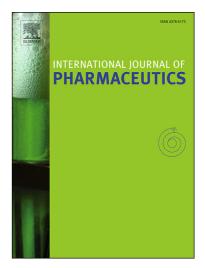
Accepted Manuscript

Controlled Drug Delivery from 3D Printed Two-Photon Polymerized Poly(Ethylene Glycol) Dimethacrylate Devices

Anh-Vu Do, Kristan Worthington, Budd Tucker, Aliasger K. Salem

PII:	S0378-5173(18)30724-5
DOI:	https://doi.org/10.1016/j.ijpharm.2018.09.065
Reference:	IJP 17813
To appear in:	International Journal of Pharmaceutics
Received Date:	3 August 2018
Revised Date:	24 September 2018
Accepted Date:	26 September 2018



Please cite this article as: A-V. Do, K. Worthington, B. Tucker, A.K. Salem, Controlled Drug Delivery from 3D Printed Two-Photon Polymerized Poly(Ethylene Glycol) Dimethacrylate Devices, *International Journal of Pharmaceutics* (2018), doi: https://doi.org/10.1016/j.ijpharm.2018.09.065

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

Controlled Drug Delivery from 3D Printed Two-Photon Polymerized Poly(Ethylene Glycol) **Dimethacrylate Devices**

Anh-Vu Do^{1,2#}, Kristan Worthington,^{3,4#} Budd Tucker,³ Aliasger K. Salem^{1,2,4*}

¹Division of Pharmaceutics and Translational Therapeutics, College of Pharmacy, University of lowa

²Department of Chemical and Biochemical Engineering, College of Engineering, The University of Iowa

³Institute for Vision Research, Department of Ophthalmology and Visual Sciences, College of Medicine, The University of Iowa

⁴Department of Biomedical Engineering, College of Engineering, The University of Iowa *e-mail: aliasger-salem@uiowa.edu #joint first author

Abstract

Controlled drug delivery systems have been utilized to enhance the therapeutic effects of many drugs by delivering drugs in a time-dependent and sustained manner. Here, with the aid of 3D printing technology, drug delivery devices were fabricated and tested using a model drug (fluorophore: rhodamine B). Poly(ethylene glycol) dimethacrylate (PEGDMA) devices were fabricated using a two-photon polymerization (TPP) system and rhodamine B was homogenously entrapped inside the polymer matrix during photopolymerization. These devices were printed with varying porosity and morphology using varying printing parameters such as slicing and hatching distance. The effects of these variables on drug release kinetics were determined by evaluating device fluorescence over the course of one week. These PEGDMA-based structures were then investigated for toxicity and biocompatibility in vitro, where MTS assays were performed using a range of cell types including induced pluripotent stem cells (iPSCs). Overall, tuning the hatching distance, slicing distance, and pore size of the fabricated devices modulated the rhodamine B release profile, in each case presumably due to resulting changes in the motility of the small molecule and its access to structure edges. In general, increased spacing provided higher drug release while smaller spacing resulted in some occlusion, preventing media infiltration and thus resulting in reduced fluorophore release. The devices had no cytotoxic effects on human embryonic kidney cells (HEK293), bone marrow stromal stem cells (BMSCs) or iPSCs. Thus, we have demonstrated the utility of two-photon polymerization to create biocompatible, complex miniature devices with fine details and tunable release of a model drug. Keywords: 3D Printing, Two-photon Polymerization, Controlled Drug Release, PEGDMA

Introduction

Recent advances in 3D printing, including the ability to construct complex structures with fine precision, open the door to rapid and facile production of controlled release devices (Acosta-Velez et al., 2018; Clark et al., 2017; Do et al., 2015; Fina et al., 2018; Goole and Amighi, 2016; Hollander et al., 2018; Khaled et al., 2018; Martinez et al., 2017; Zhang et al., 2017). Newly developed technologies such as two-photon polymerization (TPP) enable researchers to prototype micro- and nanostructures with high resolution. Compared to typical fused deposition modeling printing (50-200 µm resolution) and stereolithography (~20 µm resolution), TPP can be used to create structures with features of the order of approximately 100 nm resolution (Melchels et al., 2010). With such high resolution and precision, TPP enables the fabrication of complex nanoscale devices (Timashev et al., 2016; Worthington et al., 2017).

Download English Version:

https://daneshyari.com/en/article/11023145

Download Persian Version:

https://daneshyari.com/article/11023145

Daneshyari.com