Starfish-Derived Biphasic Calcium Phosphate as a Sustainable Drug Delivery Platform

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Abstract

The proliferation of *Asterias rubens*, a common echinoderm, presents ecological and economic issues in mussel aquaculture by preying on juvenile *Mytilus edulis*, causing significant biomass and financial losses (Agüera et al., 2021). Addressing these impacts requires sustainable strategies, possibly through biomass utilization. This study evaluates using *A. rubens* ossicles to produce biomedically relevant calcium phosphate-based materials, focusing on biphasic calcium phosphate (BCP), which is compatible with advanced drug delivery systems. To assess BCP formation, the ossicles' calcium carbonate underwent hydrothermal conversion using phosphate solutions, investigating Ca/P molar ratios of 1.50, 1.59, or 1.62 at pH levels of 8.5 or 10.0 (Marques C.F. et al., 2017). The crystallinity and morphology were analyzed via X-ray diffraction (XRD) and scanning electron microscopy (SEM). At a Ca/P ratio of 1.50, synthesis at pH 8.5 predominantly yielded poorly crystalline hydroxyapatite, known for its biocompatibility and favourable interactions with biological tissue, and more β-TCP phase. Cytocompatibility studies using SaOs-2 cells identified a preference for materials created with a Ca/P ratio of 1.5 at pH 10, suggesting suitability for biomedical applications. Additionally, the encapsulation efficiency of therapeutic molecules within the BCP matrix and controlled release profiles were explored. The ionic exchange properties of BCP facilitated the sustained release of pharmacological agents, presenting significant advantages for extended therapeutic efficacy, which may be critical in developing effective delivery systems that enhance patient compliance. Overall, this research supports the use of starfish ossicles as a sustainable source for bioceramics in drug delivery systems, advancing biomedicine while promoting marine resource sustainability.

Keywords: Calcium phosphate, Biomass utilization, Drug delivery systems

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