



# Biological activity of glutathione-based silver nanoparticles

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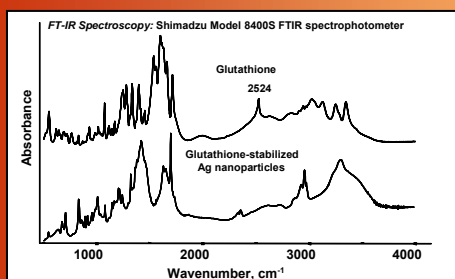
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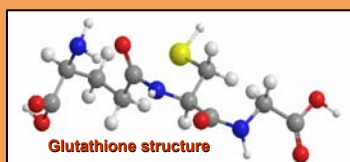
Herein we describe the preparation of glutathione (GSH) stabilized Ag nanoparticles (Ag Np) and their biological activity. Many chemical reduction methods have been used to synthesize Ag Np from silver salts [1-4]. The reaction described here uses silver nitrate as the starting material and sodium borohydride as reducing agent. The characterization of Ag Np and thiol-stabilized metal nanoparticles (GSH-Ag Np) was performed by FT-IR, UV-Vis, AFM and SEM techniques. GSH-Ag Np were biologically active at concentrations less than  $10^{-5}$  M, whereas free Ag Np treatment with the same concentration was inoffensive. At  $10^{-6}$  M concentration, Ag Np stimulated microorganisms growing, while  $10^{-4}$  M and higher concentrations of these nanoparticles became increasingly more toxic.

## Experimental

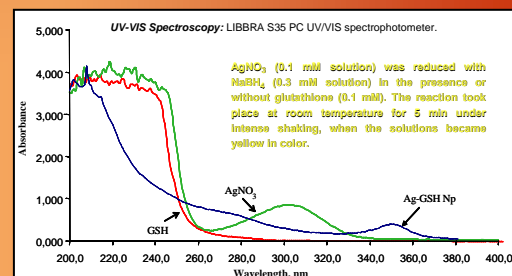
**Reagents:** silver nitrate, sodium borohydride, glutathione, *Escherichia coli-DH5a*, *Triticum aestivum-Henika* variety



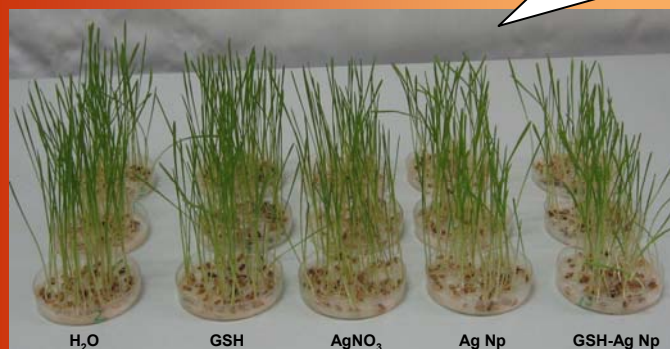
IR spectra of GSH and GSH-Ag Np. The specific thiol vibration ( $2524\text{ cm}^{-1}$  band), which appears in GSH spectrum is missing in GSH-Ag Np spectrum, because of the new S-Ag<sup>0</sup> bond.



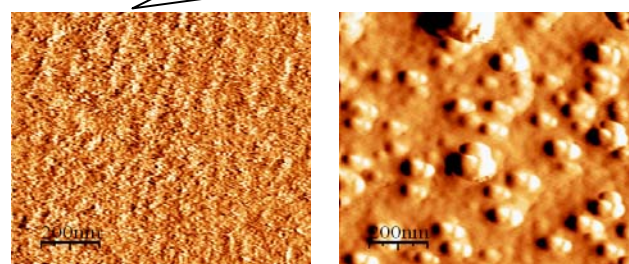
Silver ions have a low effect on seed germination, and the total plant height is reduced by 12 %, while Ag Np resulted in plants with a lower height, but higher batch weight than those treated with Ag<sup>+</sup>, even close to the blank value; even the plants were rather small, they were more vigorous. The stabilized Ag Np decreased the toxicity level. GSH-Ag Np showed biological activity [7] at concentration lower than  $10^{-4}$  M, whereas the treatment with the same concentration of Ag Np was harmless.



Morphological analysis of surfaces confirmed the formation of nanoparticles, which crowded when allowed to stay for 48 hours in aqueous suspensions, forming relatively large aggregates (20-150 nm) with different shapes.



Biological activity of GSH, Ag<sup>+</sup>, Ag Np și GSH-Ag Np



AFM images: a) glutathione; b) silver nanoparticles.

SEM images: a) Ag Np; b) GSH-Ag Np.

## Conclusions

- ❖ GSH-Ag Np showed biological activity at lower conc. than  $10^{-5}$  M.
- ❖ Concentrations greater or equal to  $10^{-4}$  M of these Ag Np have a bacterial growth-inhibiting effect.
- ❖ The  $10^{-6}$  M suspension of Ag Np stimulated microorganisms growing.
- ❖ Silver, Ag<sup>+</sup> and Ag Np, have generally been considered to be quite harmless to people.
- ❖ The most recent research has demonstrated that Ag Np penetrate mammalian cells and damage the genotype. Moreover, it has been demonstrated that Ag Np penetrate the skin via pores and glands [5,6].
- ❖ The impact on health of Ag Np are not entirely known and need more studies.

## References

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