Photocurable Poly(ethylene glycol) as a Bioink for the Inkjet 3D Pharming of Hydrophobic Drugs

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Abstract

Binder jetting and material extrusion are the two most common additive manufacturing techniques used to create pharmaceutical tablets. However, their versatility is limited since the powder component is present throughout the dosage forms fabricated by binder jet 3D printing and material extrusion 3D printing requires high operating temperatures. Conversely, material jetting allows for compositional control at a voxel level and can dispense material at room temperature. Unfortunately, there are a limited number of materials that are both printable and biocompatible. Therefore, the aim of this study was to engineer photocurable bioinks that are suitable for hydrophobic active pharmaceutical ingredients and have rapid gelation times upon visible light exposure. The resulting bioinks were comprised of poly(ethylene glycol) diacrylate (250 Da) as the crosslinkable monomer, Eosin Y as the photoinitiator, and methoxide-poly(ethylene glycol)-amine as the coinitiator. Additionally, poly(ethylene glycol) (200 Da) was added as a plasticizer to modulate the drug release profiles, and Naproxen was used as the model drug due to its high hydrophobicity. Various bioink formulations were dispensed into the bottom half of blank preform tablets – made via direct compression – using a piezoelectric nozzle, photopolymerized, and capped with the top half of the preform tablet to complete the pharmaceutical dosage form. Results from the release studies showed that drug release can be modulated by both the percent of poly(ethylene glycol) diacrylate in the formulation and the light exposure time used to cure the bioinks. These bioinks have the potential to expand the library of materials available for creating pharmaceutical tablets via inkjet printing with personalized drug dosages.