VIABILITY AND STABILITY OF LYOPHILIZED MICROMYCETES IN THE PRESENCE OF Cu AND ZnO NANOPARTICLES

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The publications of recent years demonstrate the effect of nanoparticles (NPs) on growth, morpho-cultural peculiarities, viability and biosynthetic processes in microorganisms. It was demonstrated that with the help of nanoparticles introduced into the microorganism cultivation medium, their morphological characteristics can be modified and biosynthetic processes stimulated, thus obtaining the expected microbial product of a higher quantity and quality.

This material presents the results obtained in the study of the viability and stability of 20 micromycetes from the genera *Aspergillus*, *Trichoderm*a, *Penicillium* lyophilized in the presence of Cu NPs and ZnO NPs. Morpho-cultural peculiarities and antifungal activity were studied. Phytopathogens were used as test cultures: *A. niger*, *A. alternata*, *B. cinerea*, *F. solani*, *F. oxysporum*.

It was found that the supplementation of Cu or ZnO NPs in the culture medium acts individually and insignificantly on the morpho-cultural particularities of the studied micromycetes. In some cultures, changes related to the order of color, growth rate and colony sporulation were observed, and in others insignificant stimulations or decreases in colony growth were recorded. The viability of strains grown on agar media supplemented with NP after lyophilization and storage in a lyophilized state, in most cases, varies within the limits of ± 2-4%, but there can also be stimulations up to 10%, compared to the control variant. ZnO NP acts more beneficially on the biosynthetic properties, stimulating the antifungal activity of *Penicillium* and *Trichoderma* strains, compared to the tested phytopathogens, from 2% to 16%, compared to the control.

ZnO NPs in a concentration of 0.1 mg/l supplemented in the lyoprotective medium have a beneficial effect on viability. Thus, it stimulates the viability of strains of the genus *Aspergillus* by 4 - 12.5%, of strains of the genus *Trichoderma* by 10-14.7% compared to the control, and compared to strains of the genus *Penicillium* it is neutral (± 1%/M), but after 1 year of storage in a lyophilized state, the viability of the studied strains is at the level of the control variant. ZnO nanoparticles supplemented in the protective medium can modify the antifungal activity of micromycetes of the genus *Trichoderma* and *Penicillium* against some phytopathogens. In most cases, it contributes to the stimulation of antifungal activity against the phytopathogens tested by 4-30%. Changes in the morpho-cultural characteristics of the studied cultures after lyophilization were not observed.

The action of Cu or ZnO NPs solutions as a rehydrator in the revitalization of micromycete strains is different depending on the concentration used and the tested culture. The rehydration of the strains with the Cu MPs solutions in the concentration of 0.001 mg/ml contributes to the stimulation by 1 - 4% of the viability, and the rehydration with the nanosolution of ZnO in the same concentration, decreases by 5-11% the viability of micromycetes, compared to the control.

It was found that Cu Nsolution in revitalization of lyophilized strains of the genus *Penicillium* significantly stimulates antifungal activity against phytopathogens tested by 4.0 - 40%, and the revitalization of strains of the genus *Trichoderma* by 7.5 - 21.3%, compared to the control.

At the same time, Cu NPs solutions used to revitalize lyophilized micromycete strains do not change their morpho-cultural particularities, and ZnO nanoparticles solutions significantly change these particularities, thus contributing to the reduction of micromycete growth and development.

According to the presented results, we can conclude that Cu and ZnO NPs supplemented in the cultivation medium, the protection medium or the revitalization medium of lyophilized strains, act insignificantly on the growth, viability after lyophilization and storage, but significantly modify the biosynthetic properties, significantly stimulating the antifungal activity against the phytopathogens tested.

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