3D-printed PLA/Gel hybrid in liver tissue engineering: Effects of architecture on biological functions

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Abstract

The liver is one of the vital organs in the body, and the gold standard of treatment for liver function impairment is liver transplantation, which poses many challenges. The specific 3D structure of liver, which significantly impacts the growth and function of its cells, has made biofabrication with the 3D printing of scaffolds suitable for this approach. In this study, to investigate the effect of scaffold geometry on the performance of HepG2 cells, Poly-Lactic acid (PLA) polymer was used as the input of the Fused Deposition Modeling (FDM) 3D-printing machine. Samples with simple square and bioinspired hexagonal cross-section designs were printed. 1% and 2% of gelatin-coating were applied to the 3D printed PLA to improve the wettability and surface properties of the scaffold. SEM pictures were used to analyze the structural properties of PLA-Gel hybrid scaffolds, EDS to investigate the presence of gelatin, water contact angle measurement for wettability, and weight loss for degradation. *In vitro* tests were performed by culturing HepG2 cells on the scaffold to evaluate the cell adhesion, viability, cytotoxicity, and specific liver functions. Then, high-precision scaffolds were printed and the presence of gelatin was detected. Also, the effect of geometry on cell function was confirmed in viability, adhesion, and functional tests. The albumin and urea production of the Hexagonal PLA scaffold was about 1.22 ±0.02 fold higher than the square design in 3 days. This study will hopefully advance our understanding of liver tissue engineering toward a promising perspective for liver regeneration.

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