Promising bioglasses for medical applications

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Introduction Infectious diseases are one of the most important causes of death in the World. The constant use of antibiotics to treat infections has led to the development of resistant bacterial strains. Therefore, noticeable efforts from different scientific fields have been devoted to solve this problem. In materials science, several metal ions have been studied for their antibacterial properties. Copper (Cu) is one of the most used due to its low toxicity to mammalian cells[1]. The aim of this work is to evaluate the antibacterial effects and the biocompatibility of un-doped calcium phosphate glasses (CPG) and Cu^{2+}-doped (CPG_Cu) ones, which have shown in previous studies interesting degradative, mechanical and optical properties to be used in biophotonic applications[2].

Experimental methods CPG and CPG_Cu were analyzed with inductively coupled plasma–optical emission spectroscopy (ICP-OES) to evaluate their content of Ca, P, Na, Mg, B, Si and Cu. The antimicrobial effect of CPGs against four of the most common causing-infections bacteria, namely *Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* PAO1 and *Klebsiella pneumoniae* were investigated; the biocompatibility was performed using NIH-3T3 cells. These viability assays in both bacteria (after 24h) and eukaryotic cells (after 24 and 48h) were evaluated through the quantitative 3-(4,5-dimethylthiazole-2-yl)-2,5-diphenyl tetrazolium bromide (MTT) test, which was performed in both direct and indirect contact and measures dehydrogenase activity as an indicator of the metabolic state. Moreover, we investigated the viability of adherent cells with MTT and confirmed it with scanning electron microscopy (SEM) and confocal laser scanning microscopy (CLSM).

Results and discussion The obtained results demonstrated the promising antibacterial properties of CPG_Cu with respect to CPG, in particular against Gram-negative bacteria. The particular efficacy against *E. coli*, *P. aeruginosa* and *K. pneumoniae* is due to the different

composition of bacterial surface. The preliminary quantitative and qualitative (SEM and CLSM) studies performed using 3T3 cells showed that CPG and CPG_Cu were not toxic.

Conclusion The results suggested that the tested bioresorbable bioglasses showed biocompatible and antibacterial properties useful for medical applications.

References

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