

Preparation of complexes based on chitosan-Ag nanocomposite and cephalosporin antibiotics

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Bacterial drug resistance is a global problem of modern society. It is known that the resistance of microorganisms to metal nanoparticles and their oxides, in contrast to traditional antibiotics, is rarely occurred. In order to improve the biocompatibility and aggregative stability of nanoparticles, it seems promising to use polysaccharides in their synthesis, which can be used simultaneously as reducing agents and stabilizers [1]. Recent studies have shown that combining nanoparticles with antibiotics not only reduces the toxicity of both agents towards human cells by decreasing the requirement for high dosages but also enhances their bactericidal properties [2]. Combining antibiotics with nanoparticles also restores their ability to destroy bacteria that have acquired resistance to them.

In this work the effect of the mass ratio of chitosan-Ag : antibiotic in the reaction mixture on the physicochemical properties of complexes was established. Chitosan-Ag nanocomposite in aqueous solutions were synthesized by a facile hydrothermal method. Antibiotics of the third-generation cephalosporin group (ceftriaxone and cefotaxime) have been used to form complexes with chitosan-Ag nanocomposite. It was shown that when the mass ratio of ceftriaxone:chitosan-Ag in the reaction mixture changes from 0.5 to 1.25, the efficiency of antibiotic binding to nanoparticles increases 10 times: from 7.2 ± 0.2 to 71.7 ± 0.2 %. A further increase in the concentration of ceftriaxone during the synthesis leads to a gradual decrease in the efficiency of its binding to $14.2 \pm 0.3\%$ (with an 8-fold excess in relation to chitosan-Ag). In the case of cefotaxime, with a change in the mass ratio of antibiotic: chitosan-Ag in the reaction mixture from 0.5 to 10.0, a smooth decrease in the efficiency of its binding from 66.2 ± 1.5 to $13.0 \pm 0.7\%$ was observed. It was found that the maximum content of ceftriaxone and cefotaxime in the synthesized complex was 1.06 ± 0.01 and 1.29 ± 0.03 mg / mg chitosan-Ag, respectively.

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References

- [1] K. Hileuskaya et al. Colloids Surf. A (2020) 585:124141.
- [2] M. H. Hassan et al. Am. J. Microbiol. Res. (2016) 4:132-137.