INTISARI

PENGARUH PENAMBAHAN KONSENTRASI CHA DARI TULANG SOTONG (*SEPIA OFFICINALIS* L.) PADA *SCAFFOLD* CHA/PEO/CS DENGAN METODE *FREEZE DRYING* UNTUK APLIKASI REKAYASA JARINGAN TULANG

Scaffold karbonat hidroksiapatit/*Polyehtylene Oxide*/kitosan (CHA/PEO/CS) berhasil difabrikasi dengan variasi konsentrasi CHA 1, 5, 10, dan 15wt% menggunakan metode *freeze drying*. Biokeramik CHA disintesis menggunakan bahan biogenik tulang sotong (*Sepia officinalis* L.) sebagai sumber penyedia kalsium karbonat ($CaCO_3$). $CaCO_3$ terdekomposisi CaO sempurna pada suhu kalsinasi 1000°C (sampel CaO1000) berdasarkan karakterisasi *X-Ray Diffraction* (XRD) dan *Fourier Transform Infra-Red* (FTIR). Sampel CaO1000 kemudian digunakan dalam sintesis CHA melalui metode hidrotermal dengan variasi suhu kalsinasi nonkalsin (CHA0) dan kalsinasi 200°C selama 2 jam (CHA200). Analisis XRD dan FTIR berhasil mengonfirmasi tebentuknya fase CHA tipe-B dari kedua hasil sampel CHA. Analisis *Scanning Electron Microscopy-Energy Dispersive X-Ray* (SEM-EDX) sampel CHA0 menunjukkan rasio Ca/P 1,71 dan sesuai dengan referensi rasio molar Ca/P pada tulang manusia, sedangkan sampel CHA200 hanya sebesar 1,53. CHA sebagai biokeramik dikompositkan bersama dengan PEO dan CS untuk membentuk *scaffold* dengan struktur berpori. Penambahan konsentrasi CHA mempengaruhi sifat fisiko-kimia dan mekanik dari *scaffold*. Analisis XRD menunjukkan semakin rendah konsentrasi CHA menghasilkan dislokasi yang lebih baik sehingga dapat memudahkan terjadinya proliferasi sel. Analisis FTIR mengonfirmasi adanya vibrasi gugus fungsi PEO dan CS. Hal ini membuktikan bahwa metode *freeze drying* telah berhasil dilakukan tanpa menghilangkan kandungan polimer dari *scaffold* saat proses sublimasi sehingga menyebabkan terbentuknya pori pada *scaffold*. Analisis SEM menunjukkan porositas *scaffold* CHA/PEO/CS yang menurun seiring penambahan konsentrasi CHA pada interval 43,1-52,1%. Nilai tersebut mendekati porositas ideal untuk tulang kanselus dengan ukuran pori berskala makro dan mikropori, meskipun sampel 15wt% tidak menunjukkan adanya makropori. Berkurangnya porositas akibat penambahan CHA dapat meningkatkan nilai kuat tekan *scaffold*, dimana hasil uji bernilai antara 2,8-8,4 MPa. Namun, semakin tinggi konsentrasi CHA akan menurunkan kemampuan *scaffold* untuk menyerap air sehingga mengurangi rasio *swelling*.

Kata kunci: Karbonat Hidroksiapatit, kitosan, PEO, *scaffold*, tulang sotong

ABSTRACT

INFLUENCE OF VARYING CHA CONCENTRATION FROM CUTTLEFISH BONE (*SEPIA OFFICINALIS* L.) ON CHA/PEO/CS SCAFFOLD USING FREEZE DRYING METHOD FOR BONE TISSUE ENGINEERING

A carbonated hydroxyapatite/polyethylene oxide/chitosan (CHA/PEO/CS) scaffold was successfully fabricated with varying CHA concentrations of 1, 5, 10, and 15wt% using *freeze drying* method. CHA bioceramics were synthesized using cuttlefish bone (*Sepia officinalis* L.) as a source of calcium carbonate ($CaCO_3$). CaCO3 completely decomposed into CaO at a calcination temperature of 1000°C (CaO 1000 sample) based on X-Ray Diffraction (XRD) and Fourier Transform Infra-Red (FTIR) characterization. Subsequently, the CaO1000 sample was utilized for the synthesis of CHA using a hydrothermal method, with calcination temperature varying between noncalcined (CHA0) and 200°C calcination for 2 hours (CHA200). XRD and FTIR analyses confirmed the formation of a B-type CHA phase in both CHA samples. Scanning Electron Microscopy-Energy Dispersive X-Ray (SEM-EDX) analysis of the CHA0 sample showed a Ca/P ratio of 1.71, which was in accordance with the reference Ca/P molar ratio in human bone, whereas that of the CHA200 sample was only 1.53. CHA as a bioceramic was composited with PEO and CS to form a scaffold with a porous structure. The addition of CHA affects the physico-chemical and mechanical properties of the scaffolds. XRD analysis showed that a lower concentration of CHA resulted in better dislocation, which could facilitate cell proliferation. FTIR analysis confirmed the vibrations of the PEO and CS functional groups. This proves that the freeze drying method was successfully performed without removing the polymer content from the scaffold during the sublimation process, resulting in the formation of pores in the scaffold. SEM analysis showed that the porosity of CHA/PEO/CS scaffold decreased with the addition of CHA concentration in the range of 43.1-52.1%. This value is close to the ideal porosity for cancellous bone with macro- and micropore-scale pore sizes, although the 15wt% sample did not show any macropores. The reduced porosity due to the addition of CHA can increase the compressive strength of the scaffold, where the test results are between 2.8-8.4 MPa. However, a higher CHA concentration decreased the ability of the scaffold to absorb water, thus reducing the swelling ratio.

Keyword: Carbonated Hydroxyapatie, Chitosan, PEO, Scaffold, Cuttlebone