



Development and Characterization of Hydroxyapatite-Based Materials Derived from Waste Nile Tilapia Scales from Mekong River Cage-Farming Communities for a Targeted Drug Delivery System in Bone Infection Treatment.

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Abstract

This study focuses on the extraction and characterization of hydroxyapatite (HAp) derived from Nile tilapia scales to evaluate its quality and suitability as a drug delivery material for bone infection treatment. The fish scales were cleaned, soaked in NaOH solution, and calcined at 1,000 °C for 3 h. Five HAp formulations were prepared, four of which were further treated with KOH at concentrations of 1 M and 3 M for 1 and 5 hours. Chemical structure was analyzed using Fourier-transform infrared spectroscopy (FT-IR), porosity was determined by iodine number via iodometry, and surface characteristics were examined by field-emission scanning electron microscopy (FESEM). Gentamicin was used as the model antibiotic, and its release from HAp pellets was measured using spectrophotometry. Statistical analysis was performed using one-way ANOVA followed by Tukey's HSD post hoc test ($p < 0.01$). The HAp appeared as a white powder containing P–O, P–OH, and CO_3^{2-} bonds. The surface exhibited porosity, and iodine number varied significantly among formulations ($p < 0.01$). HAp treated with 1M KOH for 5 hours showed the highest iodine number and encapsulated the most gentamicin. Pellets retained their shape for up to one day in fluid before disintegration. In simulated body fluid (SBF), Gentamicin release increased daily, with rapid release during days 1–4, while in distilled water, release increased quickly during days 1–3. The release rate and total amount decreased over time. The Higuchi model fit all formulations well ($R^2 \approx 1$), and no significant differences in Gentamicin release were observed among pellets.

Keywords: hydroxyapatite, tilapia scales, drug delivery system