

Amali, Mochamad Arsyal. 2019. **Biokomposit *Poly(Ethylene Glycol) Dimethacrylate (PEGDMA) – Nanofibrillated Cellulose (NFC) sebagai Injectable Hydrogel untuk Terapi Penderita Herniated Nucleus Pulposus (HNP)***. Skripsi ini dibawah bimbingan Dr. Prihartini Widiyanti, drg., M.Kes., S.Bio., CCD dan Dr. Ir. Aminatun, M.Si., Program Studi Teknik Biomedis, Departemen Fisika, Fakultas Sains dan Teknologi, Universitas Airlangga.

ABSTRAK

Berdasarkan data Kemenkes RI tahun 2011, 80% penduduk merasakan nyeri punggung bawah akibat Penyakit Akibat Kerja (PAK). Penyakit tertinggi yang disebabkan karena nyeri punggung bawah adalah *Herniated Nucleus Pulposus (HNP)* dimana Nukleus Pulposus (NP) menonjol keluar melalui *annulus fibrosus*. *Injectable Hydrogel* merupakan metode untuk mengembalikan fungsi NP akibat degenerasi dengan minimal *invasive surgery*. Penelitian ini bertujuan untuk mengetahui karakteristik *Injectable Hydrogel* berbasis *poly(ethylene glycol) dimethacrylate (PEGDMA)* dan *nanofibrillated cellulose (NFC)* melalui mekanisme fotopolimerisasi dengan fotoinisiator *Irgacure 2959* dalam pembentukan hidrogel dengan variasi konsentrasi PEGDMA:NFC diantaranya 1:0; 1:0,25; 1:0,5; 1:0,75. Karakterisasi pada penelitian ini yaitu uji morfologi dengan SEM, uji FTIR, uji *swelling*, uji viskositas, uji kuat tekan, dan uji *In Vitro Injection Model*. Dalam uji morfologi pada NFC telah berhasil terbentuk fiber dengan diameter 100 nm dari hasil *electrospinning* pada *ethyl cellulose (EC)*. Uji FTIR hidrogel menunjukkan hasil fotopolimerisasi adanya ikatan konjugasi antara *Irgacure 2959* dan PEGDMA menghasilkan C-C di frekuensi 1349,20 cm⁻¹. Uji *swelling* menggunakan *Phosphate Buffer Saline (PBS)* memenuhi standar pada variasi 1:0,25; 1:0,5; dan 1:0,75 masing-masing 87,07%, 84,84%, dan 80,42%. Uji viskositas dalam injektabilitas hidrogel menunjukkan hasil sebesar 73,67 dPa.s. Uji kuat tekan didapatkan hasil yang baik pada sampel 1:0,75 menunjukkan hasil 3,42 kPa. Pada uji *In Vitro Injection Model* menunjukkan semakin tinggi konsentrasi NFC, keadaan gel ketika dilepas dari agarose akan semakin tidak *rupture*. Biokomposit hidrogel PEGDMA/NFC berpotensi diaplikasikan sebagai *injectable hydrogel* untuk terapi penderita HNP berdasarkan morfologi, gugus fungsi, rasio *swelling*, viskositas, kuat tekan dan *in vitro injection model*.

Kata Kunci : *Injectable hydrogel*, PEGDMA, NFC, fotopolimerisasi

Amali, Mochamad Arsyal. 2019. **Biocomposite of Poly(Ethylene Glycol) Dimethacrylate (PEGDMA) - Nanofibrillated Cellulose (NFC) as an Injectable Hydrogel for the Therapy of Herniated Nucleus Pulposus (HNP)**. This script was under supervised by Dr. Prihartini Widiyanti, drg., M.Kes., S.Bio., CCD and Dr. Ir. Aminatun, M.Si., Undergraduate Study of Biomedical Engineering, Department of Physics, Faculty of Science and Technology, Airlangga University.

ABSTRACT

Based on data from the Indonesian Ministry of Health in 2011, approximately 80% of the population felt lower back pain due to work-related illness (PAK). The highest case of disease caused by lower back pain is Herniated Nucleus Pulposus (HNP), which occurs partially separated Nucleus Pulposus (NP) inside the vertebral canal. Injectable Hydrogel is a new way that is easily formed to restore NP function due to degeneration with minimally invasive surgery. This study aims to determine the characteristics of poly-based injectable hydrogel (ethylene glycol) dimethacrylate (PEGDMA) and nanofibrillated cellulose (NFC) through photopolymerization mechanism with Irgacure 2959 photoinitiator in the formation of hydrogels with variations of PEGDMA concentration: NFC including 1: 0; 1: 0.25; 1: 0.5; 1: 0.75. Characterization in this study is morphological testing with SEM, FTIR test, swelling test, viscosity test, compressive strength test, and In Vitro Injection Model test. In the morphological test on NFC, a fiber with a diameter of 100 nm has been formed from the results of electrospinning on ethyl cellulose (EC). The FTIR hydrogel test showed the photopolymerization results of the conjugate bond between Irgacure 2959 and PEGDMA producing C-C at a frequency of 1349.20 cm⁻¹. Then the swelling test using Phosphate Buffer Saline (PBS) meets the standard in variation 1: 0.25; 1: 0.5; and 1: 0.75, respectively 87.07%, 84.84%, and 80.42%. Then the viscosity test played a role in the injectability of hydrogels having a standard 80dPa.s showed a result of 73.67 dPa.s. Compressive strength test showed good results in sample 1: 0.75 which showed 3,42 kPa. In the In Vitro Injection Model test shows that the higher the concentration of NFC, the gel state when released from agarose will increasingly not rupture. PEGDMA / NFC hydrogel potential has the potential to be applied as an injectable hydrogel for the treatment of HNP patients based on morphology, functional groups, swelling ratio, viscosity, compressive strength and in vitro injection model.

Keywords : Injectable hydrogel, PEGDMA, NFC, photopolymerization