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Liesegang Ring Formation in Hydroxyapatite Composites: A Biomimetic Approach to Controlled Drug Delivery

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Introduction. This research is devoted to the development of a biomimetic system based on hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$, HA), modified by amino acids, silver nanoparticles and infrared-sensitive polyelectrolytes to prolong drug release. The investigation aims to develop a drug delivery biocoating with enhanced drug loading capacity and controlled release mechanisms. It is relevant to examine synergistic interactions and optimize release dynamics. Thus, the tasks were to address existing limitations in drug delivery systems, establish a foundation for future advancements in the design and functionality of biomimetic platforms, and significantly contribute to the ongoing development of drug delivery technologies. 1].

Body. The capacity of HA, a promising material for bone implants and biomaterials due to its superior biocompatibility and structural similarities to bone's primary inorganic component, to generate Liesegang rings (LRs) under gradual and regulated conditions inside an agar matrix can serve as a simplified model system for simulating growth in the human body [2]. The system involves agar diffusion, resulting in the formation of HA (enhanced with glycine of different concentrations or produced with different outer electrolytes) through the diffusion of calcium phosphates through Na_2HPO_4. The composite was then incorporated with tetracycline hydrochloride and deposition of infrared-sensitive polyelectrolytes [3].The combination of PDADMAC (poly (diallyldimethylammonium chloride)) and Heparin forms a robust PE, while HA provides a biocompatible matrix. Infrared (IR) light at 808 nm was utilized as a trigger for controlled drug release, offering a non-invasive method to modulate therapeutic delivery. Physical and chemical characterization of HA was carried out.

Findings. The different concentrations of glycine are found to have a significant effect on the crystallinity of the HA due to its effect on kinetic of HA crystallization (nucleation of new crystals) by enhancing the surface diffusion mechanism in the precipitate. It is found that the addition of glycine to the system does not affect the p-factor of the resulting rings, which is equal to ca. to 1.00. Furthermore, on results of different electrolytes on Infrared-triggered delivery; the study reveals that the choice of electrolytes significantly impacts the drug delivery efficacy of HA-based systems. Infrared exposure enabled more controlled antibiotic release due to silver nanoparticle peaks in the composition.

List of references:

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