

Development of Octacalcium Phosphate/Polymer Bio-Composites for Bone Regeneration

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Abstract: Octacalcium phosphate materials (OCP) find widespread application as synthetic bone grafts owing to their relevant properties. OCP has been identified as a direct precursor of bone apatite crystals during the bone biomineralization process [1]. Consequently, it is extensively used as a bone substitute in various forms, such as granules and three-dimensional scaffolds.

OCP consists of apatite layers interleaved with hydrated layers, which closely mimic the mineral part of natural bone [1]. Its notable advantage lies in its ability to regenerate bone tissue faster and more efficiently than the other calcium phosphate-based materials [2]. Despite these advantages, their limited biodegradability and mechanical properties pose limitations in the orthopedic field. In this perspective, an effective method to enhance these properties involves integrating an organic phase within the OCP inorganic matrix [3].

This study aims to design novel three-dimensional bio-composites combining octacalcium phosphate with polymers, specifically chitosan and alginate. The OCP powders were synthesized at various pH levels, and the OCP composites were functionalized through in-situ precipitation in the presence of the polymer phase. The impact of synthesis conditions (pH, liquid and solid phases, and the polymer content) on OCP phase formation and on the mechanical properties of the composites were investigated. The *in vitro* bioactivity of the composites was tested by monitoring apatite formation over a 14-day period in simulated body fluid (SBF). The obtained results revealed that pH influenced OCP formation, while the composites maintained a stable OCP composition regardless of polymer content. Mechanical tests demonstrated a significant improvement in strength compared to polymer-free OCP. The immersion of the biocomposites in SBF solution confirmed their bioactivity and biodegradability *in vitro*. Further biological investigations *in vitro* are needed to evaluate the potential of the formulated materials in orthopedic applications.

Keywords: Octacalcium phosphate, Chitosan, Alginate, Biocomposite.

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