Effect of Ag nanocrystals embedded in potato starch matrix on growth of *Escherichia coli* and *Staphylococus aureus*

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Introduction

Over the past few decades, inorganic nanoparticles, whose structures exhibit significantly novel and improved physical, chemical, and biological properties, phenomena, and functionality due to their nanoscale size, have elicited much interest. Nanophasic and nanostructured materials are attracting a great deal of attention because of their potential for achieving specific processes and selectivity, especially in biological and pharmaceutical applications [2, 8]. Recent studies have demonstrated that specially formulated metal oxide nanoparticles have good antibacterial activity [7], and antimicrobial formulations comprising nanoparticles could be effective bactericidal materials [3, 4, 6]. In this study we present results of the action of Ag nanoparticles embedded in starch matrix on growth of *Escherichia coli* and *Staphylococus aureus*. Experiments were performed using different concentrations (5, 10, 25, 50, 75 and 150 ppm) of Ag nanostructures in growing medium (NB). Both bacterial strains were grown on the solid medium for 5 days at temperature 37^{o}C. Concentration depended effect of microorganisms growth inhibition was observed. We found that total growth of both bacterial strains was completely stopped at Nano Ag concentration of 150 ppm. Ag nanoparticles were synthesized in Starch gel by reducing silver nitrate by various reducing agents. physical properties of Ag nanocrystals were characterized by employing various techniques such as UV-Visible and IR spectroscopy, TEM/SEM electron microscopy, X-ray photoelectron spectroscopy, Energy-Dispersive X-Ray Spectroscopy (EDS) and thermal properities of biocomposites also were measured [1].

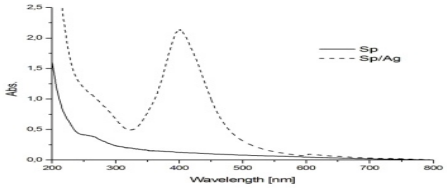

Fig. 1: UV/VIS Spectra

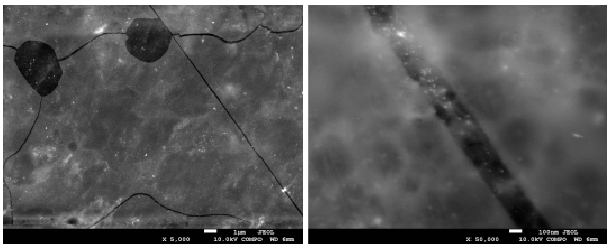

Fig. 2: Transmission Electron Microscopy (SEM and TEM)

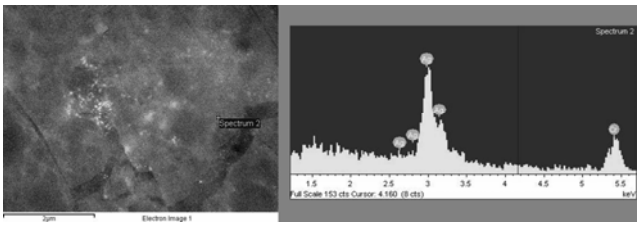

Fig. 3: Energy-Dispersive X-Ray Spectroscopy (EDS)

Experimental

Escherichia coli ATCC 25922 and Staphylococcus aureus ATCC 25929 were obtained from the American Type Culture Collection (Manassas, VA), wild clinical culture of: *E. coli, and S. aureus* were obtained from Private Microbiological Analitical Laboratory. Difco nutrient broth (NB) (BD234000) and Difco nutrient agar (BD 213000) medium (Becton Dickinson and Co.) were used to grow and maintain the bacterial cultures per the supplier's protocol.

In this work we investigated the antibacterial properties of silver nanoparticles against the gram-negative bacterium: *Escherichia coli ATCC* 25922 *and* gram-positive *Staphylococcus aureus ATCC 25929* on agar plates. In these experiments we also used four different wild clinical strains of *E. coli*:

E. coli 14 471 - *1*

E. coli 14 574 - *2*

E. coli 14 072 - *3*

E. coli 14 438 - *4*

as well as four different wild clinical strains of *S. aureus*:

S. aureus 14 945 - *1*

S. aureus15 057	-	*2*
S. aureus14 987	-	*3*
S. aureus15 007	-	*4*

Organism preparation

Escherichia coli ATCC 25922, Staphylococcus aureus ATCC 25929 and wild clinical culture of: *E. coli, and S. aureus* were grown overnight in NB at 37°C. Washed cells were resuspended in NB, and optical density (OD) was adjusted to 0.1, corresponding to 10^8 CFU/ml at 600 nm.

Bacterial growth or killing kinetics in presence of nanosilver, nanocopper and miksture of nanosilver and nanocopper.

To examine the bacterial growth or killing kinetics in the presence of silver, nanocopper and miksture of nanosilver and nanocopper nanoparticles, *E. coli* and *S. aureus* cells were grown in 100 ml of NB supplemented with different doses of silver nanoparticules (total contents: 10, 25, 50, 100, or 150ppm), at 37°C with continuous agitation. The cylindrical sample containers were placed horizontally on an orbital shaker platform and agitated at 150 rpm. Growth or killing rates and bacterial concentrations were determined by measuring OD at 600 nm. The OD values were converted into concentration of *E. coli and S. aureus* cells (CFU per milliliter) [4, 5].

Bacterial susceptibility to nanosilver

To examine the susceptibility of *E. coli and S. aureus* to different silver nanoparticles, nutrient agar plates from a solution of agar were prepared. A 100-µl sample of bacterial suspension cultured in NB (with a concentration of 10^5 or 10^7 CFU/ml of *E. coli and S. aureus*) was plated on a nutrient agar plate. The plates were then supplemented with different amounts of nanosize particles (10 to 150 ppm), and the plates were incubated further at 37°C. The numbers of resultant colonies were counted after 24 h of incubation. The counts from three independent experiments corresponding to a particular sample were averaged.

Results and discussion

Results of our experiments show that the best inhibition of bacterial growth is received when the strains are treated with 150 ppm of nanosilver particles. Figure 4 shows the influence of 150 ppm of nanosilver on *E. coli* and *S. aureus* strains. There is no visible growth of bacteria.

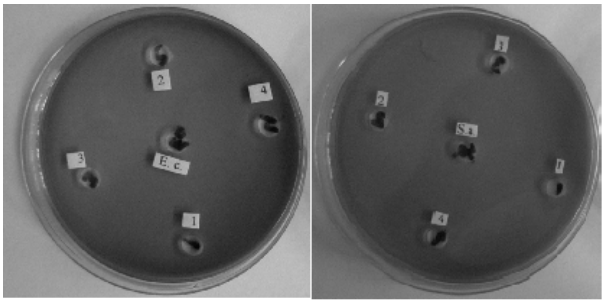

Fig. 4. Influence 100 ppm of Ag on inhibition of: *E. coli and S. aureus growth.*

References

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