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«Smart» hydrogel nanocomposites for biomedical applications

Yu.M. Samchenko¹, A.P. Maletsky², L.O. Kernosenko¹, O.A. Samoilenko³,
I.I. Ganusevich³, S.M. Dybkova¹

¹ F.D. Ovcharenko Institute of Biocolloid Chemistry, NAS of Ukraine
42, Akademika Vernadskoho Blvd., Kyiv, Ukraine, 03142

² Filatov Institute of eye diseases and tissue therapy, NAMS of Ukraine
49/51, Francuzsky Blvd., Odessa, Ukraine, 65006

³ R.E. Kavetsky Institute of Experimental Pathology, Oncology and Radiology, NAS of Ukraine
45, Vasylkivska Str., Kyiv, Ukraine, 03022

yu1sam@yahoo.com, maletskiy@filatov.com.ua, a-samoilenko@ukr.net

Background. Application of polymer composites based hydrogels filled by functionalized nanoparticles (acid-modified nanoclay laponite and gold nanoparticles) allows their use for early diagnosis of cancer and filling postoperative cavities, especially after tumor resection. **Methods.** **Methods** for the synthesis of porous materials based on polyvinylformal soaked by copolymer acrylic hydrogels with incorporated spherical gold nanoparticles (an average size of 30 nm) and antitumor and bactericidal drugs for the filling of postoperative cavities, especially after tumor resection were developed. The hydrogel for the early detection of oncological diseases, was synthesized by radical polymerization of acrylamide; acid-activated Laponite (aLap), synthetic nano-sized clay mineral, previously obtained by pretreating of native Laponite (Lap) under the temperature of 50 °C and redox initiating pair. **Results.** The synthesized hybride hydrogel materials were characterized by the methods of laser correlation spectroscopy, FTIR and UV spectroscopy, electron microscopy (SEM), X-ray diffraction analysis, zymography, *etc.* Swelling degree and sorption ability of hydrogel towards Doxorubicin and Albucide medical preparation were also analyzed. Electrophoregrams obtained using a modified polyacrylamide gel demonstrated that the best separation of the globulin fraction was observed using a gel with incorporated aLap (treatment of native Lap with 0.5 N H₂SO₄). Due to the better separation of the high molecular

weight protein fraction (70 kDa–250 kDa), a difference in the number of bands between the donor, patient with CRC without metastases and patient with CRC with metastases was observed. It has been shown that the synthesized hybrid polymer systems based on highly porous polyvinylformal, which possess open-end (not blocked) pores, soaked by copolymer acrylic hydrogels with integrated gold nanoparticles can be used to fill postoperative cavities with simultaneous targeted release of incorporated cytostatic preparation Doxorubicin and bacteriostatic agent Albucide. The sodium dodecyl sulfate-polyacrylamide gel system with incorporated nanoparticles of aLap demonstrated high efficiency in the electrophoretic separation of peripheral blood plasma proteins for the early diagnosis of colorectal cancer. **Conclusions.** Acid modification of Lap can serve as a basis for the development of the nanocomposite hydrogel diagnostic systems. The synthesized hybrid polymeric materials based on porous polyvinylformal, acrylic hydrogels and gold nanoparticles can be used to fill postoperative cavities with simultaneous targeted release of the incorporated Doxorubicin and Albucide. **Grants.** The authors are grateful for the financial support of the National Research Foundation within the projects No 2021.01/0178 (Yu.S., A.M., L.K., S.D.) and No 2022.01/0039 (O.S., I.G.). **Keywords:** hydrogels, endoprostheses, diagnosis of cancer, Albucid, Doxorubicin.