MODELLING KINETICS OF CIPROFLOXACIN RELEASE FROM ALGINATE-CHITOSAN POLYELECTROLYTE COMPLEXES

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Polyelectrolyte complexes (PECs) are promising materials for pharmaceutical applications due to their ability to encapsulate active substances, enhance drug stability, and regulate drug release. Alginate and chitosan are natural polysaccharides that have been actively studied due to their biocompatibility, biodegradability, and ability to form complex structures when combined with other polymers. However, traditional methods for preparing PECs often result in unstable structures with variable properties, which limits their use in modern drug delivery systems.

In this study, a controlled method was developed for preparing alginate-chitosan (AC) polyelectrolyte complexes (PECs) with the immobilized ciprofloxacin. Additionally, the introduction of sodium hyaluronate into the system for the formation of AC-hyaluronate (ACH) complexes was investigated to improve mechanical and biological characteristics. Ciprofloxacin in vitro demonstrates high antibacterial activity against a wide range of gram-negative and gram-positive pathogens. Its immobilization was carried out by absorption from solution onto a pre-prepared PECs. The kinetic characteristics of the release were studied by immersing dried PECs in buffer solutions with pH 5.5, 7.2 and 8.2, which correspond to the physiological conditions of the skin, infected and chronic wounds.

Analysis of ciprofloxacin release profiles revealed a rapid initial phase, during which more than 50 % of the drug was released within the first 10 minutes (Fig. 1). After this, a gradual release of the active substance was observed. Comparative analysis of kinetic parameters showed that the ACH complex exhibits higher sensitivity to changes in the pH compared to AC complex, which may be a key factor for the controlled release of the drug substance.

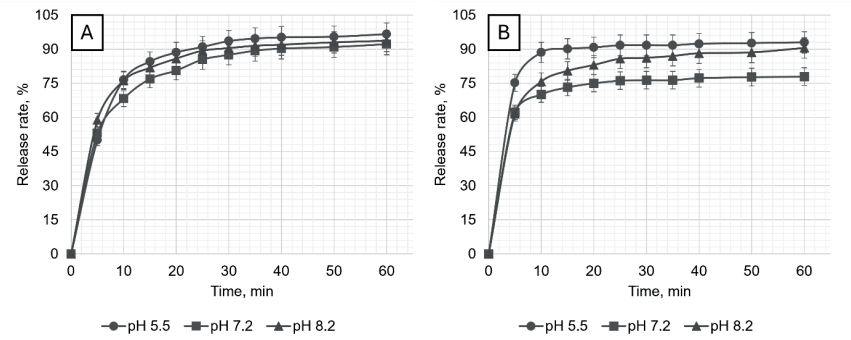

Fig. 1. Ciprofloxacin release rates from complexes A) AC and B) ACH

The developed polyelectrolyte complexes based on alginate, chitosan and sodium hyaluronate demonstrate promise for use in the treatment of infected and chronic wounds. The rapid initial release of ciprofloxacin provides immediate antimicrobial action, while the prolonged release contributes to long-term antibacterial activity. The ability of the complexes to adapt to changes in the pH of the environment opens up opportunities for their use in military medicine, in particular for the treatment of open wounds in combat conditions, where effective and immediate suppression of the infectious process is necessary.