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EVALUATION OF THE ANTIMICROBIAL PROPERTIES OF PHYTOSYNTHESIZED METAL NANOPARTICLES

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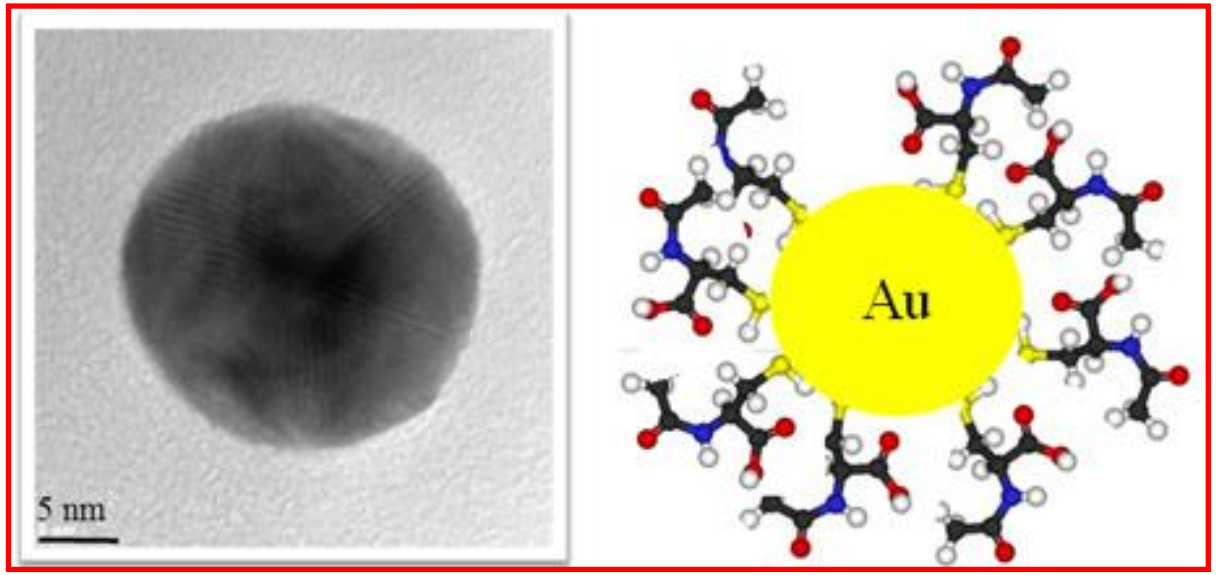
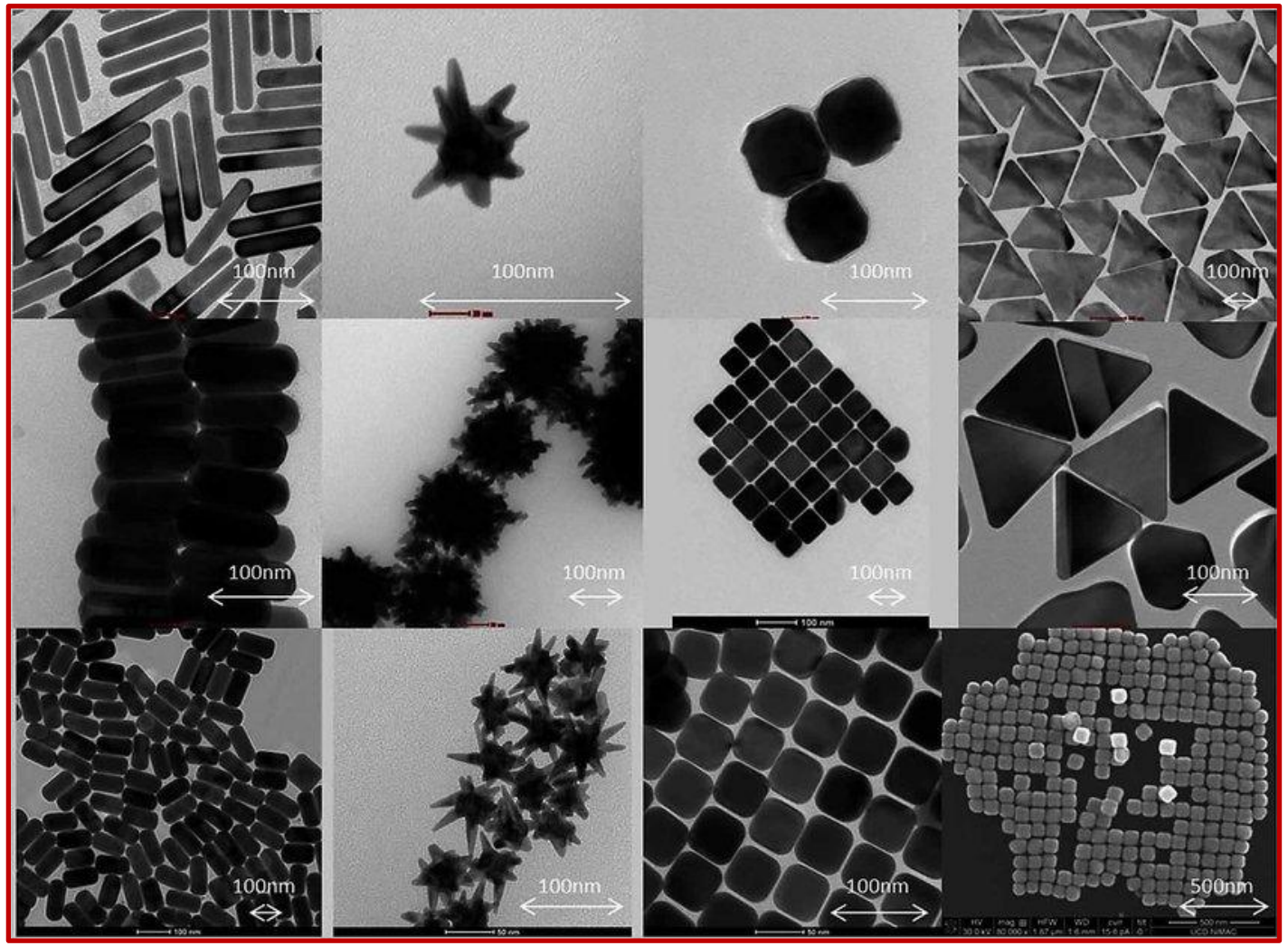
Project topic

Development of the **green methods** for synthesis of colloidal **gold nanoparticles** solutions by using aqueous plant extracts:

- ***friendly to environment***
- ***cost effectivity***
- ***stability***
- ***shape and size control***
- ***biocompatibility***

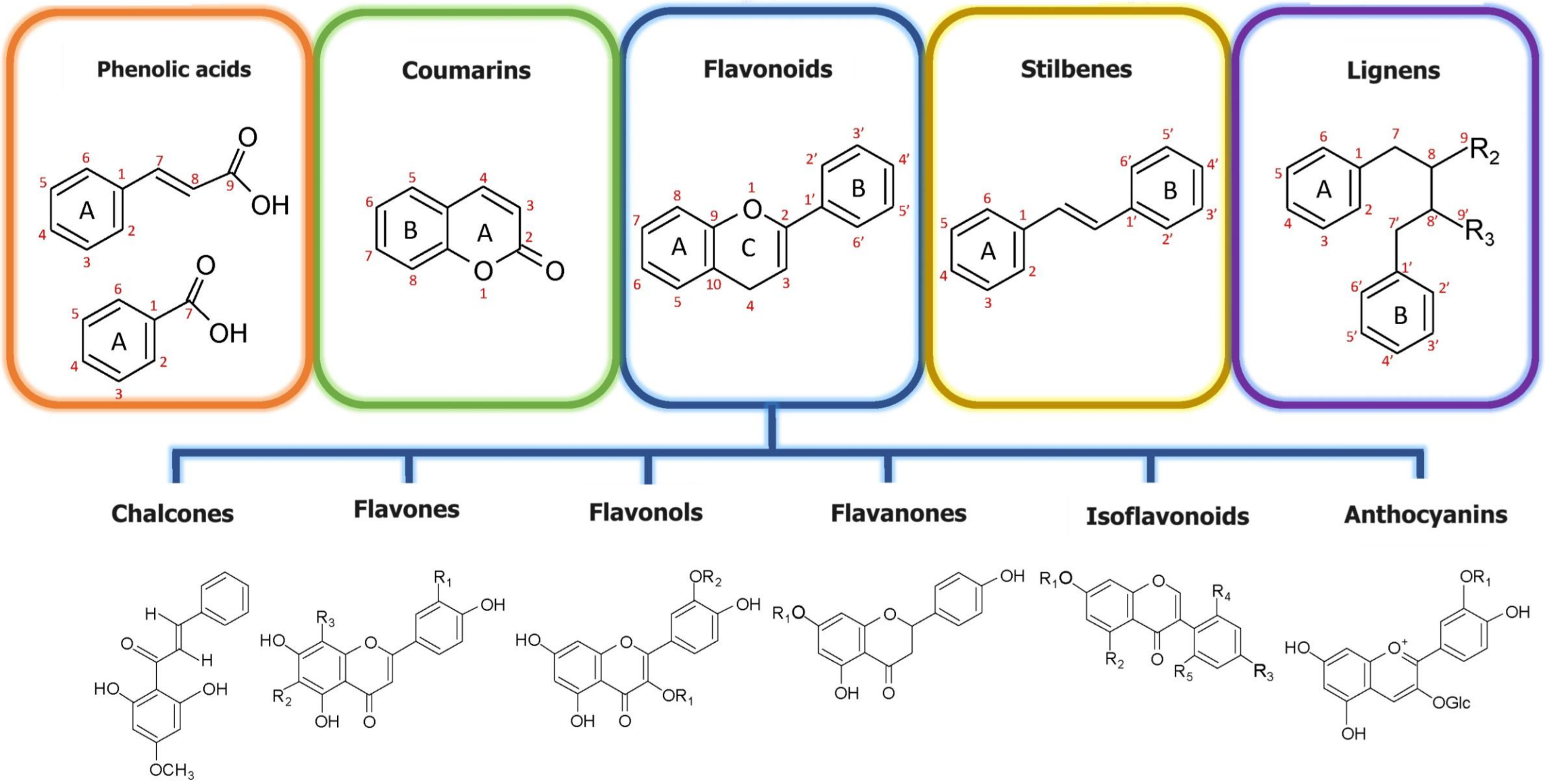


Shape management

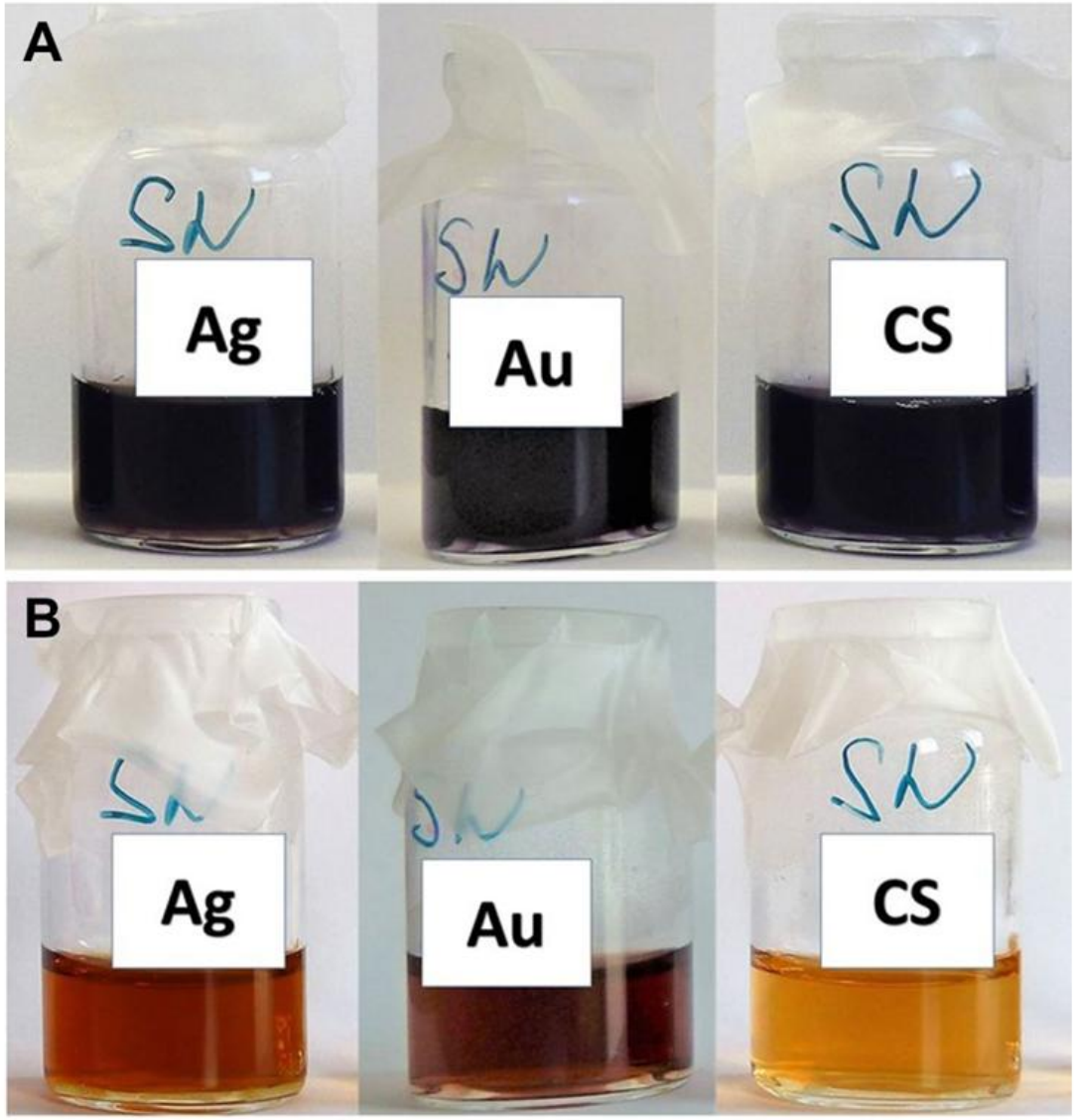


Bouloudenine, M. & Bououdina, M. (2016). Toxic Effects of Engineered Nanoparticles on Living Cells. In M. Bououdina (Ed.), *Emerging Research on Bioinspired Materials Engineering* (pp. 35-68). IGI Global Scientific Publishing. https://doi.org/10.4018/978-1-4666-9811-6.ch002

Plant polyphenols



Reaction mixtures prepared with polyphenolic fraction of the elderberry extract



(A) at the beginning of the synthesis (A) and (B) after 24 h of heating at 65 °C

Ag: sample of silver solution,
Au: sample of gold solution,
CS: control sample (extract without metal salt precursor)

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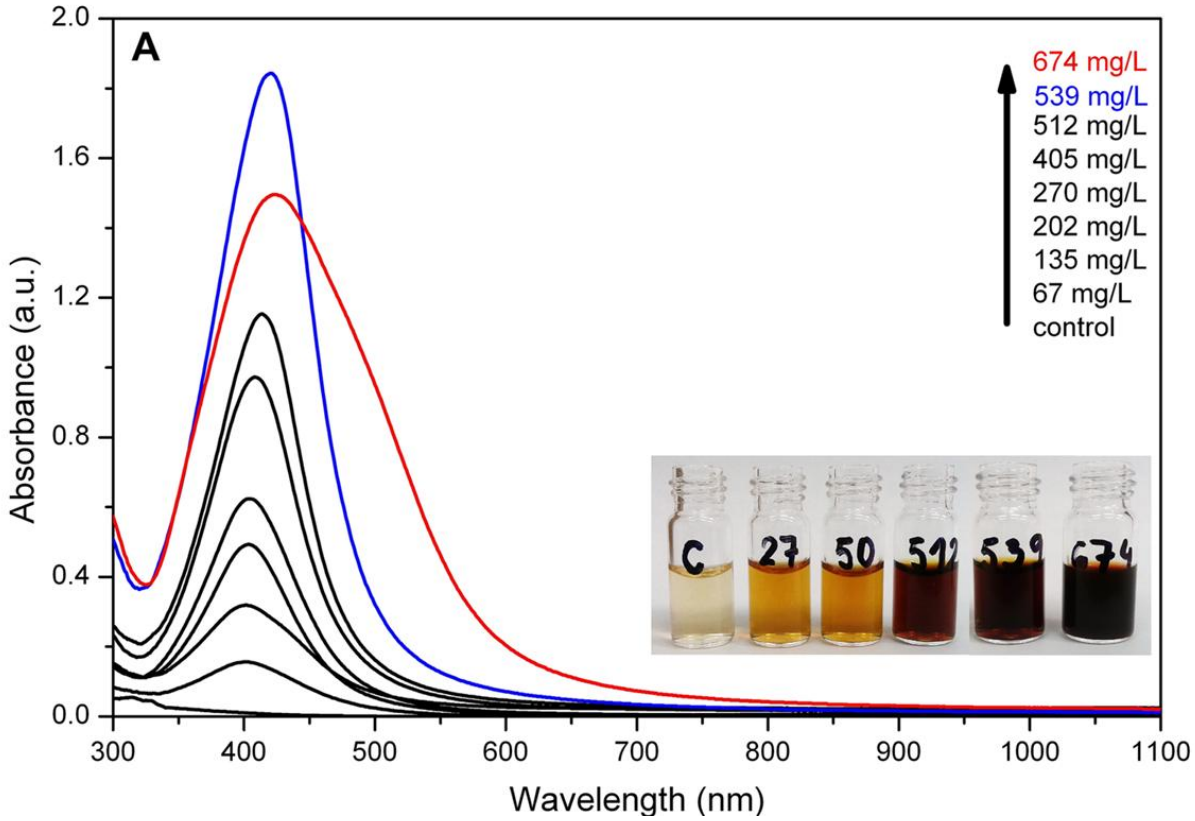
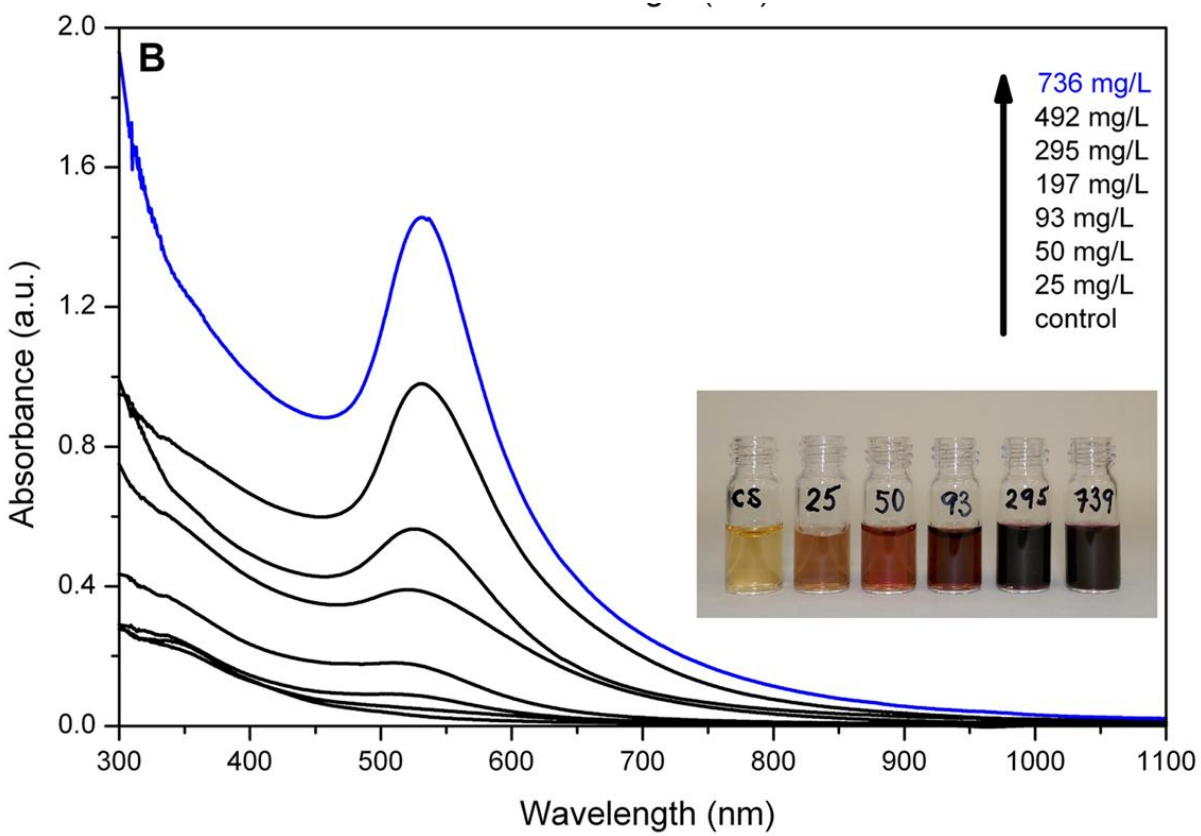
UV–Vis spectra of AgNPs (A) and AuNPs (B)





**black 2.5% of plant extract and blue/red 5.0% of plant extract*

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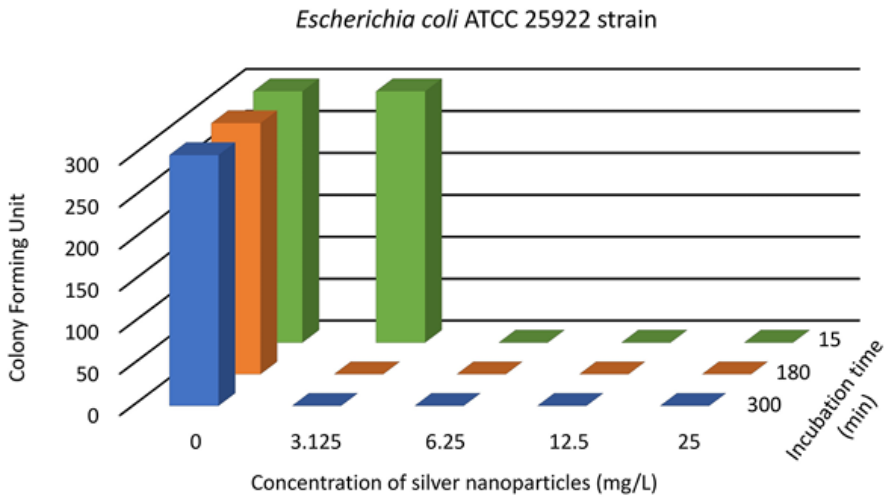
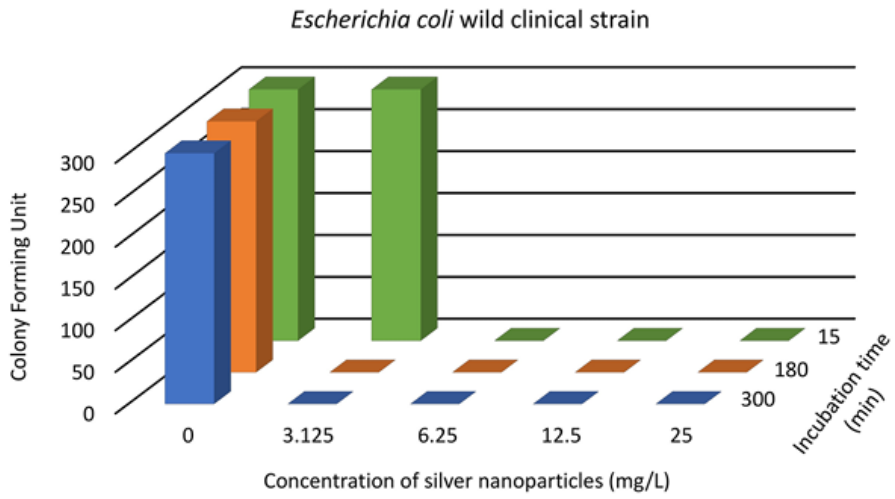
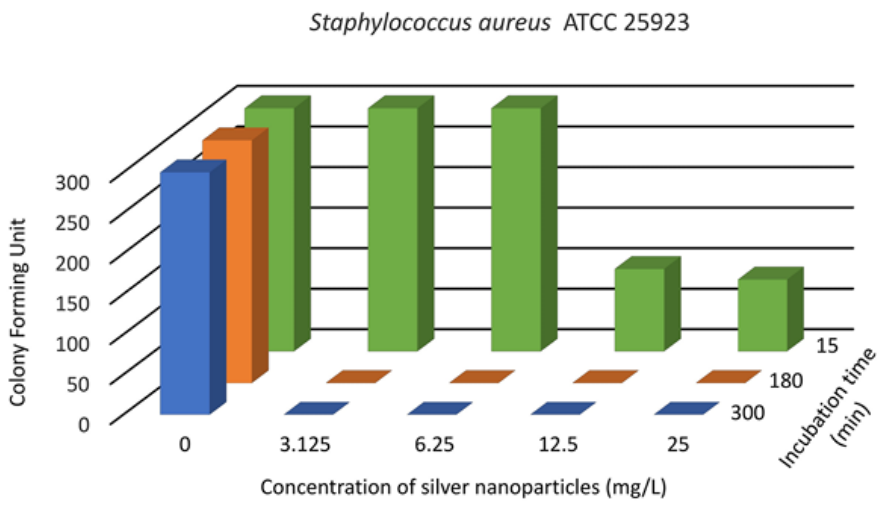
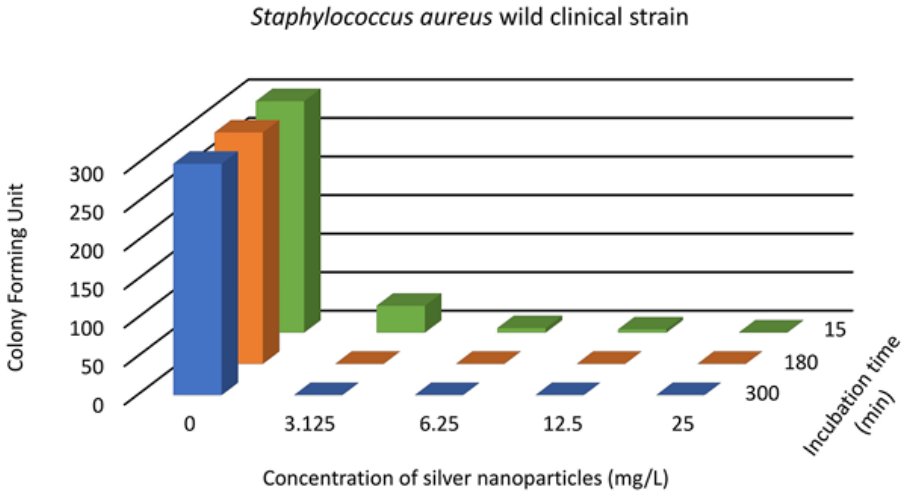
Growth inhibition of the tested bacterial strains by varying AgNPs concentrations









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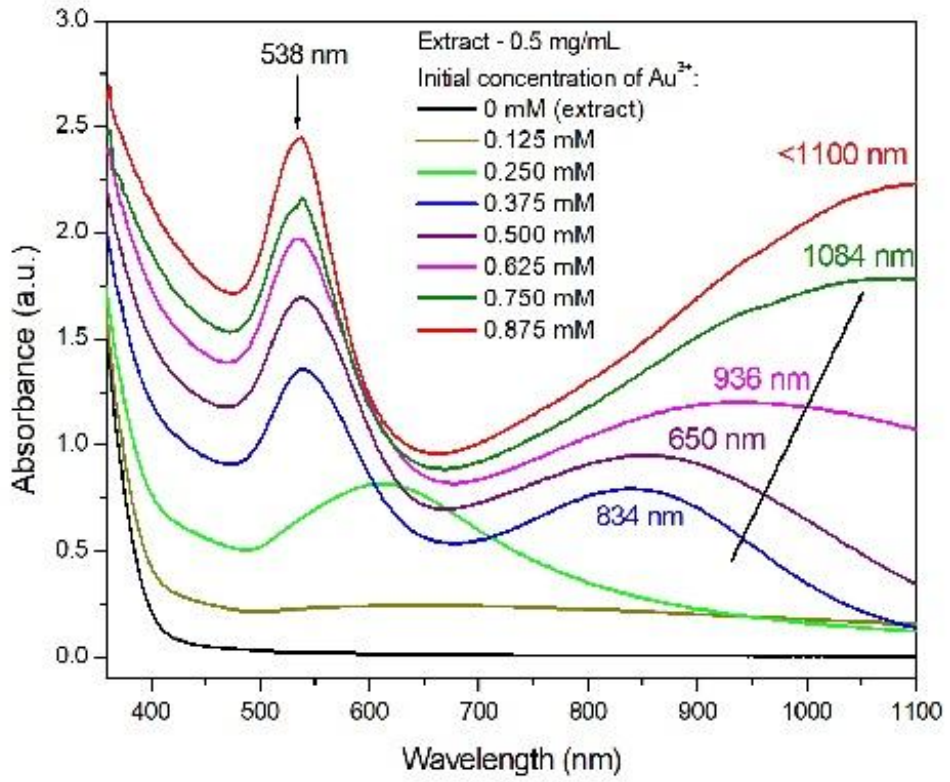
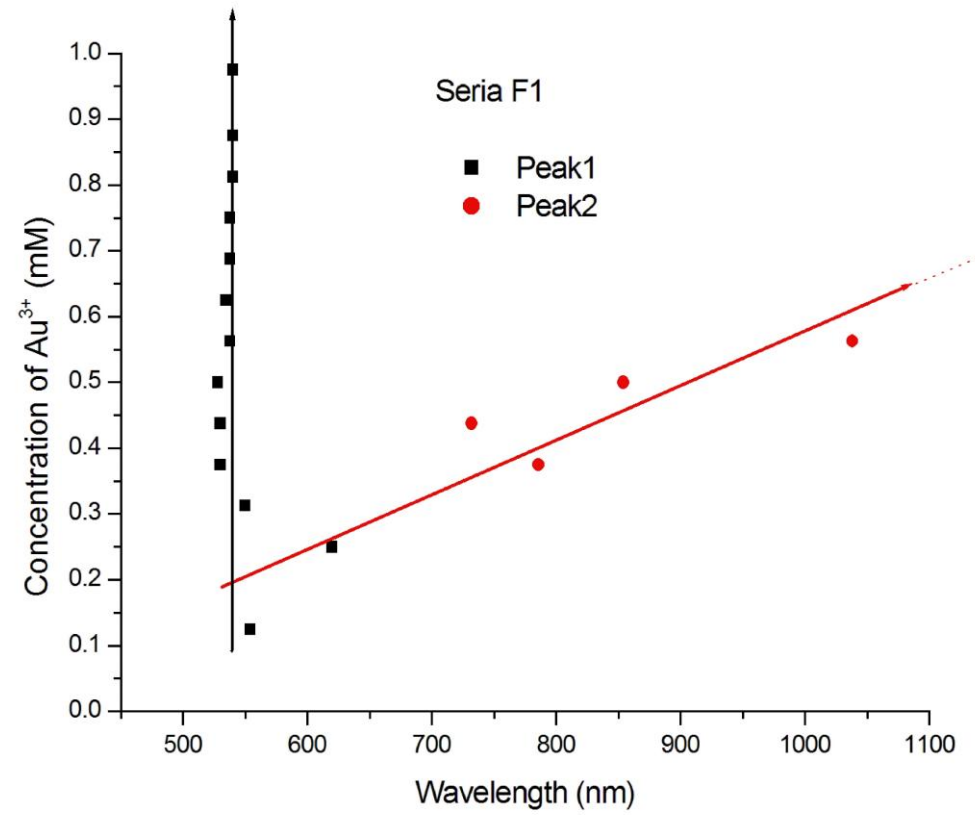
Conclusions

- The biological activity of silver nanoparticles applied in form of nanocolloids with a different concentration on selected *S. aureus* and *E. coli* bacterial strains was confirmed.

- Antibacterial tests showed significant antimicrobial properties of AgNPs already at con centration 6.25 mg/L after 15 min of incubation.

Synthesis of AuNPs using aqueous peppermint extract (*Mentha* x *piperita*)





Mariychuk, R., Smolková, R. et al. The regularities of the ***Mentha piperita*** L. extract mediated synthesis of gold nanoparticles with a response in the infrared range (2022) Applied Nanoscience, 12 (4), pp. 1071-1083. DOI: 10.1007/s13204-021-01740-8

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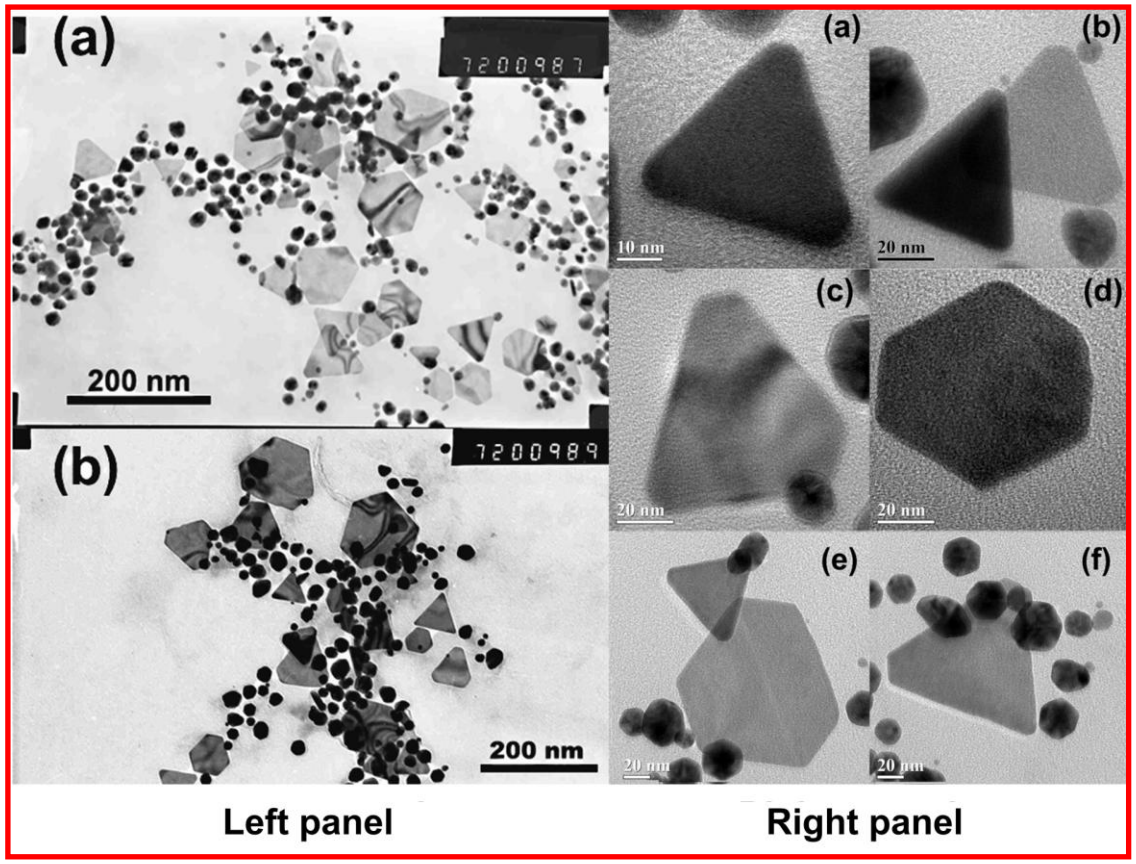

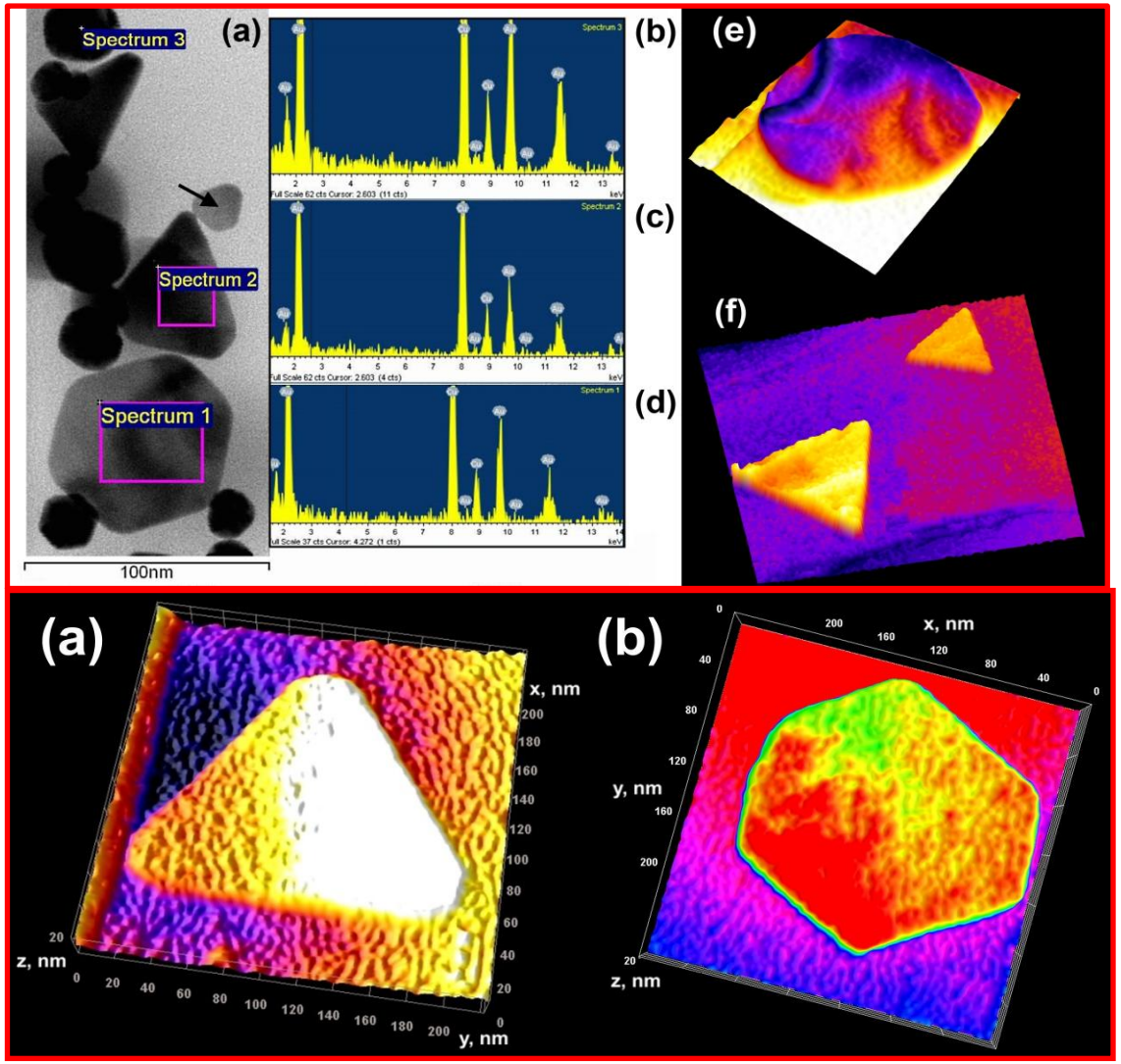

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Conclusions

Silver nanoparticles (AgNPs) typically inhibit microbial growth, with resistance levels varying across strains. The *Pseudomonas putida* USM4 strain demonstrated inhibited biomass accumulation in the presence of AgNPs, but the cells remained viable

Similarly, the *Pseudarthrobacter oxydans* USM2 strain showed resistance to AgNPs at 0.125 mM, while biomass accumulation was inhibited at 0.25 mM without causing complete cell death.

In *Brevundimonas vesicularis* USM1, initial growth was followed by cell lysis; the strain exhibited the ability to interact with and precipitate silver, highlighting its potential for environmental biotechnology applications.

Regarding **gold nanoparticles (AuNPs)**, the strains *Pseudomonas putida* USM4 and *Pseudarthrobacter oxydans* USM2 showed no significant inhibition, while *Brevundimonas vesicularis* USM1 also precipitated gold, likely through organic ligand decomposition, consistent with the known minimal impact of AuNPs on microorganisms.

These results are promising for further studies on the interaction pathways between microorganisms and metal nanoparticles.

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Thank you for your attention!