Structural and bone marrow stem cell biocompatibility studies of hydrogel synthesized via chemo-enzymatic route

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Abstract
Natural biopolymers have many attractive medical applications; however, complications due to fibrosis caused a reduction in diffusion and dispersal of nutrients and waste products. Consequently, severe immuno-compatibility problems and poor mechanical and degradation properties in synthetic polymers ensue. Hence, the present study investigates a novel hydrogel material synthesized from caprolactone, ethylene glycol, ethylenediamine, polyethylene glycol, ammonium persulfate, and tetramethylthelyenediamine via chemo-enzymatic route. Spectroscopic analyses indicated the formation of polyurea and polyhydroxyurethane as the primary building block of the hydrogel starting material. Biocompatibility studies showed positive observation in biosafety test using direct contact cytotoxicity assay in addition to active cellular growth on the hydrogel scaffold based on fluorescence observation. The synthesized hydrogel also exhibited (self) fluorescence properties under specific wavelength excitation. Hence, synthesized hydrogel could be a potential candidate for medical imaging as well as tissue engineering applications as a tissue expander, coating material, biosensor, and drug delivery system.

Keywords
Polyurea, polyhydroxyurethane, neocell, cytotoxicity, fluorescence, resazurin

Introduction
A wide range of polymeric biomaterials have been used in the biomedical field. They are mainly utilized as scaffolds and implants in roles including repair, replacement, or diagnostic applications.¹-³ Hydrogel biomaterials have found widespread use in dental, skin, drug distribution, and various surgical applications.³ The large molecular mass of the polymer contributes to the distinctive and, often advantageous, physical properties relative to the small molecule compounds. The supramolecular architecture of polymers can be designed to facilitate semicrystalline structures rather than crystalline structures, with concomitant modulation of its durability and viscoelasticity characteristics. It is relatively easy to fabricate a wide variety of compositions, properties, and forms (i.e. solids, fibers, fabrics, films, and gels) from polymers to obtain complex designs and structures. Being organic in nature, biopolymers offer many advantages over metallic and ceramic biomaterials. Furthermore, the market value of medical polymers is estimated at more than a billion dollars with an annual increase of 10–20%.⁵ Hydrogels as a form of colloidal gel

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