SYNTHESIS AND CHARACTERIZATION OF HYDROXYAPATITE POWDER FROM TILAPIA FISH BONES AND SCALES USING CALCINATION METHOD

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ABSTRACT

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Synthetic production of Hydroxyapatite (HAp) often involves high costs and complex processes. This research seeks to address environmental concerns and reduce dependence on ressource-intensive synthetic and production methods of HAp by repurposing bio-waste. This study focuses on the synthesis of HAp, ($Ca_{10}(PO_4)_6(OH)_2$) powder from a sustainable and cost-effective bio-waste source, namely tilapia fish bones and scales, via calcination. HAp is a biocompatible material whose chemical structure is similar to human bones and teeth that it finds extensive uses in biomedical applications, such as bones grafts, dental implants, and tissue engineering. The main objective of this study was to produce HAp powder from this natural source and compare the characteristics and purity of the powder produced at different calcination times using X-Ray Diffraction (XRD) and Fourier-Transform Infrared (FTIR) Spectroscopy method. In this study, tilapia fish bones and scales were cleaned, dried, ground into powder, and then calcined using a muffle furnace at 900 °C for two different time periods: 2 hours (TP2) and 5 hours (TP5). The resulting HAp powder was then characterized using XRD for phase and crystallization analysis, and FTIR spectroscopy to identify functional groups. The results showed that the calcination time had a significant effect on the quality of HAp powder. The TP5 sample calcined for 5 hours produced a clean and homogeneous white powder, indicating complete removal of organic matter, compared to the grey TP2 sample. XRD analysis confirmed that the TP5 sample had a higher degree of crystallinity and phase purity, with sharper and stronger diffraction peaks especially at 2-Theta angle of 31.9°. FTIR analysis also supported this finding, where the spectrum of TP5 showed clearer absorption bands for phosphate (PO_4^{3-}) and hydroxyl (OH^-) functional groups, as well as a reduction in carbonate impurities, indicating a more stable and pure HAp structure. Based on the study, the TP2 sample showed broader peaks and incomplete phase development than TP5 sample. In conclusion, this study successfully demonstrated that high-quality HAp powder can be synthesized from tilapia bone and scale waste, with the optimum conditions achieved at a calcination temperature of 900 °C for 5 hours. This method offers great potential as an environmentally friendly and economical route for the production of biomaterials for biomedical applications.

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