



Universidade Federal do ABC

Green synthesis of silver nanoparticles using green tea extract, characterization, antibacterial activity and biocompatibility

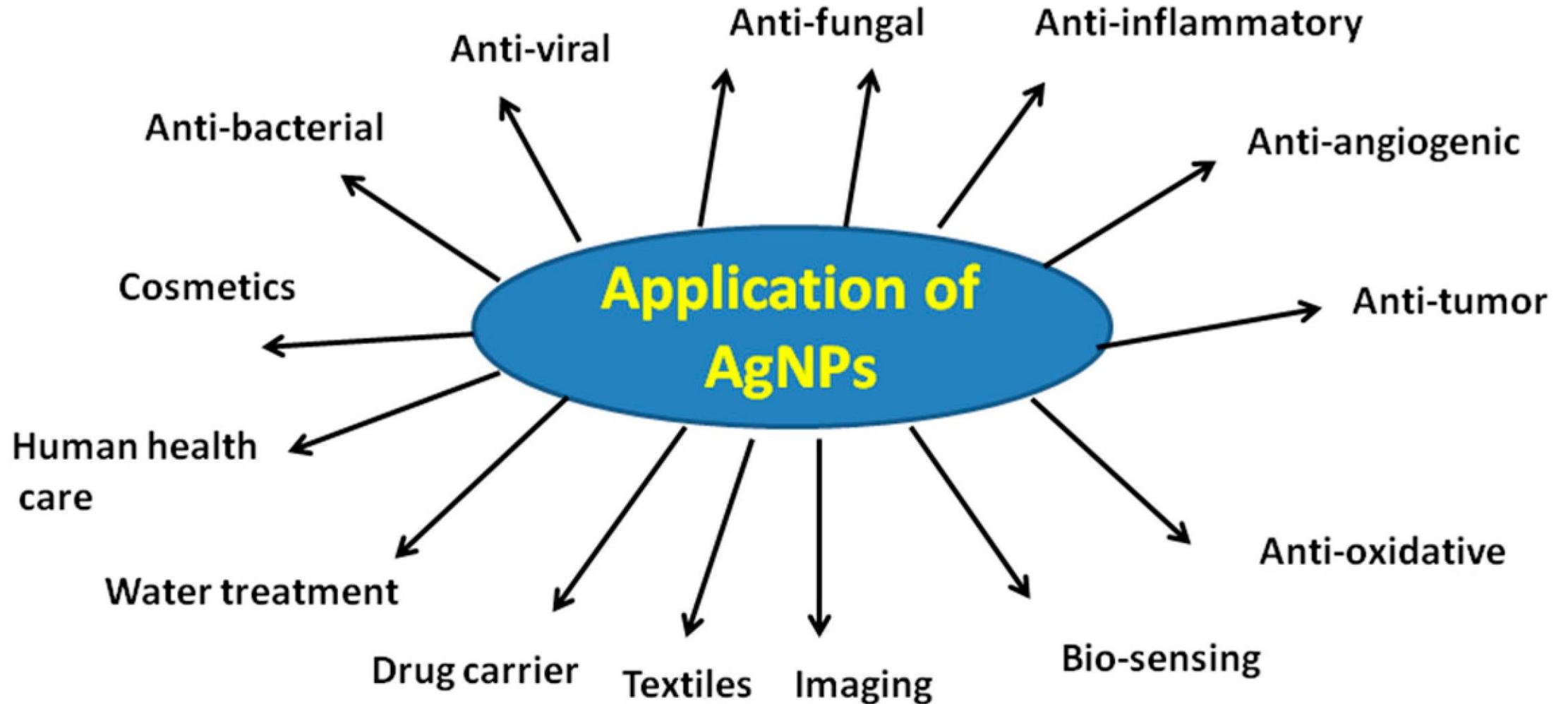
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Student

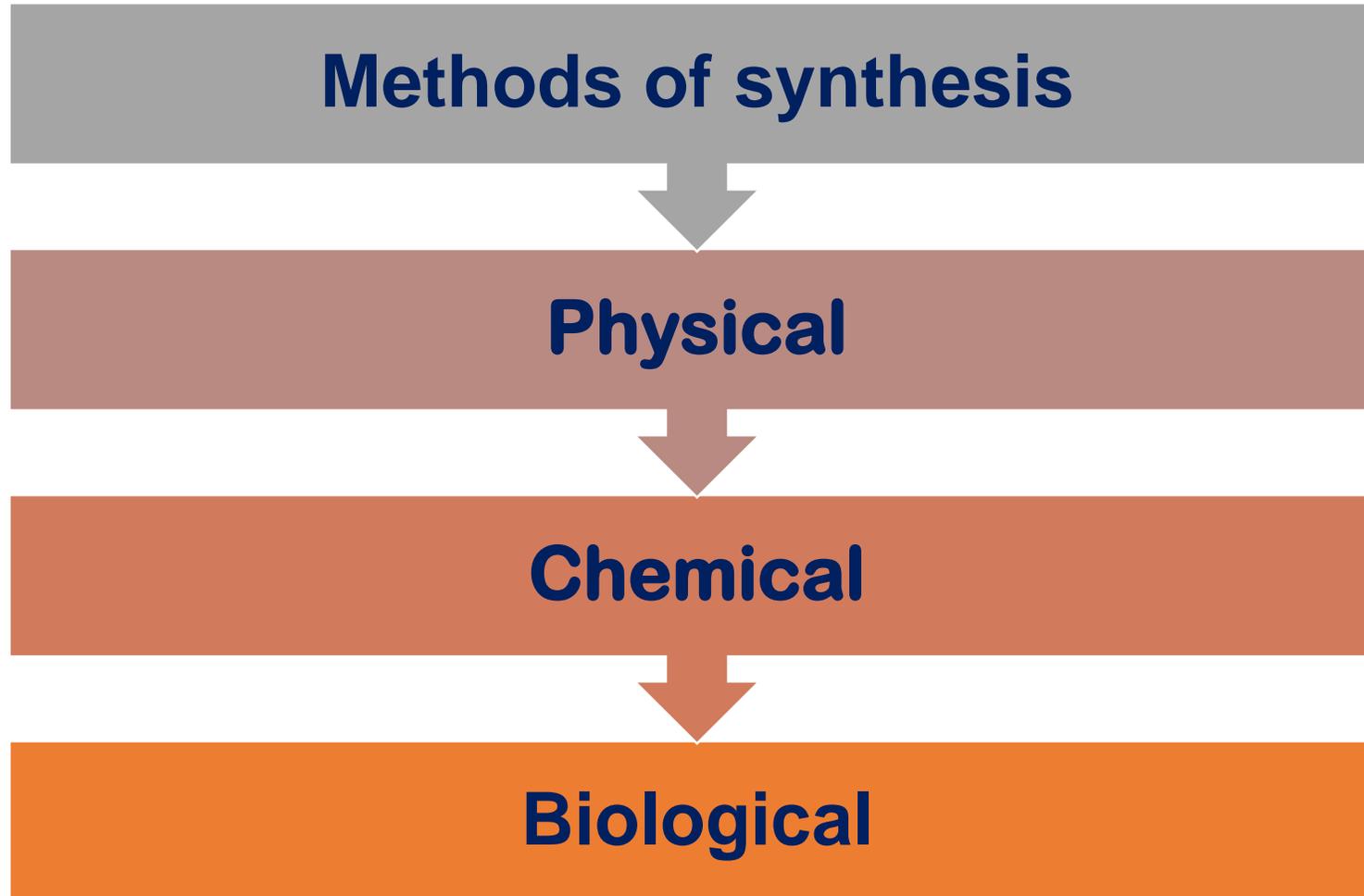
Federal University of ABC, Brazil

Silver nanoparticles (AgNPs)



Methods of synthesis of AgNPs

The most generalized methods for nanoparticle synthesis are chemical, physical and biological methods



Green chemistry



Biological method

Solvent usually is water

Simple steps

Toxic chemicals

Zero contamination

The reducing agent act as stabilizer

Synthesis of AgNPs-Green tea extract



Green tea extract

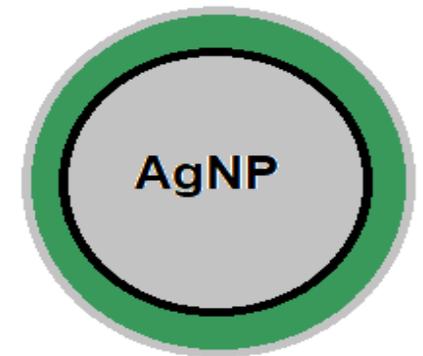
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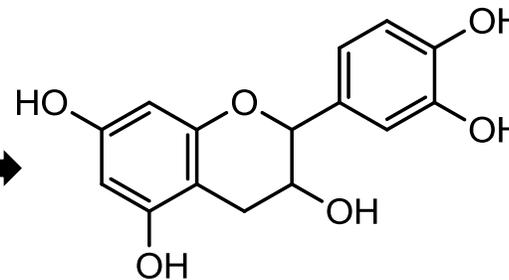
Silver nitrate
(AgNO₃)



AgNPs

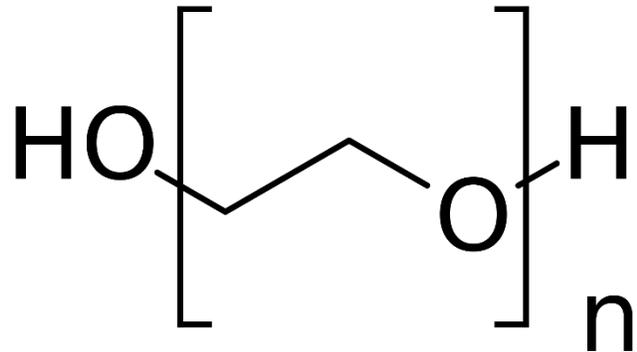
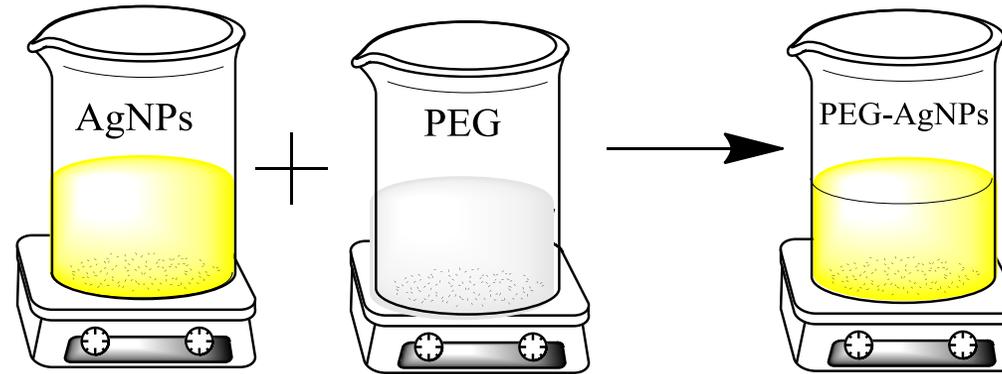


Camellia sinensis



Catechin

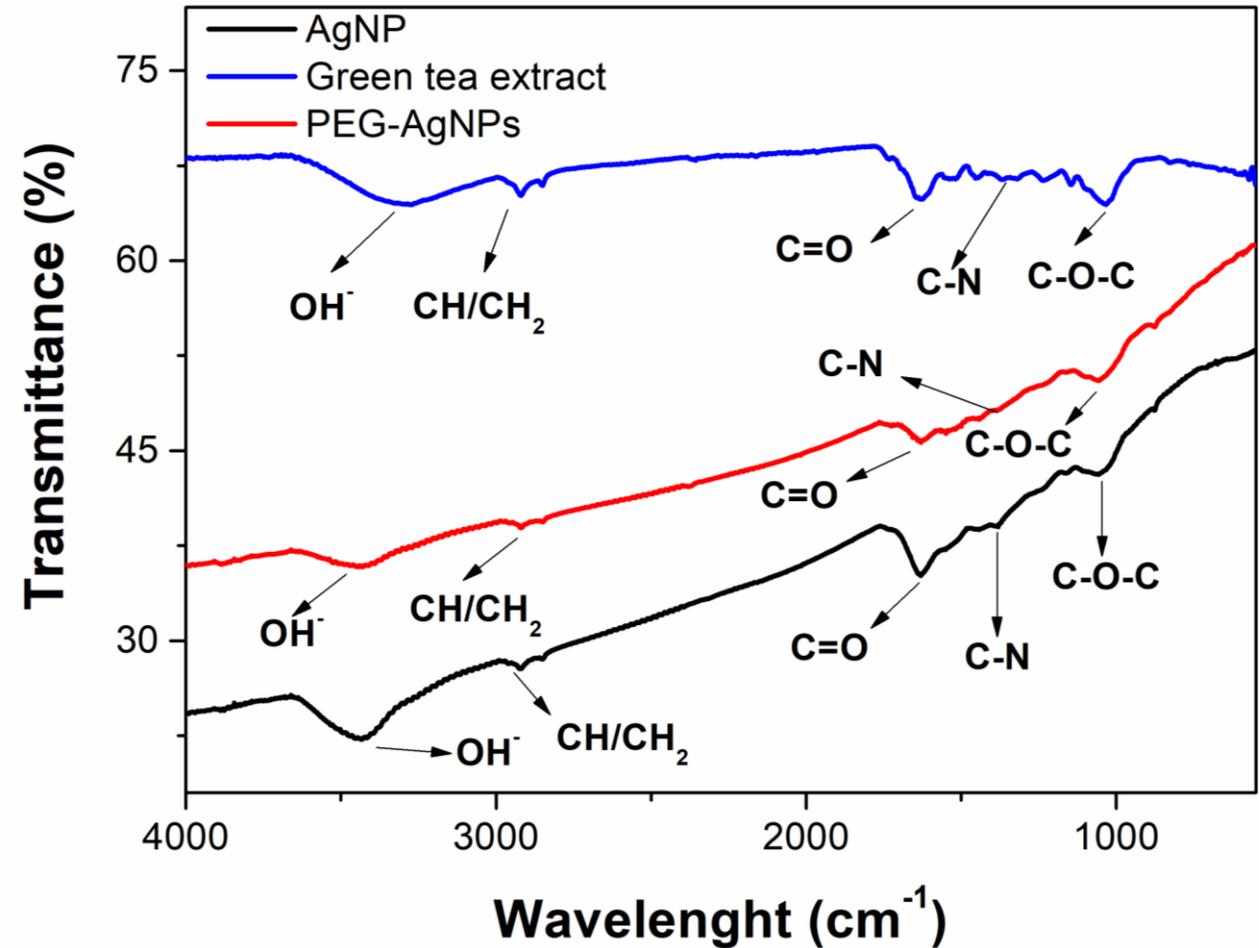
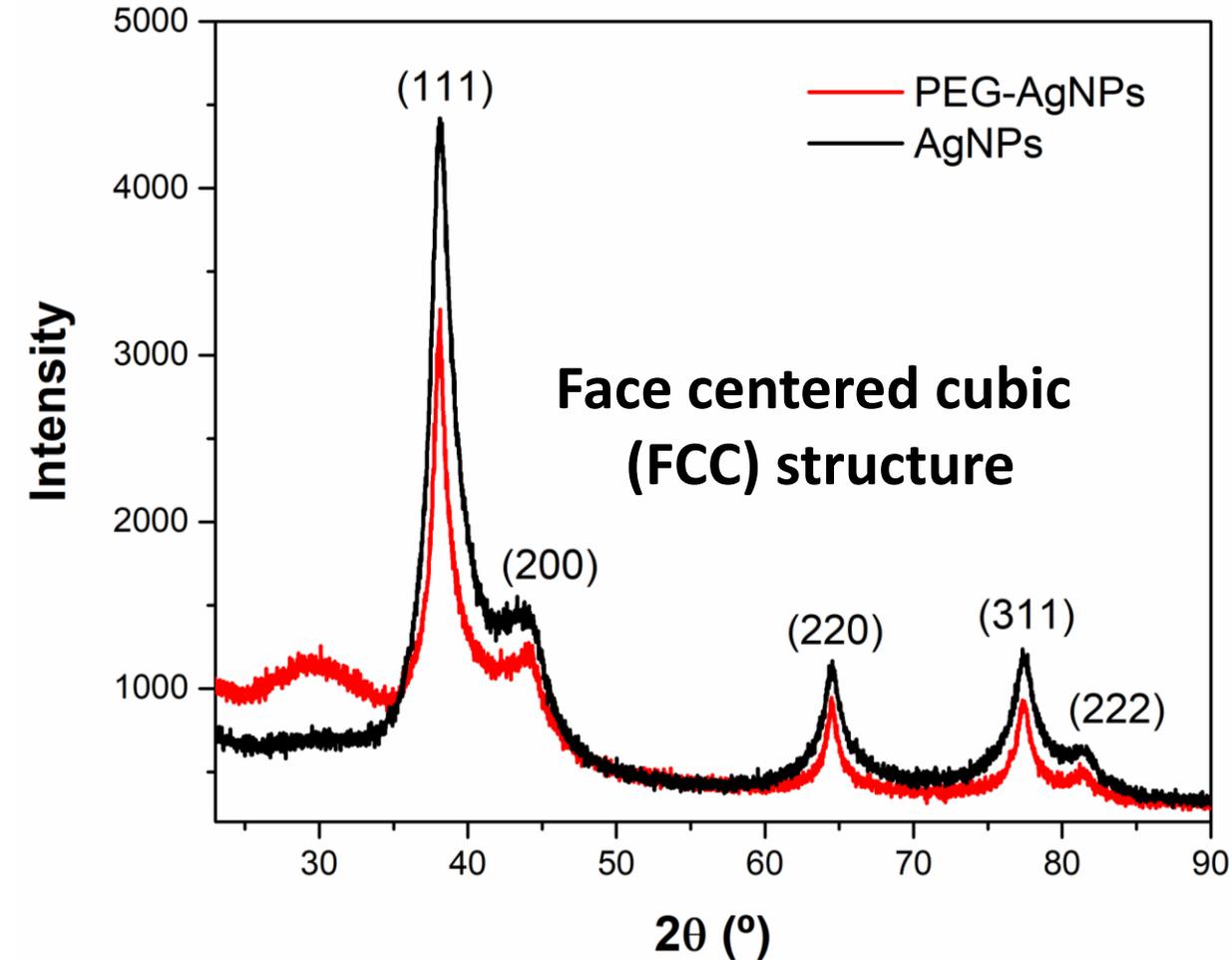
Synthesis of PEG-AgNPs



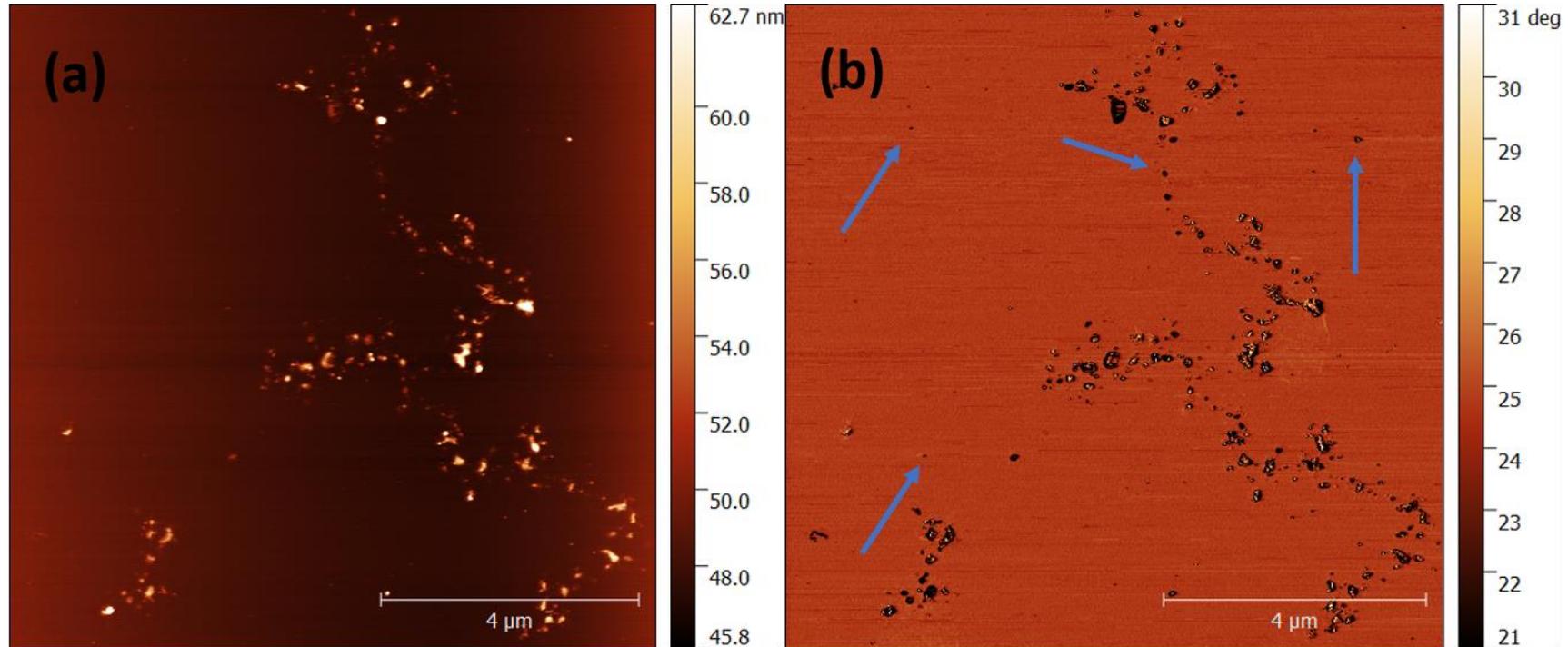
Polyethylene glycol (PEG)

- Biocompatible
- Non-toxic
- Widely used in biomedical applications

X-ray diffraction (XRD)/Fourier-transform infrared spectroscopy (FTIR)



Atomic force microscopy (AFM)



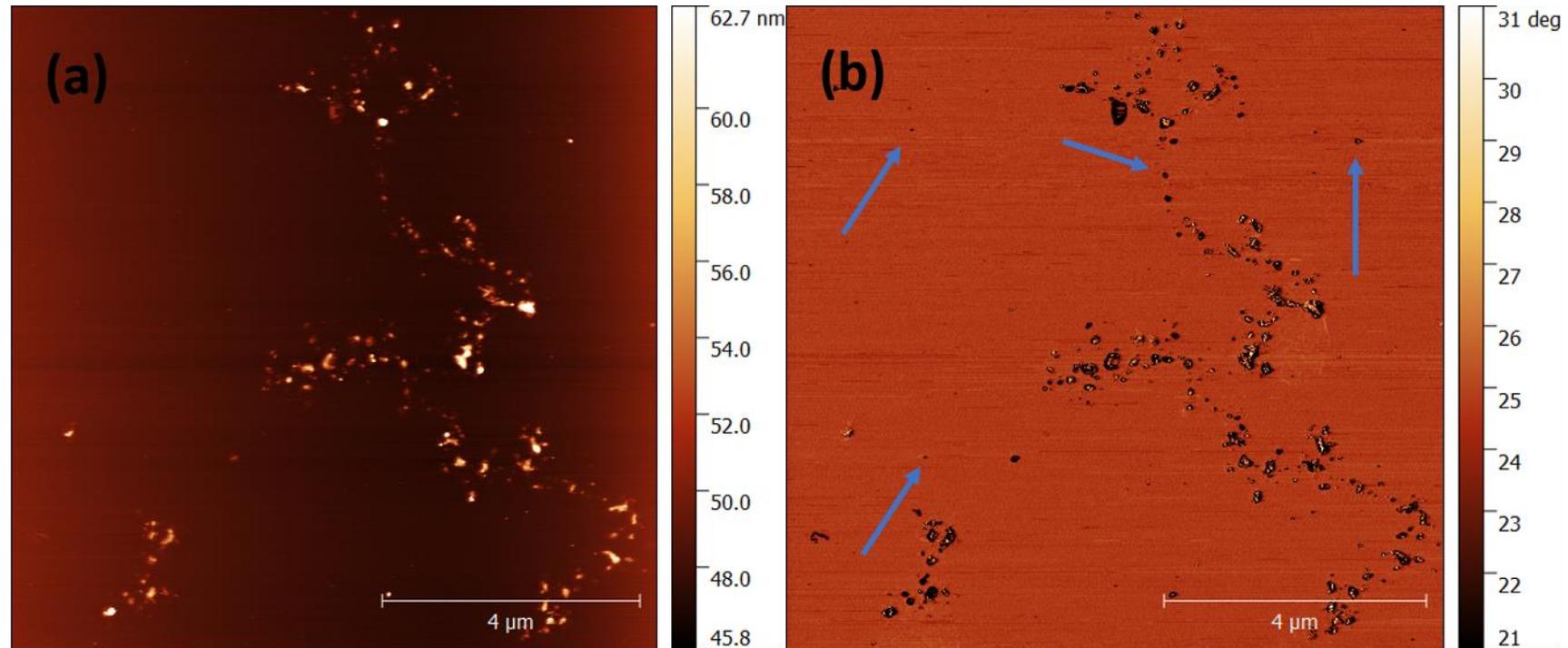
AgNPs

Size: 3.9 ± 1.6 nm

PEG-AgNPs

Size: 4.2 ± 1.3 nm

Atomic force microscopy (AFM)



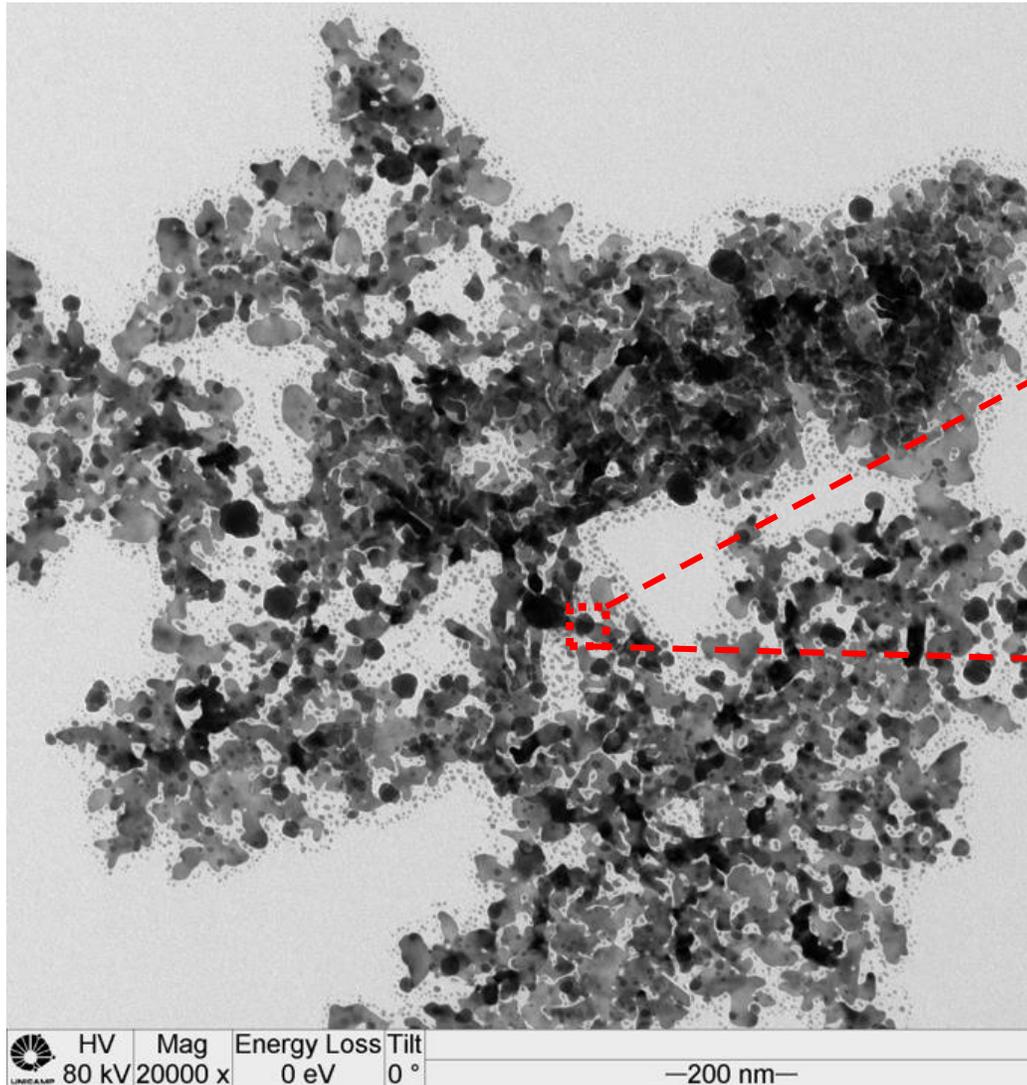
AgNPs

Size: $3.9 \pm 1.6\text{nm}$

PEG-AgNPs

Size: $4.2 \pm 1.3\text{nm}$

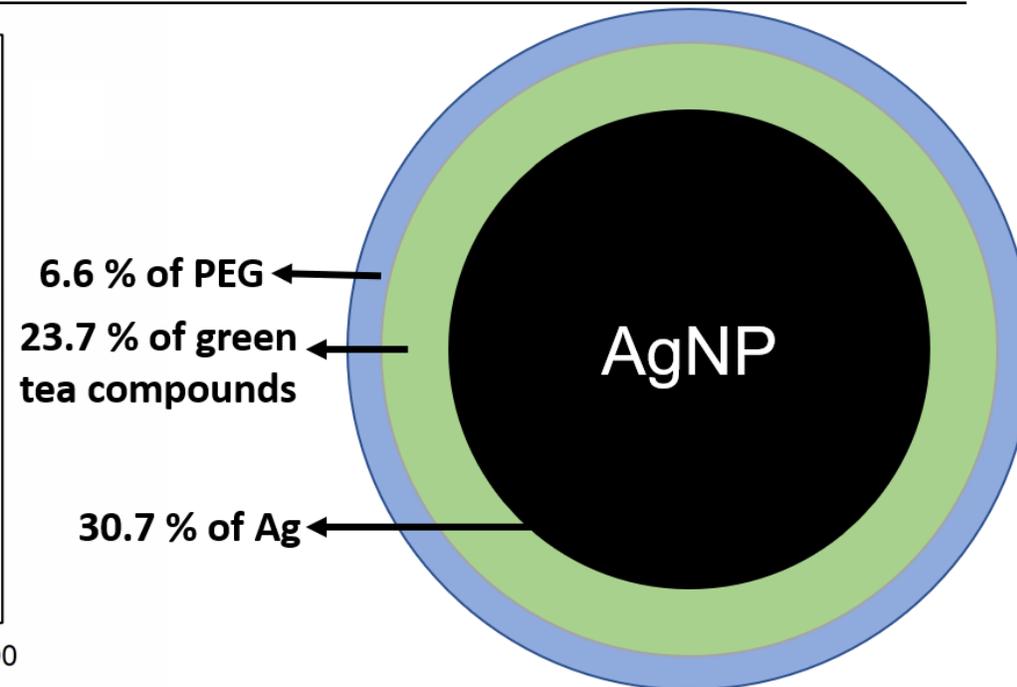
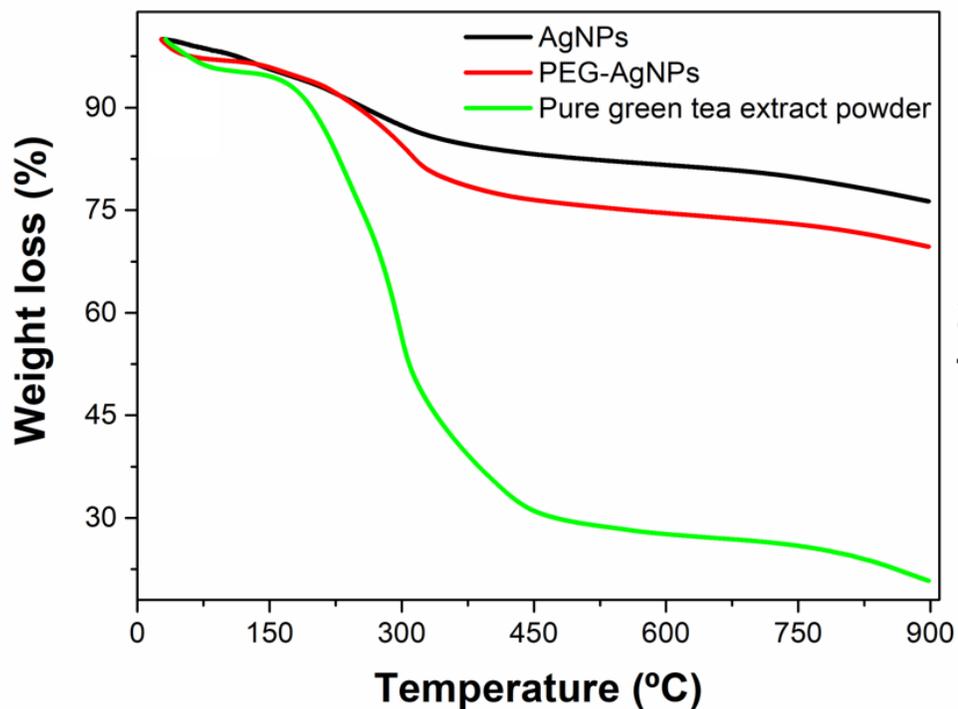
Transmission electron microscopy (TEM)



Spherical shape

DLS/TGA measurements

	Hydrodynamic Size (nm)	PDI	Zeta Potential (mV)
AgNPs	34.68 ± 4.95	0.28 ± 0.01	-35.5 ± 3.32
PEG-AgNPs	43.87 ± 3.08	0.25 ± 0.02	-37.03 ± 1.49



Antibacterial activity

AgNPs

PEG-AgNPs

Bacteria

MIC ($\mu\text{g/mL}$)

MBC ($\mu\text{g/mL}$)

MIC ($\mu\text{g/mL}$)

MBC ($\mu\text{g/mL}$)

Staphylococcus aureus



250

250

250

250

ATCC 29213

Klebsiella pneumoniae



250

250

500

500

ATCC 700603

Escherichia coli



15

15

60

60

ATCC 25922

Pseudomonas aeruginosa



30

30

125

125

ATCC 27853

Salmonella enterica



7

15

60

60

ATCC 14028

Antibacterial activity

AgNPs

PEG-AgNPs

Bacteria

MIC ($\mu\text{g/mL}$)

MBC ($\mu\text{g/mL}$)

MIC ($\mu\text{g/mL}$)

MBC ($\mu\text{g/mL}$)

Staphylococcus aureus

ATCC 29213



250

250

250

250

Klebsiella pneumoniae

ATCC 700603



250

250

500

500

Escherichia coli

ATCC 25922



15

15

60

60

Pseudomonas aeruginosa

ATCC 27853



30

30

125

125

Salmonella enterica

ATCC 14028



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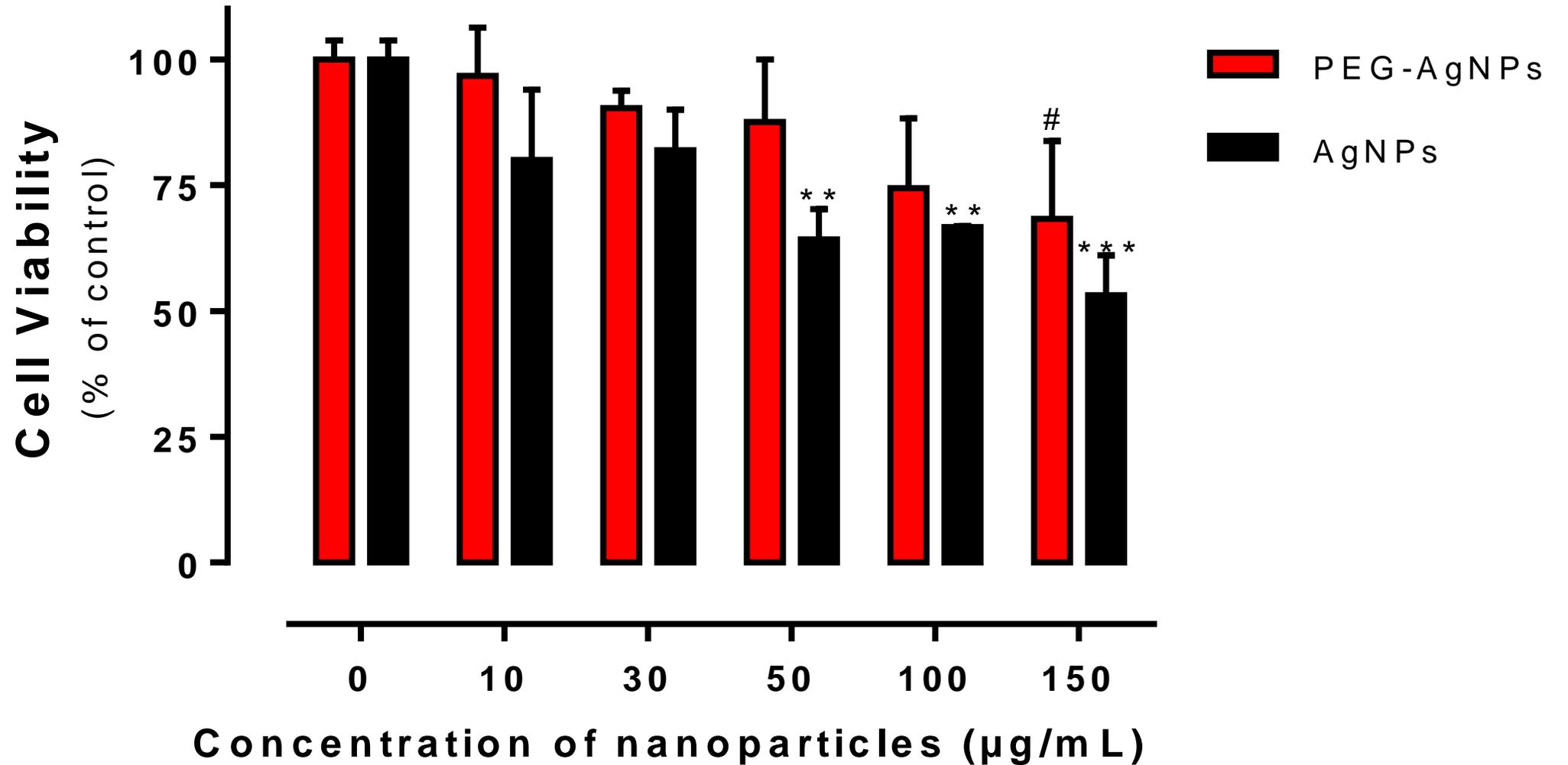
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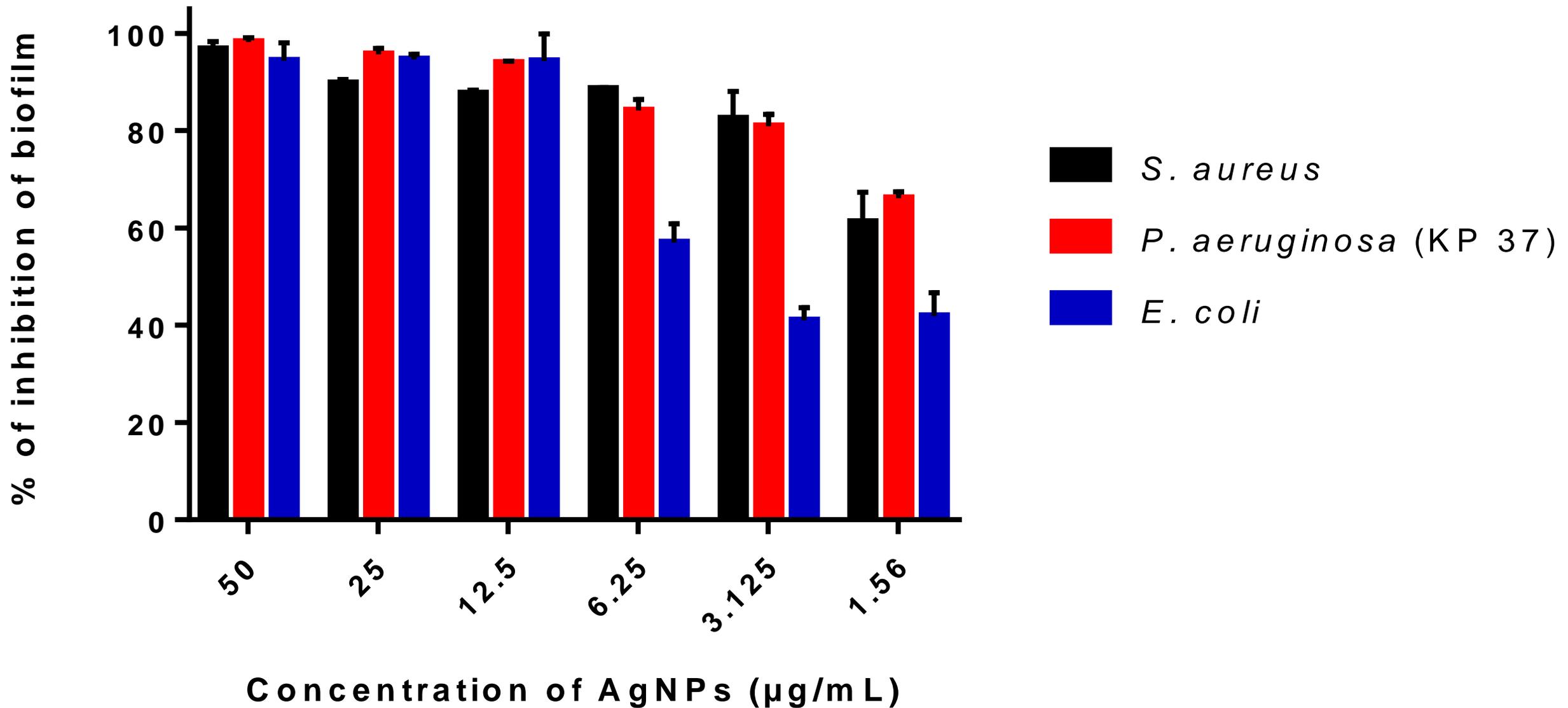
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Citotoxicity

Human keratinocytes (HaCat)



Anti-Biofilm Efficacy



Conclusions

- ✓ AgNPs were synthesized by green tea extract, which contains polyphenols, such as catechin.
- ✓ The polyphenols act as capping agent on the surface of AgNPs, avoiding nanoparticle oxidation and/or aggregation.
- ✓ The nanoparticles were not significantly toxic to the studied cell line at low concentrations.

Conclusions

- ✓ The concentrations of AgNPs required to achieve an antibacterial effect towards *Escherichia coli*, *Pseudomonas aeruginosa* and *Salmonella enterica* were not cytotoxic to the cells evaluated.
- ✓ The AgNPs demonstrated to be a potent material to combat biofilm.
- ✓ These nanoparticles may find important biomedical applications.

**Thank you for
your attention!**

UV-Vis analysis

