Fabrikasi Scaffold Graphene Oxide/Hyaluronate/Fibrin untuk Induksi Osteogenesis pada Perbaikan Rekayasa Jaringan Osteochondral. = Fabrication of Graphene Oxide/Hyaluronate/Fibrin Scaffold for Induced Ostegenesis in Osteochondral Tissue Engineering Repair

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Abstrak

Pendahuluan: Proses degeneratif yaitu berkurangnya kemampuan sel dalam menjalankan fungsi dan kematian sel karena metabolisme tubuh yang lemah. Penyakit degeneratif terjadi pada usia manula 50 tahun. Salah satu penyakit degeneratif adalah ostearthiritis, osteoarthritis menduduki 10 besar penyebab disabilitas yang disebabkan oleh degeneratif. Kejadian osteoarthritis pada tahun 2050 meningkat 20% diseluruh dunia tidak terkecuali Indonesia mengalami kenaikan 5% pada kurun beberapa tahun. Osteoarthritis merupakan kerusakan sendi yang terjadi penuaan dikarenakan kurangnya produksi kolagen yang sulit beregenerasi, kerusakan terjadi pada jaringan osteochondral yaitu jaringan pada sendi dan pada ujung tulang yang dilapisi oleh kartilago artikular. Jaringan kartilago artikular memiliki kekurangan meregenerasi yaitu sulit memperbaiki jaringan apabila terjadi kerusakan. Metode rekayasa jaringan memberikan pilihan terbaik dengan menggunakan mesenchymal stem cells, scaffold dan senyawa kimia signaling untuk mengembalikan kerusakan tersebut. Tujuan: Fabrikasi scaffold graphene oxide /hyaluronate/fibrin yang dapat menginduksi osteogenesis pada perbaikan rekayasa jaringan osteochondral dengan mengkarakterisasi sifat scaffold dengan parameter uji fisika, kimia, dan biologi. Metode: Sintesis kimia; fabrikasi scaffold metode freeze driying; karakterisasi SEM dan FTIR; uji tekan dan porositas; uji swelling, wettability, dan laju degradasi; uji biokompabilitas (viabilitas sel kualitatif dan kuantitatif (MTS assay); uji diferensiasi sel (pewarnaan alizarin red); dan analisis statistik. Hasil: Fabrikasi scaffold dibagi menjadi tiga kelompok GO, GOHA, dan GOHAF dengan metode freeze drying diameter 1 cm dan luas permukaan 4,17 cm2. Karakterisasi uji SEM rentang ukuran pori sebesar 20 – 200 m. Pada scaffold GO 100 – 250 m, GOHA 80 – 200 m, dan GOHAF 20 – 150 m. FTIR scaffold GO terdapat gugus O-H, C=O, C=C, C-OH, dan C-H; pada scaffold GOHA terdapat gugus O-H, C=O, C=C, C-OH, C-H, dan amida II; pada scaffold GOHAF terdapat gugus O-H, C=O, C=C, C-OH, C-H, amida II dan amida I. Uji mekanik tekan pada kekerasan tekan scaffold GO sebesar 294 KPa, GOHA dan GOHAF sebesar 194 KPa. Sedangkan pada Young’s Modulus GO 0.09 MPa lebih kecil dibandingkan GOHA 0.11 MPa, dan GOHAF 0.10 MPa. Laju porositas pada GO lebih besar yaitu berturut-turut H+1 sebesar 77%, H+3 sebesar 67%, dan H+5 sebesar 61%; scaffold GOHA lebih rendah yaitu H+1 sebesar 41%, H+3 sebesar 30%, dan H+5 sebesar 18%; scaffold GOHAF lebih rendah H+1 sebesar 37%, H+3 sebesar 24%, dan H+5 sebesar 11%. Rasio swelling terbaik yaitu pada scaffold GOHAF lebih rendah 8,48%. Kapasitas wettability terbaik yaitu pada scaffold GOHAF lebih rendah 28%. Rasio

laju degradasi terbaik yaitu pada scaffold GOHAF lebih rendah 0.30%. Persentase viabilitas sel kualitatif (direct) terbaik yaitu scaffold GOHAF sebesar 75% dan persentase viabilitas sel kualitatif (indirect) terbaik yaitu scaffold GOHAF sebesar 109% pada perendaman 48 jam dan 72 jam dengan nilai absorbansi 0,72 OD. Uji diferensiasi sel osteogenik yang terbaik yaitu pada scaffold GOHAF sebesar 905% terdiferensiasi menjadi sel osteogenik dengan absorbansi 0,0915 OD. Terdapat pengaruh komposisi scaffold graphene oxide/hyaluronate/fibrin (GOHAF) terhadap jumlah induksi osteogenesis atau terdiferensiasi menjadi sel osteogenik dengan hasil uji statistik signifikasi p value <0,05.

.....Introduction: The degenerative processes, namely the reduced ability of cells to carry out functions and cell death due to weak metabolism. Degenerative diseases occur in seniors aged 50 years. One of the degenerative diseases is osteoarthritis, osteoarthritis occupies the top 10 causes of disability caused by degenerative. The incidence of osteoarthritis in 2050 increases by 20% worldwide, including Indonesia, which has increased by 5% in several years. Osteoarthritis is joint damage that occurs with aging due to a lack of collagen production, which is difficult to regenerate, damage occurs in osteochondral tissue, namely the tissue in the joints and at the ends of bones covered by articular cartilage. The articular cartilage tissue has the disadvantage of regenerating that it is difficult to repair the tissue if there is damage. The tissue engineering method provides the best choice by using mesenchymal stem cells, scaffold, and chemical signaling compounds to reverse the damage. Objective: Fabrication of graphene oxide/hyaluronate/fibrin scaffold for induced osteogenesis in osteochondral tissue engineering repair. Methods: Chemical synthesis; scaffold fabrication freeze driying method; SEM and FTIR characterization; compressive and porosity test; swelling, wettability, and degradation rate tests; biocompatibility test (qualitative and quantitative cell viability (MTS assay)); cell differentiation test (alizarin red stain); and statistical analysis. Result: Scaffold fabrication was divided into three groups GO, GOHA, and GOHAF by a freeze-drying method with a diameter of 1 cm and a surface area of 4.17 cm2. Characterization of SEM test pore size ranges of 20-200 m. The scaffold is GO 100 - 250 m, GOHA 80 - 200 m, and GOHAF 20 - 150 m. FTIR scaffold GO contains O-H, C = O, C = C, C-OH, and C-H groups; on the GOHA scaffold there are O-H, C = O, C = C, C-OH, C-H, and amide II groups; on the GOHAF scaffold, there are groups of O-H, C = O, C = C, C-OH, C-H, amide II and amide I. The compressive mechanical test on the compressive hardness of the GO scaffold is 294 KPa, GOHA and GOHAF are 194 KPa. Whereas in Young's Modulus GO 0.09 MPa is smaller than GOHA 0.11 MPa, and GOHAF 0.10 MPa. The porosity rate in GO was greater in H + 1 of 77%, H + 3 of 67%, and H + 5 of 61%; than GOHA scaffold was lower in H + 1 by 41%, H + 3 by 30%, and H + 5 by 18%; than GOHAF scaffold was lower in H + 1 by 37%, H + 3 by 24%, and H + 5 by 11%. The best swelling ratio is the GOHAF scaffold which is 8.48%. The best wettability capacity is the GOHAF scaffold, which is 28%. The best degradation rate ratio is the GOHAF scaffold which is 0.30%. The best qualitative (direct) cell viability percentage was 75% GOHAF scaffold and the best qualitative (indirect) cell viability

percentage was 109% GOHAF scaffold immersion for 48 hours and 72 hours with an absorbance value of 0.72 OD. The best osteogenic cell differentiation test is the GOHAF scaffold, which is 905% differentiated into osteogenic cells with an absorbance of 0.0915 OD. There is an effect on the composition of the scaffold graphene oxide/hyaluronate/fibrin (GOHAF) in the amount of osteogenesis induction or differentiation into osteogenic cells with statistical test results of significance p-value <0.05.