Green synthesized silver nanoparticles as potential safety disinfectants

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Introduction

Multiple biological threats, including the current situation with the coronavirus-provoked pandemic, determine the increasing demand in the effective and safe disinfectants. Such a problem is actual both for medicine and veterinary. Traditional alcohol- and chlorine-based disinfectants have some disadvantages and limitations especially for veterinary use. As per the modern studies, nanomaterials particularly silver nanoparticles can serve as novel high effective and safe disinfectants with wide spectra of antimicrobial, antifungal and antiviral activity. The application of "green synthesis" methods among the different ways to obtain nanoparticles gives opportunity to receive cheaper nanomaterials possessed by higher biocompatibility and safety together with the basic requested properties.

Aims

Green synthesis of silver nanoparticles, their safety assessment *in vitro* and estimation of the antimicrobial activity as potential disinfectant.

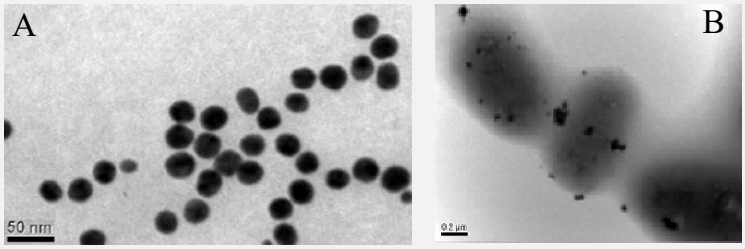
Methods

Silver nanoparticles (AgNPs) were synthesized in water medium by the reduction of the silver nitrate ($AgNO_3$) using tannin and mint extract as reducing agents.

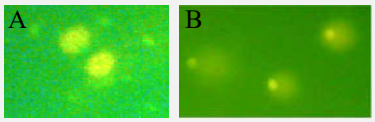
Safety assessment of the synthesized AgNPs was defined *in vitro* using cell lines L929 and MDBK with the level of their cytotoxicity (MTT-test and crystal violet staining method) and genotoxicity (Comet assay in alkaline conditions) according to [1].

The quantitative suspension test [2] using *Escherichia coli* 4, *Salmonella enteritidis* 131 and *Salmonella Dublin 515* clinical isolates was used to estimate antimicrobial activity of the synthesized AgNPs.

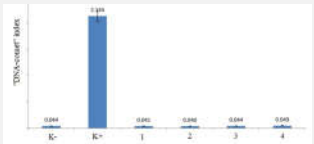
Results



TEM images of the synthesized AgNPs (A) (average particles size 30 nm) and *E.coli* 4 cells with accumulated AgNPs (B).



Electrophoretic image of the "DNA-comets" preparations: A – undamaged DNA; B – damaged DNA of the cells.



Evaluation of the genotoxicity for the synthesized AgNPs (L929 cell line): K- - negative control (DNA of the native cells); K+ - positive control (damaged DNA of the cells under the influence of mutagen N-Nitroso-N-methylurea) ; 1-4 - DNA of the cells after the influence of AgNPs.

Antimicrobial activity of the synthesized AgNPs after 30 and 45 min exposition of the microbial suspensions with nanoparticles.

Test-strains (clinical isolates)	Control	Exposition of the microbial suspensions (10^9 CFU/ml) with AgNPs (8,0 mg/ml)	
		30 min	45 min
Escherichia coli 4	++++	ø	ø
Salmonella enteritidis 131	++++	ø	ø
Salmonella dublin 515	++++	ø	ø

Note: ++++ an intensive growth of a microorganism; ø – absence of the bacteria cells' growth (total inhibition of the bacteria cells' growth).

Conclusion

Synthesized AgNPs (30 nm) were characterized as biosafe for eukaryotic cells according to the criteria of genotoxicity and cytotoxicity together with the determined pronounced bactericidal effect against bacteria clinical isolates used in the work. Obtained results indicate the potential use of these nanoparticles as safety disinfectants.

References

1. Guidelines "Safety assessment of drug nanopreparations" approved by the Scientific Expert Council of the State Expert Centre of the Ministry of Health of Ukraine, 2013, Kyiv, Ukraine. – 108 p.

2. Methods of laboratory research and testing of medical preventive disinfectants to evaluate their effectiveness and safety: A Guide. – M., 2010. – 615 p.

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