BACTERICIDAL AND FUNGICIDAL ACTIVITY OF SILVER NANOPARTICLES STABILIZED BY DIDECYLDIMETHYLAMMONIUM BROMIDE

Sergey Vladimirovich Anisimov[1], Andrew Georgievich Khramtsov[2], Andrey Vladimirovich Blinov[3*], Anastasia Alexandrovna Blinova[3], Alexander Vladimirovich Serov[3], Alexander Alexandrovich Kravtsov[4,5], Vladimir Sergeevich Metel[2]

[1]PC "MKS", Dovatortsev str. 36, 355036 Stavropol, Russia
[2]Center for Biotechnological Engineering, Institute of Living systems, North Caucasus Federal University, Pushkina str. 1, 355009 Stavropol, Russia
[3]Institute of Engineering, North Caucasus Federal University, Pushkina str. 1, 355009 Stavropol, Russia
[4] Federal Research Center - The Southern Scientific Centre of the Russian Academy of Sciences, Chehova str. 41, 344006 Rostov-on-Don, Russia
[5]Scientific-research Laboratory of Ceramics and Techno-chemistry, Scientific-laboratory complex of Clean Rooms, Institute of Engineering, North-Caucasus Federal University, Pushkina str. 1, 355009 Stavropol, Russia

[*]e-mail: blinov.a@mail.ru

Abstract

As is known, silver nanoparticles have unique physical, chemical and medico-biological properties, which make it possible to apply them in various fields of medicine, food industry, sanitation and other branches of science and technology. Silver nanoparticles exert bactericidal, bacteriostatic, antiviral and antifungal properties against more than 500 pathogens, yeast fungi and viruses. The prospect of using nanosilver as a disinfecting agent is due to its following advantages: no adaptation of microorganisms, safety in relation to the human body, universality of action, high antimicrobial effect. Within the framework of the present work, the bactericidal and fungicidal properties of nanosilver stabilized by a quaternary ammonium compound - didecyldimethylammonium bromide were investigated.

In order to study antimicrobial activity and determine the minimum inhibitory concentration, tests on the sensitivity of microorganisms to the developed silver nanoparticles by serial dilutions on a liquid nutrient medium were carried out. As a bacterial culture, *Escherichia coli* was used. Meat and peptone broth was used as a nutrient medium for the cultivation of test strains. Test tubes with *E. coli* cultures were placed in a thermostat for 24 hours at a temperature t = 37 ^{0}C. After a day, the changes that occurred in test tubes were registered. The fungicidal activity of nanosized silver stabilized by didecyldimethylammonium bromide was studied on a *Penicillium roqueforti* mold culture, using the disk diffusion method. Sowing the spore suspension of fungi was carried out on the surface of the nutrient medium - Saburo agar. Next, paper disks with a diameter of 10 mm were placed on the prepared culture sample, each of which was coated with the same amount of silver nanoparticles preparation with different concentrations: C (Ag) = 0.5 mg/mL, 0.05 mg/mL, 0.005 mg/mL, and 0.0005 mg/mL. Then the samples were incubated in a thermostat at a temperature of t = 25 ^{0}C; after two days, the growth suppression zone of mold culture *Penicillium roqueforti* was analyzed. Another experiment was also conducted to determine the effect of the active acidity of the medium on the fungicidal activity of the developed nanosilver preparation. In this experiment, a series of samples with various pH values from 3 to 11 was prepared. The studies were also performed using the disk diffusion methods with Saburo agar as a medium.

It was found that the minimum inhibitory concentration of nanosilver stabilized by didecyldimethylammonium bromide with respect to *E. coli* is 0.005 mg/mL. After analyzing the experimental data obtained, we can talk about the synergistic antibacterial effect of silver nanoparticles and stabilizer - didecyldimethylammonium bromide. Regarding the mold culture of *Penicillium roqueforti*, it was determined that samples with concentrations of the disinfecting component C (Ag) = 0.5 mg/mL, 0.05 mg/mL, 0.005 mg/mL significantly inhibit the vital activity of the mold culture.

It has been established that in the entire range of active acidity of the medium (pH) under consideration, nanosilver stabilized by DDAB exhibits high fungicidal activity.

Key words: *Nanosilver, Didecyldimethylammonium bromide, Fungicidal and bactericidal activity.*