

## INTISARI

### **Sintesis Biokeramik Mineral Kalsium Fosfat Berbasis Tulang Sotong dan Fabrikasi Scaffold Polietilen Glikol/Polivinil Piroolidon/Hidroksiapatit**

Oleh

M. Revikansyah Aqshal Fadlika  
21/480050/PA/20836

Kerusakan tulang memerlukan material alternatif yang mampu mendukung regenerasi jaringan. Salah satu kandidat yang potensial adalah *scaffold* berbasis polimer dan biokerami. Penelitian ini bertujuan mensintesis hidroksiapatit (HA), bifasik kalsium fosfat (BCP), dan  $\beta$ -trikalsium fosfat ( $\beta$ -TCP) dari tulang sotong (*Sepia officinalis* L.) melalui metode presipitasi. Selain itu, HA hasil sintesis difabrikasi menjadi *scaffold* berbasis polietilen glikol (PEG), polivinil pirolidon (PVP), dan HA menggunakan metode *freeze-drying* dengan variasi konsentrasi HA sebesar 0, 20, dan 40 wt%. Semua sampel dievaluasi sifat fisikokimianya menggunakan *X-Ray Diffraction* (XRD), *Fourier Transform Infra-Red* (FTIR), dan *Scanning Electron Microscope* (SEM). Proses kalsinasi tulang sotong pada suhu 1000 °C menyebabkan dekomposisi kalsium karbonat ( $\text{CaCO}_3$ , fase aragonit) menjadi kalsium oksida (CaO), ditunjukkan oleh hilangnya sebagian besar gugus karbonat pada FTIR, perubahan morfologi menjadi agregat partikel kasar pada SEM, serta perubahan puncak difraksi pada XRD. Variasi rasio kalsium dan fosfat menghasilkan tiga fase biokeramik, yaitu HA, BCP, dan  $\beta$ -TCP, masing-masing dengan kristalinitas tinggi ( $\pm 88$ -90%) dan ukuran kristalit 42-45 nm. Analisis FTIR mengonfirmasi keberadaan gugus fosfat, hidroksil, dan karbonat, sedangkan SEM menunjukkan perbedaan morfologi dengan ukuran partikel rata-rata  $205 \pm 6$  nm (HA),  $171 \pm 5$  nm (BCP), dan  $193 \pm 2$  nm ( $\beta$ -TCP). *Scaffold* PEG/PVP/HA-0 memiliki porositas 67,7% dengan ukuran pori rata-rata  $2,4 \pm 0,7$   $\mu\text{m}$ . Penambahan HA menggeser puncak difraksi, menurunkan porositas menjadi 56,5% (HA-20) dan 48,4% (HA-40), serta mengecilkan ukuran pori hingga  $1,70 \pm 0,07$   $\mu\text{m}$ , tetapi meningkatkan kristalinitas hingga 84,6%. Hasil ini menunjukkan bahwa peningkatan konsentrasi HA menghasilkan *scaffold* yang lebih padat dan stabil, meskipun dengan porositas lebih rendah yang penting untuk osteointegrasi.

**Kata kunci:** HA, PEG, PVP, *scaffold*, tulang sotong

## ABSTRACT

### **Synthesis Of Cuttlefish Bone-Based Calcium Phosphate Mineral Bioceramics And Fabrication Of Polyethylene Glycol/Polyvinylpyrrolidone/Hydroxyapatit Scaffolds**

By

M. Revikansyah Aqshal Fadlika  
21/480050/PA/20836

Bone damage requires alternative materials capable of supporting tissue regeneration. One of the potential candidates is a scaffold based on polymers and bioceramics. This study aimed to synthesize hydroxyapatite (HA), biphasic calcium phosphate (BCP), and  $\beta$ -tricalcium phosphate ( $\beta$ -TCP) from cuttlebone (*Sepia officinalis* L.) through a precipitation method. In addition, the synthesized HA was fabricated into scaffolds composed of polyethylene glycol (PEG), polyvinylpyrrolidone (PVP), and HA using the freeze-drying method with HA concentrations of 0, 20, and 40 wt%. All samples were evaluated for their physicochemical properties using X-Ray Diffraction (XRD), Fourier Transform Infrared (FTIR) spectroscopy, and Scanning Electron Microscopy (SEM). Calcination of cuttlebone at 1000 °C resulted in the decomposition of calcium carbonate ( $\text{CaCO}_3$ , aragonite phase) into calcium oxide (CaO), as confirmed by the disappearance of carbonate groups in FTIR, morphological transformation into coarse aggregates in SEM, and diffraction peak shifts in XRD. Variation of calcium and phosphate ratios produced three bioceramic phases, namely HA, BCP, and  $\beta$ -TCP, each with high crystallinity ( $\pm 88$ -90%) and crystallite sizes of 42-45 nm. FTIR confirmed the presence of phosphate, hydroxyl, and carbonate groups, while SEM revealed distinct morphologies with average particle sizes of  $205 \pm 6$  nm (HA),  $171 \pm 5$  nm (BCP), and  $193 \pm 2$  nm ( $\beta$ -TCP). The PEG/PVP/HA-0 scaffold exhibited 67.7% porosity with an average pore size of  $2.4 \pm 0.7$   $\mu\text{m}$ . The addition of HA shifted diffraction peaks, reduced porosity to 56.5% (HA-20) and 48.4% (HA-40), decreased pore size to  $1.70 \pm 0.07$   $\mu\text{m}$ , but increased crystallinity up to 84.6%. These results indicate that higher HA concentrations produce denser and more stable scaffolds, although with reduced porosity which is important for osteointegration.

**Keywords:** cuttlebone, HA, PEG, PVP, scaffold