Polymer-*modified* Copper Nanoparticles:
Therapeutic Potential for Clinical Application

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Introduction

The emergence of nanotechnology in the last decades opens new doors for exploring the effect of metal nanoparticles as a new platform to apply/use in the diagnosis, prevention and treatment of oro-dental pathologies . Some of the biological properties of nanoparticles of various metals have been explored via assaying their anti-microbial effects (Ag, Zn, Cu and Au); against different bacterial and fungal species.

Yet, the viability and/or cytotoxic effects have been, to date, not well-described; especially for utility in the oral cavity.

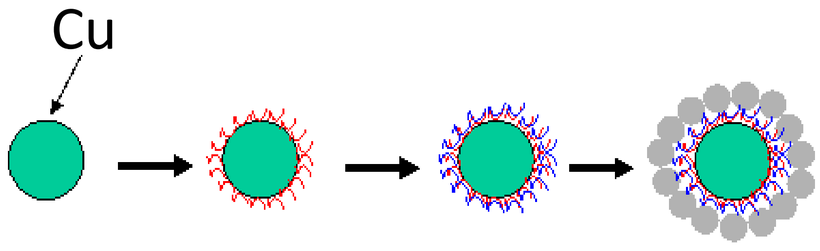
Objective

Evaluate the cytotoxicity of Copper (Cu) nanoparticles and Cu nanoparticles modified/coated with a chitin-chitosan shell and conduct a comparison with natural polymeric nanoformulations: chitosan nanoparticles.

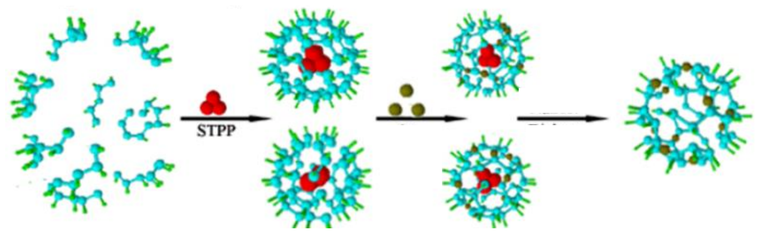
Methods

Novel Chitosan-Copper nanoparticles (NP Cu-Cs) were formulated via the *layer by layer* self-assembly technique, based on electrostatic interactions, and Chitosan nanoparticles (NP Cs) produced via ionic gelation method. Copper nanoparticles (NP Cu) were obtained from NanoTech Chile. Characterization was performed using NanoSight average hydrodynamic diameter (in nm) and Zeta potential (in mV) analysis. NIH/3T3 cell lines were cultured and maintained for 72 hours in the presence of incremental concentrations of the different nanoparticles (NP Cu, NP Cu-Cs, NP Cs).

Viability assays and proliferation (Alamar blue) analysis followed.

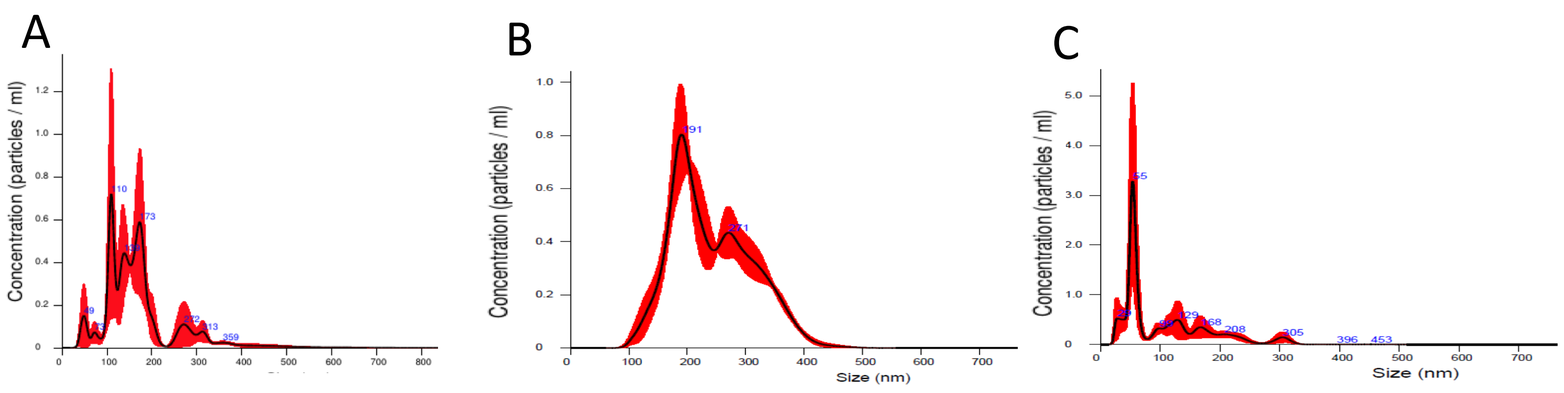


Chitosan-Copper nanoparticle *via layer-by-layer self-assembly*



Chitosan nanoparticle *via ionic gelation*

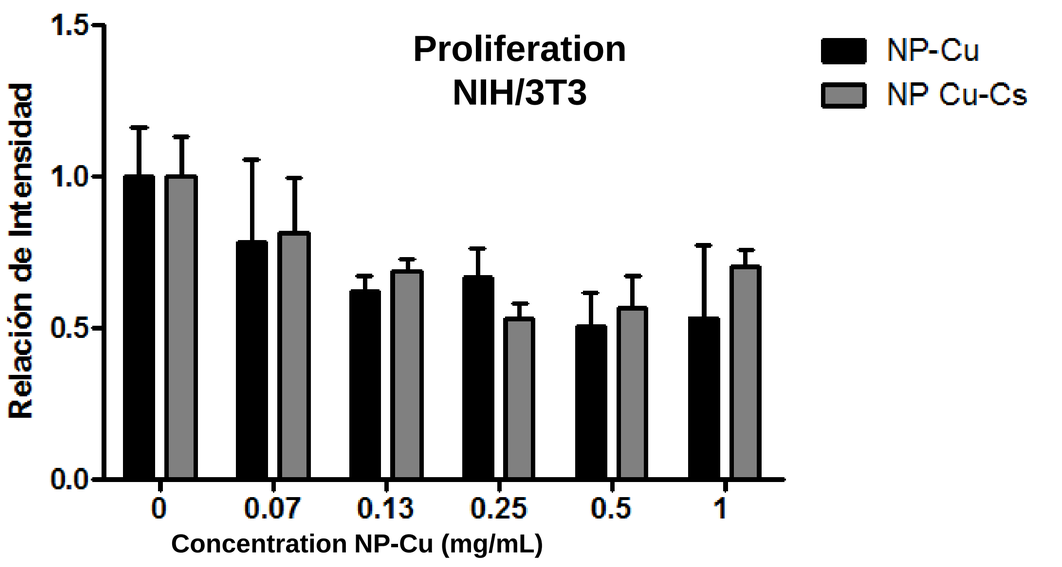
Results

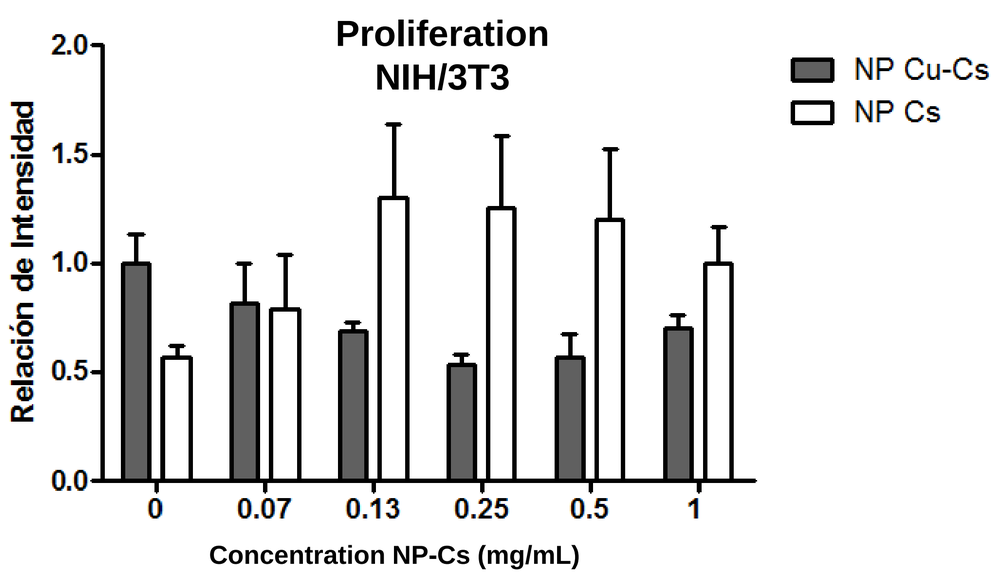


Nanoparticle size by tracking acquisition.
NP Cu (A) NP Cu-Cs (B) NP Cs (C).

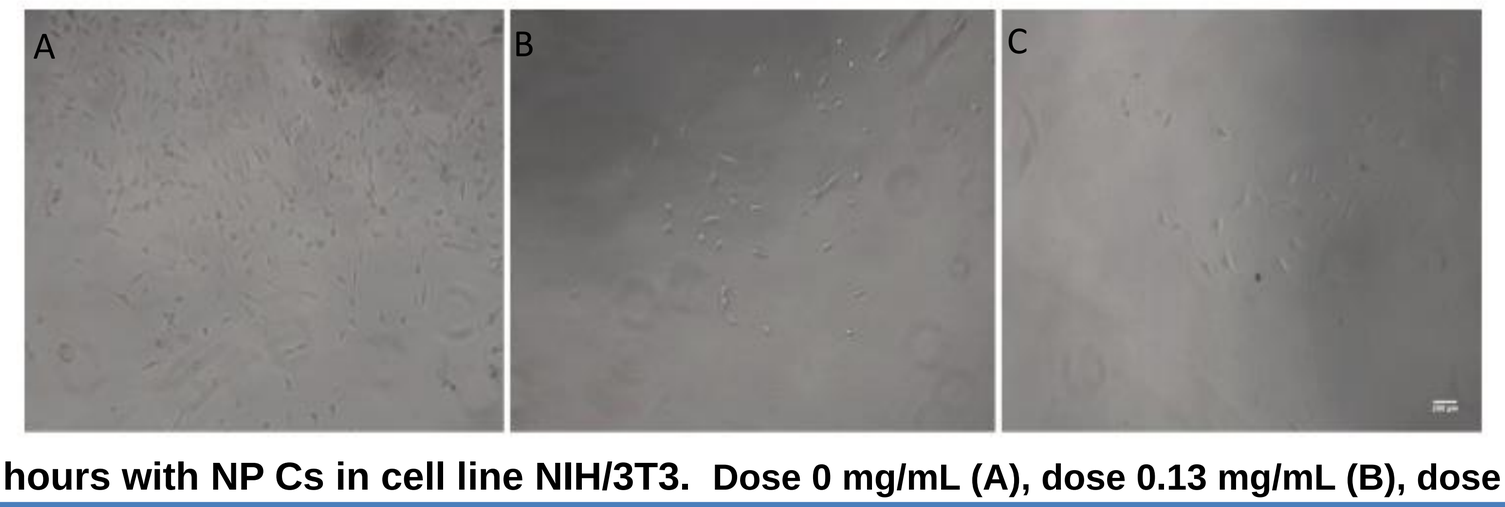
Superficial charge of NPs

Zeta potential	mV
Np Cu	-13,5 ± 3,26 14,6 ± 3,07
Np Cu Cs	29.4 ± 3.6
Np Cs	14.1 ± 2.9





Cell Viability. Treatment 72 hours: NIH/3T3 cells and NP-NP Cs Cs-Cu



Treatment incubation 72 hours with NP Cs in cell line NIH/3T3. Dose 0 mg/mL (A), dose 0.13 mg/mL (B), dose 0.07 mg/mL (C).

Conclusions

Novel, spherical, stable, positively-charged and non-toxic nanoparticles, suitable for localized drug delivery applications resulted. Ongoing work aims at pre-clinical evaluation against periodontal diseases.

References

•Essa A. and Khallaf M. Antimicrobial potential of consolidation polymers loaded with biological copper nanoparticles. BMC Microbiology (2016), 16:144
•Liu R, Liu H, Ji Z, Chang Ch, Xia T, Nel AE, and Cohen Y. Evaluation of toxicity ranking for metal oxide nanoparticles via an in vitro dosimetry model. ACS Nano (2015), 9 (9): 9303-9313.
•Vargas-Reusa M, Memarzadeha K, Huangb J, Renc G, Allaker P. Antimicrobial activity of nanoparticulate metal oxides against peri-implantitis pathogens. Int. J Antimicrobial Agents (2012), 40: 135-139.

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