

Antibacterial Activity Of Selenium Nanoparticles

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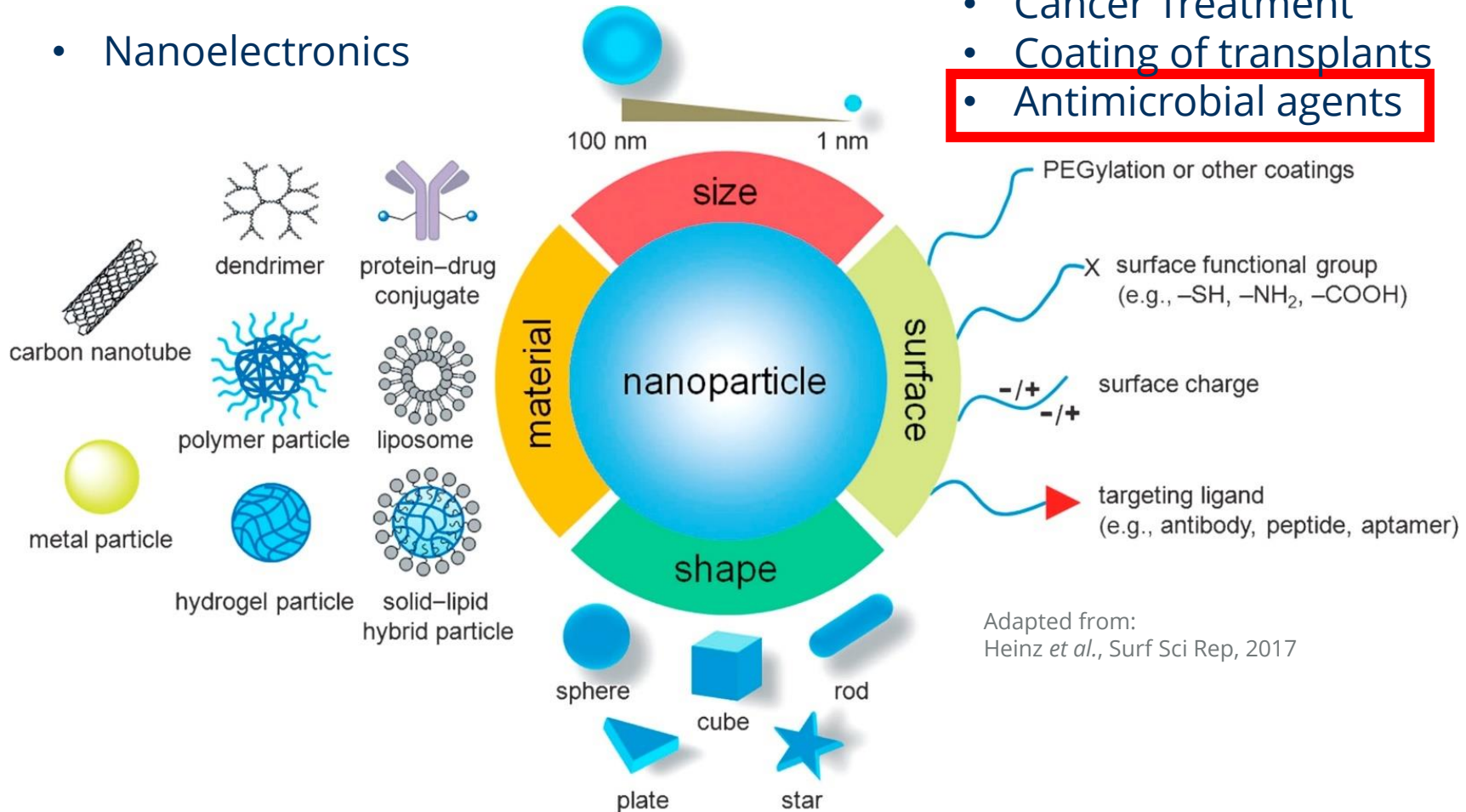
Industrial Microbiology and Microbial Biotechnology Session

Málaga, 04 July 2019

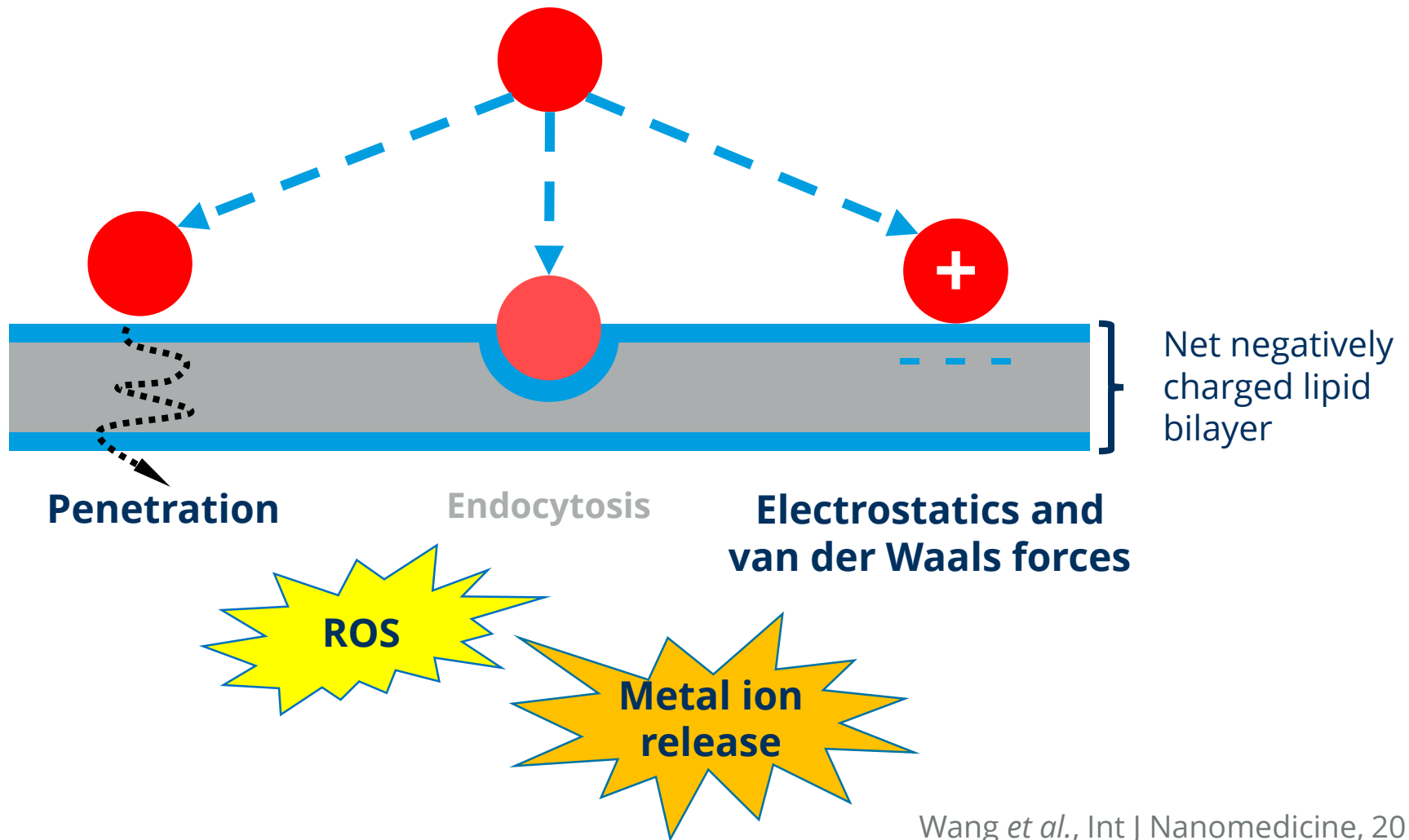
NPs are attractive tools for different applications.

- Nanomaterials
- Nanoelectronics

- Nanomedicine
 - Drug delivery
 - Cancer Treatment
 - Coating of transplants
 - Antimicrobial agents



How is the interaction between metal NPs and cells proposed?



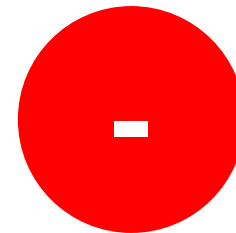
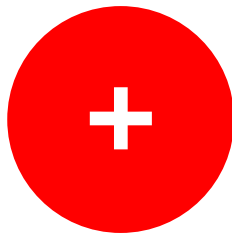
Wang *et al.*, Int J Nanomedicine, 2017

Selenium might be an alternative to silver.

- Selenium is cheaper.
- Selenium shows a low toxicity to the human body.
- Selenium NPs exhibit antimicrobial activity.¹

How do **selenium NPs INTERACT** with bacterial cells?

Does **SURFACE CHARGE** affect their **TOXICITY**?



¹ Nguyen *et al.*, Food Control, 2017

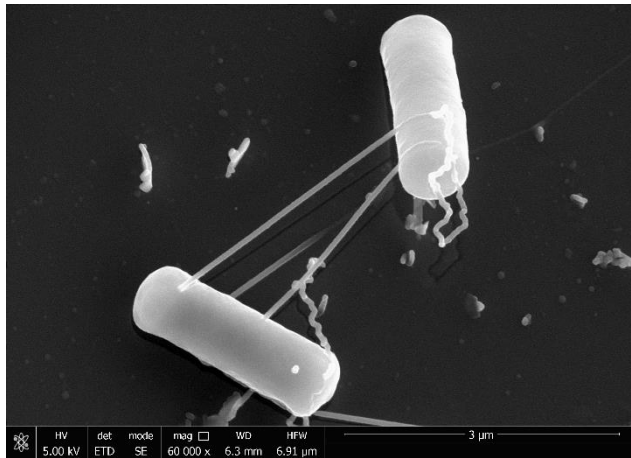
Selenium NPs and model bacterial strains

NP-coating	Zetapotential (mV)	Diameter (nm)
Chitosan (+)	+1.3 ± 0.4	85 ± 27
Undefined (-)	- 3.9 ± 0.7	86 ± 21
BSA (- - -)	- 14.7 ± 1.1	73 ± 29

Gram positive

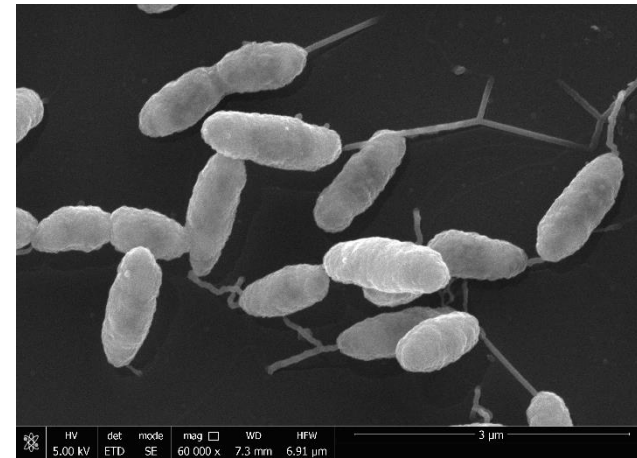
vs.

Gram negative



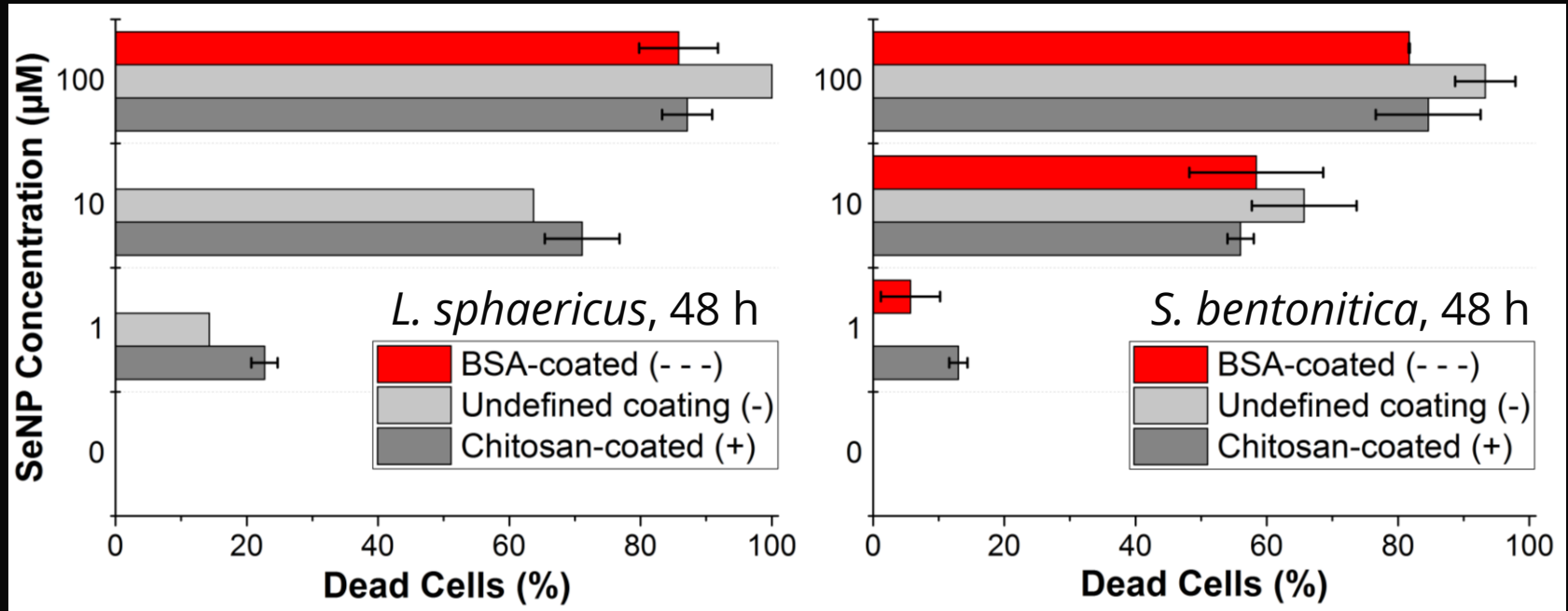
Lysinibacillus sphaericus

vs.



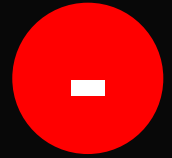
Stenotrophomonas bentonitica

NP toxicity depends on CONCENTRATION, SURFACE CHARGE and CELL WALL COMPOSITION.

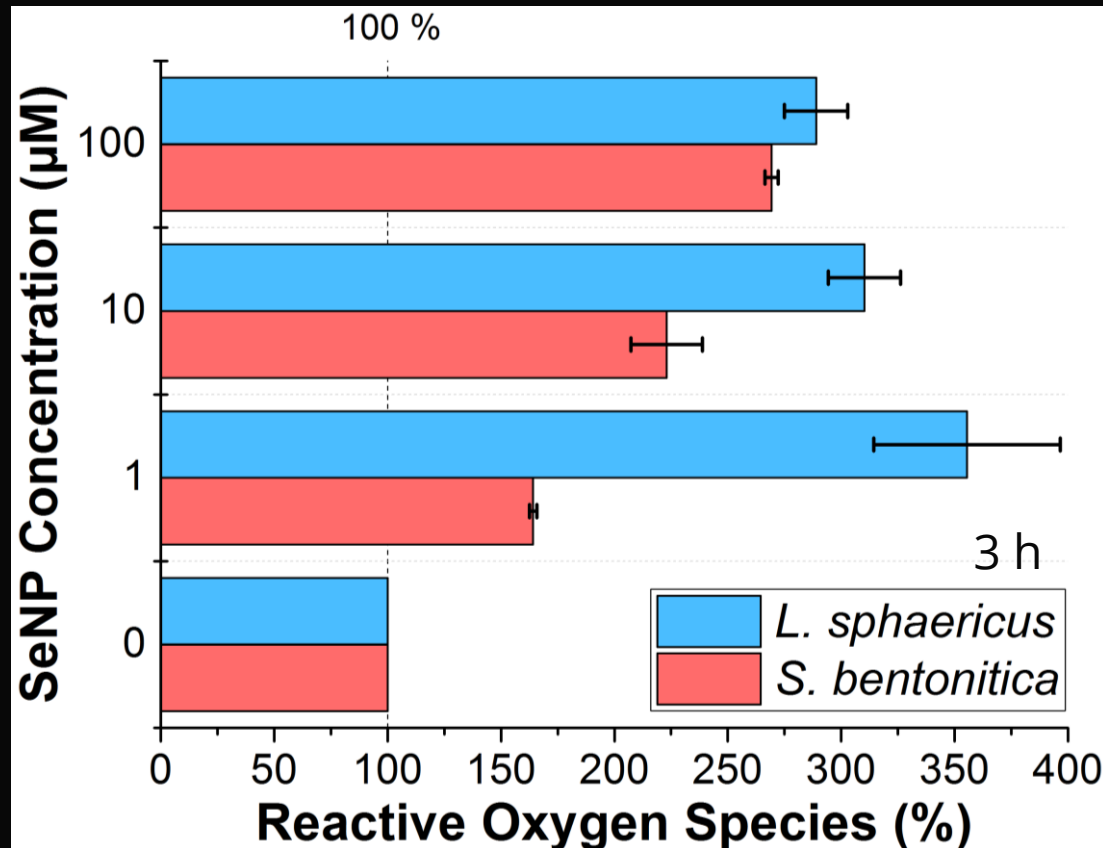


- Cell viability was measured by propidium iodide and FDA staining.
- Neutrally charged NPs show higher toxicity than negatively charged.
- Grampositive bacteria seem to be more resistant to negatively charged NPs.

Reactive oxygen species level is increased.

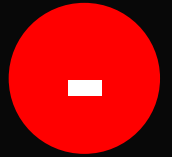
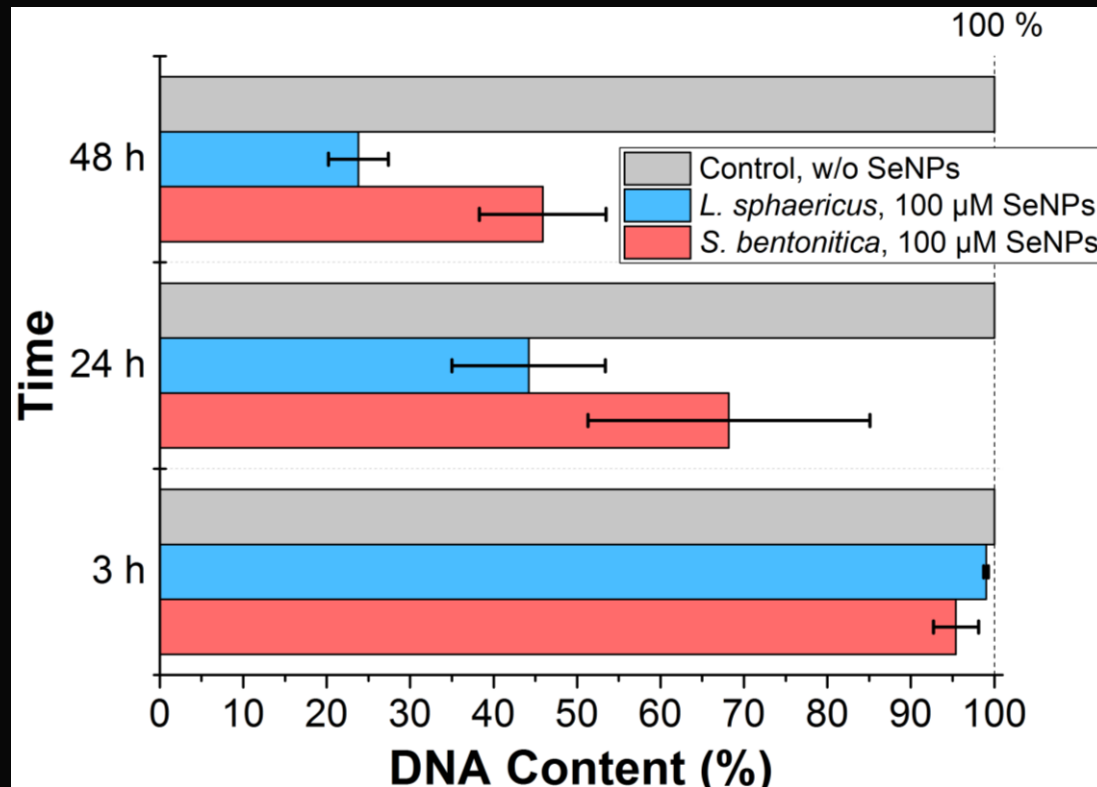


Undefined coating



- DC-FDA was used to measure intracellular reactive oxygen content.
- Selenium NPs might generate ROS which damage enzymes, DNA and lipids.

Selenium NPs decrease intracellular DNA content.



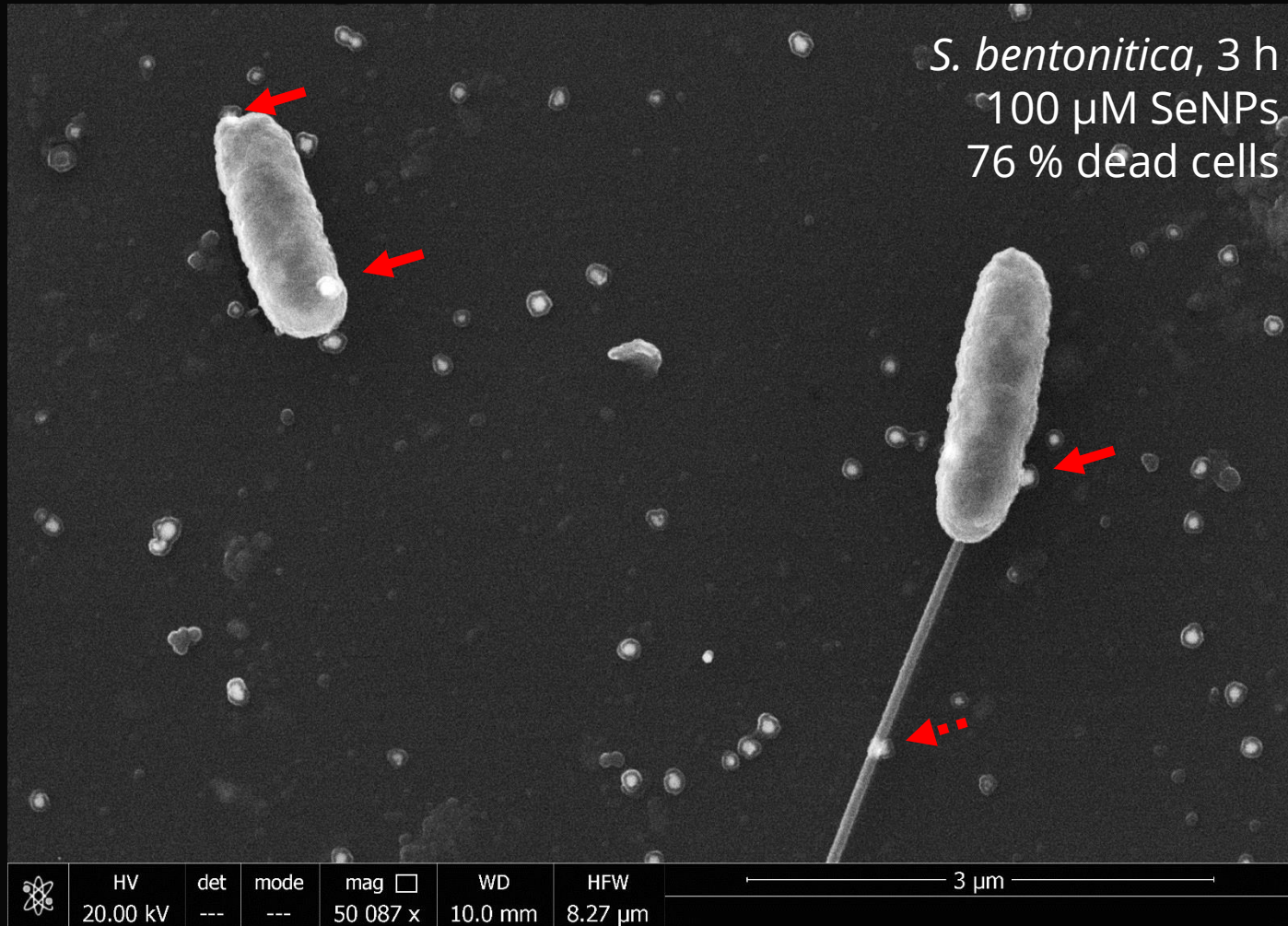
Undefined coating

- Acridine Orange is used to quantify intracellular DNA content.
- Selenium NPs might release ROS and metal ions¹, which interact with the DNA and DNA repair enzymes².

¹ Palza *et al.*, J Appl Polym Sci, 2017

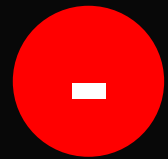
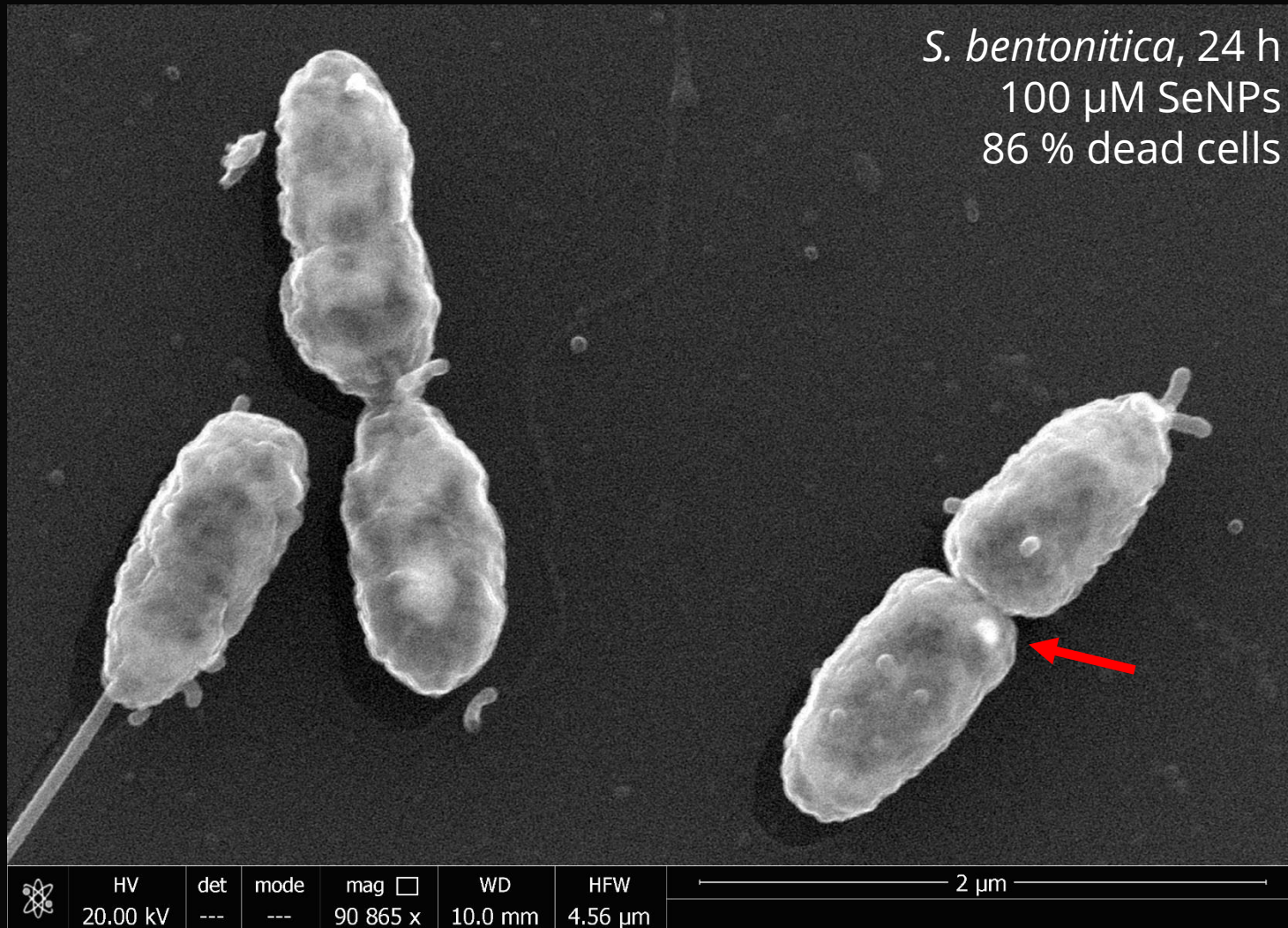
² Letavayová *et al.*, Toxicology, 2006

ESEM confirms interaction with the bacterial membrane and extracellular proteins.



Undefined coating

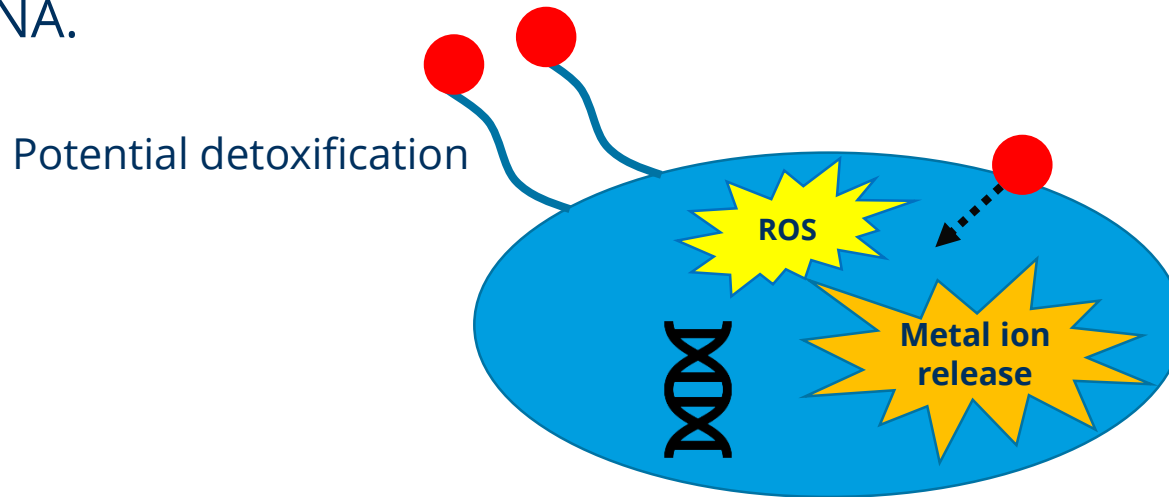
SeNPs accumulate intracellularly.



Undefined coating

Take home messages

- Selenium NPs possess antibacterial activity, proven by flow cytometry.
- Dependent on concentration, surface charge and cell wall composition.
- Toxic properties due to generation of reactive oxygen species and putative release of metal ions.
- Subsequent interaction with intracellular enzymes and destruction of DNA.



Acknowledgement

Universidad de Granada:

Prof. Mohamed Larbi Merroun

Prof. Modesto Torcuato López López

Helmholtz-Zentrum Dresden-Rossendorf:

Prof. Karim Fahmy

Sindy Kluge

Centro de Instrumentación Científica:

Jaime Lazuen Alcón (Flow Cytometry)

David Porcel Muñoz (TEM)

Isabel Sánchez Almazo (ESEM)

Daniel García-Muñoz Bautista-Cerro
(Sample preparation)

Concepción Hernández Castillo
(Sample preparation)



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Financial support:

ERASMUS+

Helmholtz-Zentrum Dresden-Rossendorf

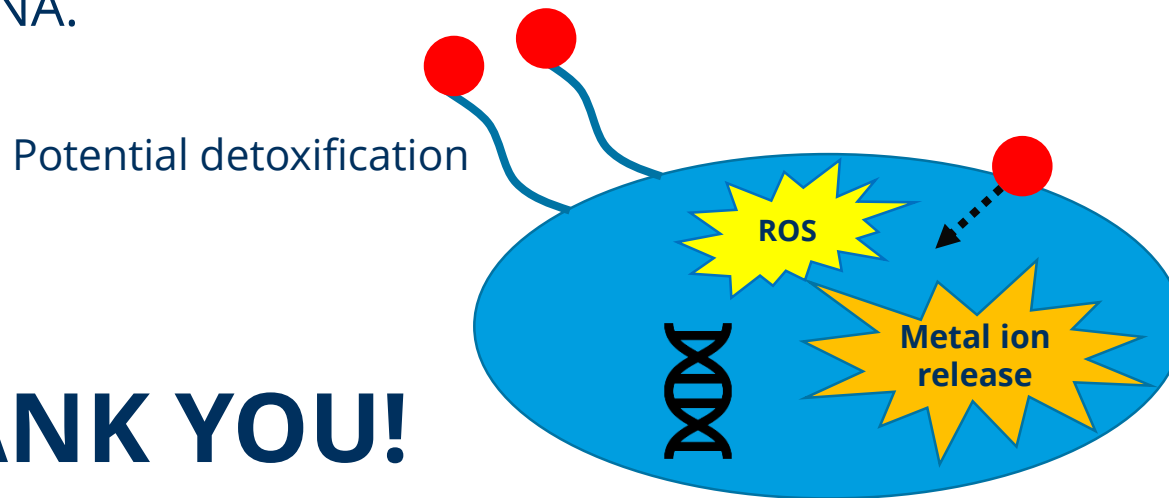
Universidad de Granada



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THANK YOU!