# PLANT-MEDIATED SYNTHESIS OF $Ag_2S$ NANOPARTICLES, THEIR SURFACE MODIFICATION AND GENOTOXIC PROPERTIES

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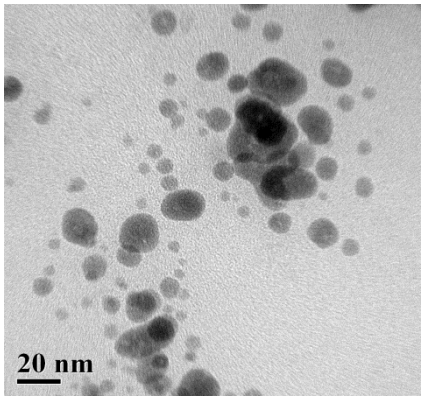
## Introduction

$Ag_2S$ quantum dots attract research interest in recent years due to their appealing near-infrared (NIR) photoluminescence in the second (NIR-II) window, which promises *in vivo* fluorescence imaging with higher penetration depth. It is very important that the nanoparticles be in a water-dispersible form for their use in any biological applications [1]. The surface modification of nanoparticles increases their luminescent quantum yields, expand their stability, prevent their aggregation and facilitates usage in biological research. The aim of this study was to synthesize $Ag_2S$ nanoparticles by hairy root extract of *Linaria maroccana*, characterize their structural, morphological and optical features and investigate genotoxic properties of silver sulfide quantum dots on a model *Allium*-test.

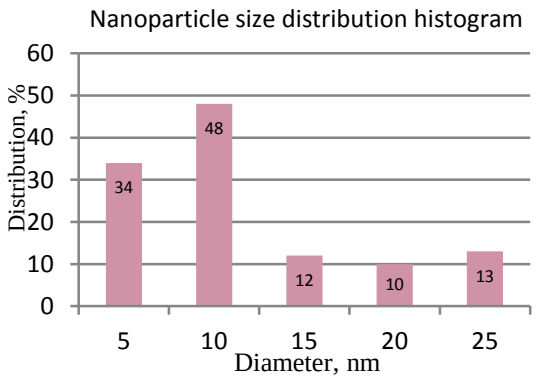
## Materials and methods

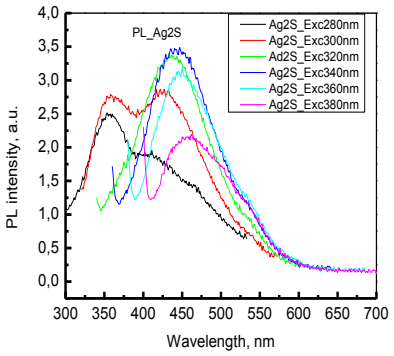
«Green» synthesis methodology was previously developed by us for cadmium-based quantum dots. All experimental details are presented in [2]. Luminescence spectra were measured using the serial spectrophotometer Cary Eclipse (Varian Inc., Agilent Tech. USA). Characterization of $Ag_2S$ quantum dots was performed using electron microscope JEOL JEM-2100 F (Japan) Each sample was dispersed ultrasonically to separate individual particles, and some drops of the suspension were deposited onto carbon coated copper grids. For surface modification experiments we have used BSA and L-cysteine solutions at concentration 10 mg/mL. To determine the genotoxicity of $Ag_2S$ nanoparticles, the roots of 4-day onion roots were treated under 4˚C for 2-4 h for mitosis synchronization in meristematic root apex cells. Then roots were fixed and treated with silver sulfide nanoparticles for 24h. Further samples were analyzed using a light fluorescence microscope Axioskop 40 (Carl Zeiss, Germany). Mitotic indexes were calculated according to a formula: $MI = \sum (P + M + A + T) / N \cdot 100\%$,

## Structural-morphological and optical features of synthsized Ag2S nanoparticles



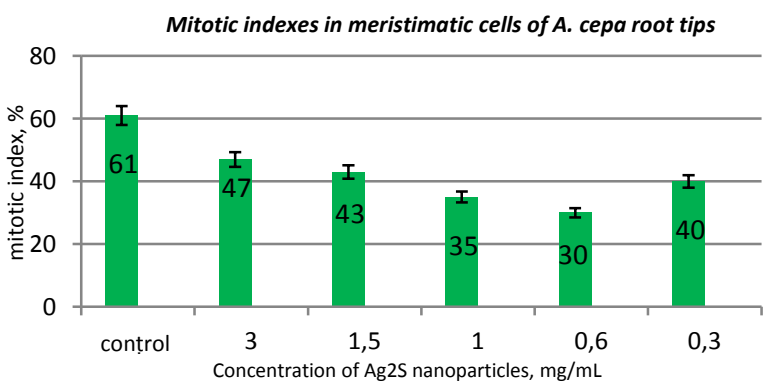

TEM micrographs of $Ag_2S$ nanoparticles. Diameter of individual spherical nanoparticles is in the range of 5 – 25 nm




Luminescent peaks at 450-500 nm depending on excitation vawelength

## Influence of Ag2S nanoparticles on mitosis of meristematic cells of *Allium cepa* roots




## CONCLUSIONS

Our study demonstrated the possibility of obtaining stable homogeneous $Ag_2S$ nanoparticles by hairy root culture. Produced nanoparticles had spherical morphology, intense luminescence and were not significantly genotoxic which allows them to be used as luminescent probe to create bioconjugates in cell biology studies.

## REFERENCES

*1. Sibiya P.N., Moloto M.J.* // Dig. J. Nanomater. Biostruct. – 2018. – **13**. – P. 411-418.

*2.Borovaya M.N., Naumenko A.P., Matvieieva N.A., Blume Ya.B., Yemets A.I.* // Nanoscale Res. Lett. – 2014. – **9**. – P.1-7.