Efficient surface derivatization of Hydroxyapatite nanoparticles with tissue-engineering applications

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Resumo:
Synthetic hydroxyapatite (Ap) nanostructures are in the forefront of research in tissue engineering due to their biomimetic features with human bone. Also, surface properties such as charge and hydrophilicity govern the affinity and the binding of biological macromolecules, essential for tissue regeneration. In this work, we report the one-pot synthesis of propionate-coated nano hydroxyapatite (nAp) with 3-phosphonopropionic acid (nApCEPA) using different concentration of CEPA in the nanoparticles (5, 10 and 30%) as an alternative strategy to increase the particles surface groups capable of supporting the covalent attachment of biomolecules. The nanomaterials were deeply characterized by infrared spectroscopy, transmission electron microscopy, X-ray diffraction, X-ray photoelectron spectroscopy, thermal gravimetric analysis, and zeta potential. These techniques indicate that, mainly ApCEPA10% shows an efficient grafting of organophosphonates leading to propionate-bound nAp particles with a hydroxyapatite core of similar morphology and composition to that of pure nAp. The effect of nApCEPA surfaces on Balb/c 3T3 cells viability was analyzed after 24 h culture by 1) Acridine Orange staining and 2) Mitochondrial activity (MTT assay). BALB/c 3T3 cells culture on nAp without CEPA were used as controls. Each assay was repeated three times in independent experiments. A statistical significant increase in cell density was observed only for cultured cells grown on 10 and 30% of nApCEPA with respect to nAp. On the other hand, MTT assays with nApCEPA10% revealed values reached to control cells (decrease only 6.4%) in the mitochondrial activity. Results demonstrated that nApCEPA are efficient, non-cytotoxic, surfaces of potential use for further derivatization with peptides that promote cell adhesion and proliferation.