# EXPLORING ALGINATE-CHITOSAN POLYELECTROLYTE COMPLEX MATRICES FOR SMART DRUG RELEASE APPLICATIONS

**Alina Sikach, Viktoriia Konovalova**

*Chemistry department, National University of Kyiv-Mohyla Academy,*
*Scovorody str., 2, 04070, Kyiv, Ukraine*
*e-mail: a.sikatch@ukma.edu.ua*

Polyelectrolyte complexes (PECs) are widely used in membranes, protein separation, pharmaceutical binding, and microcapsulation for drug delivery. In the last 20 years were investigated different methods of the encapsulation of active ingredients in a polymer matrix for their stability and solubility improvement. Drug release occurs through ion exchange, decomplexation, and dissolution. Natural polysaccharides, in particular alginate and chitosan, are actively used in pharmaceutical research due to their biocompatibility and biodegradability. However, mixing their solutions leads to the formation of chaotic structures, which limits the control over the physicochemical properties. Thus, this study is aimed at developing a controlled method for the formation of PECs for drug immobilization in delivery systems based on Alginate as polyanion and Chitosan as polycation (AC complexes).

Sodium alginate and chitosan complexes (AC) were prepared by suppressing ionic interactions using the ionic strength of the KBr solution. Alginate and chitosan solutions in KBr were simultaneously mixed at varying weight ratios (AC 2:1, AC 1:1, AC 1:2) with magnetic stirring. The kinetics of AC films swelling was executed by weight method in buffer solutions with different pH (5.5, 7.2, 8.2) after KBr leaching, followed by drying (Fig.1).

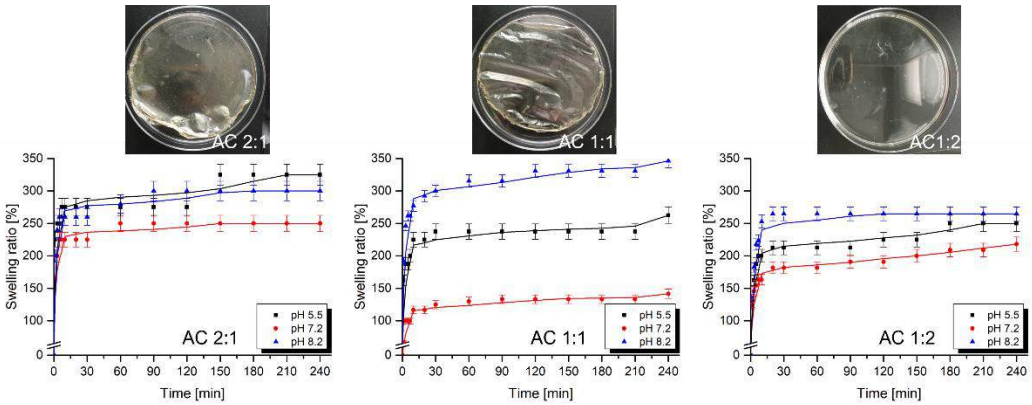


Fig.1. Appearance and swelling ratios of prepared films with different alginate: chitosan ratio.

The study of swelling kinetics reveals that swelling of the AC complexes depends on the molar ratio of the polymers. The investigation during 240 min (4 hours) revealed that the most consistent and promising profile of swelling has a 1:1 complex. AC 1:1 quickly swelled in acidic and alkaline environments, with subsequent stabilization of swelling, which is important for the controlled release of drugs. The AC 2:1 and AC 1:2 complexes exhibited lower pH sensitivity and weaker mechanical properties, limiting their drug delivery potential.

The AC 1:1 complex is a promising material for the development of smart drug delivery systems due to its pronounced pH sensitivity and stability after the initial swelling phase, which should provide controlled drug release. Its ability to respond rapidly to pH changes makes it suitable for use in environments with variable acidity, such as wounds or the gastrointestinal tract.

[1] Liu Y *et al.* Investigating coacervates as drug carriers using molecular dynamics. *Precis Med Eng.* 2024; 1(2):100012.

[2] Atma Y *et al.* Chitosan-alginate polyelectrolyte complexes for encapsulation of low molecular weight fish bioactive peptides. *Food Hydrocoll*. 2025; 160.

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