# ROLE OF IMMOBILISATION MECHANISM IN GOVERNING PANTOTHENATE RELEASE KINETICS FROM ALGINATE-CHITOSAN-HYALURONATE FILM

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The development of the aqueous phase separation method by de Vos opened up broad prospects for the development of materials based on polyelectrolyte complexes (PECs), in particular as controlled-release systems [1]. However, their release behaviour strongly depends on the chemical nature of the incorporated active compound and the mechanism of its immobilisation in the polymer matrix [2]. In this study, films based on alginate-chitosan PEC loaded with hyaluronate were used for comparison of two strategies of calcium pantothenate immobilisation: co-precipitation during film formation [3] and post-formational sorption. Films incorporating pantothenate were used to investigate the release kinetics of an anionic active pharmaceutical ingredient (API) under varying pH conditions.

Pantothenate incorporated into the polymer matrix by co-precipitation exhibited a rapid initial release (>60 % within the first 30 min) followed by a prolonged release phase lasting 3–3.5 hours (Fig. 1A). In contrast, pantothenate immobilized by sorption exhibited a pronounced pH-dependent release kinetics and reached complete release within 100 minutes at pH 5.5, indicating a reduced contribution of specific API-polymer interactions (Fig. 1). However, the release profiles at pH 7.2 and 8.2 showed a decrease in the release rate of sorbed pantothenate compared to the co-precipitated. This can be explained by the formation of stable chitosan-pantothenate complex at pH 5.5 [3] and a decrease in its stability due to protonation of the amino groups of chitosan at more alkaline pH.

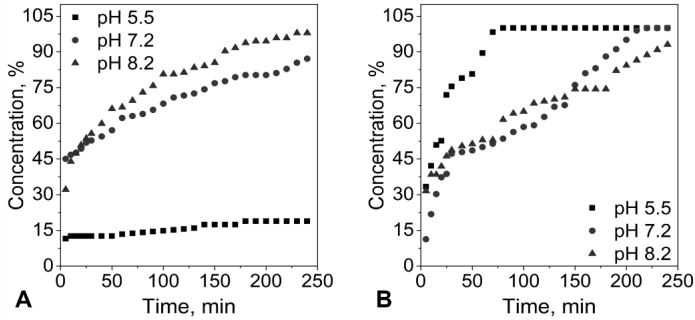


Fig. 1. Release kinetics of calcium pantothenate immobilised via co-precipitation (A) and post-sorption (B) films in simulated media with different pH values

The results demonstrate that the release kinetics of pantothenate from alginate-chitosan-hyaluronate PEC are primarily controlled by the immobilisation method and the resulting extent of chitosan-pantothenate interactions. Chitosan amino groups act as key regulators of complex stability, pH responsiveness, and prolonged release behaviour, providing a rational basis for tuning release profiles in PEC films.

[1] de Vos, W. M. *Aqueous phase separation method*, 2018.
[2] Kruk *et al.*, Adv. Colloid Interface Sci., 2022, 310, 102773.
[3] Sikach *et al.*, J. Chem. Technol., 2025, 33(4), 1000–1009.

*The work was supported by the Simons Foundation International Award ID: SFI-PD-Ukraine-00014577 (A.S. and V.K.)*