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Alginate gels and nanocomposites with prolonged release of drugs and plant protection agents

K.Yu. Samchenko[1], O.V. Goncharuk[2,3], L.O. Kernosenko[2], Yu.M. Samchenko[2]

[1] National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"
37, Beresteiskyi Ave., Kyiv, Ukraine, 03056
[2] F.D. Ovcharenko Institute of Biocolloid Chemistry, NAS of Ukraine
42, Akademika Vernadskoho Blvd., Kyiv, Ukraine, 03142
[3] Institute of Agrophysics, PAS
4, Doswiadczalna, Lublin, Poland, 20–290
samchenko.kateryna@lll.kpi.ua, iscgoncharuk@ukr.net

Background. Over the past few years, researchers have been increasingly focused on natural polymers, which are favorably distinguished from synthetic polymers, primarily by their lack of toxic effects on the humans and environment**.** This study is devoted to the creation of biosafe vehicles for targeted delivery and controlled release of drugs and plant protection products based on alginate gels and nanocomposites. **Methods.** Methods for the synthesis of alginate gels and hydrogel composites containing nanoclays have been developed. The structure of the synthesized gels and composites were characterized using IR-spectroscopy, XRD and electron microscopy. **Results.** The influence of variety of ions (Ba^{2+}, Cu^{2+}, Mn^{2+}, Al^{3+}, Fe^{2+}, Fe^{3+}, H^{+}) on ionotropic crosslinking of gels, on the swelling degree, mechanical properties and degradability of the corresponding gels and composites was studied. The composite gels based on alginate filled with nanoclays, primary montmorillonite (MMT) and Laponite, as well as the mixed gels containing alginate, pectin, gellan, agar, gum Arabic and gelatin were synthesized. The main patterns of swelling of the synthesized gels were determined and it was shown that swelling degree decreases with increasing concentrations of cross-linking agent and filler. The influence of polysaccharides in mixed alginate-based gels depends on the components ratio and alginate viscosity. The concentration of $CaCl_2$ in the range of 0.25–0.5 wt. % was chosen as optimal for the synthesis of mechanically strong hydrogels with a high swelling degree. The kinetics of gels swelling in water, saline, and phosphate buffer was studied and inherent to them Fick type of diffusion was determined using the Peppas-Ritter equation. The kinetics of sorption and release of drugs (vitamin B1, vitamin B6), growth hormones (hiberilic acid, kinetin) and pesticides (imidacloprid, flonicamide) incorporated into alginate matrices have been studied by UV spectroscopy using a SPECORD M40 spectrometer (Germany). **Conclusions.** The methods for synthesis of alginate gels and nanocomposites were developed and their physical and chemical properties were characterized. It was found that the alginate (micro)beads obtained on their basis are suitable for the targeted transport and controlled sustained release of drugs and plant protection agents during a few days. **Grants.** Authors (G.O., S.Y.) are grateful for the financial support by Polish Academy of Sciences and U.S. National Academy of Sciences (Agreement No. PAN.BFB.S.BWZ.331.022.2023 «Biocompatible hybrid hydrogels with functional in organic fillers for strengthening of plant vegetation»).

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