed a concentration-dependent cytotoxic effect toward tumor cells, while non-tumoral fibroblasts remained largely viable, indicating a selective biological response of the system to cancer cells. Intracellular uptake of AuNR-loaded coacervates was confirmed by confocal microscopy after 6 h of incubation, demonstrating their ability to act as efficient carriers for nanorod internalization. Unlike conventional approaches that require extensive chemical modification or layer-by-layer coating to mitigate the toxicity associated with CTAB-stabilized nanorods, the proposed coacervate-based platform offers a simple preparation method combined with high biocompatibility.

Preliminary photothermal experiments were conducted using B16F10 cells treated with AuNR-loaded coacervates under the same conditions as the biological assays, followed by near-infrared irradiation 24 hours after cell seeding. A homemade photoirradiation system based on an LED source with maximum emission at 810 nm was used. Cells were irradiated for 10 and 30 minutes at an irradiance of 0.75 W cm?^{2} under controlled conditions at 37 °C. These studies showed a measurable photothermal response of the hybrid system, highlighting its potential for light-triggered therapeutic applications. However, the optimal light dose to achieve more efficient and selective photothermal action in cancer cells is still being investigated.

Overall, these findings demonstrate that SA/PDDA coacervates are a promising bioinspired system for the encapsulation, intracellular delivery, and photothermal activation of gold nanorods, with potential applications in skin cancer therapy and related biomedical field.

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Palavras-chave: keywords: gold nanorods; coacervates; alginate; biocompatibility; photothermal.