3-D Printing with Modified Biocompatible Polymers for Tissue Regeneration and Drug Delivery

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In the field of targeted therapeutic treatment, there is growing interest in utilizing 3-D printing to advance personalized medicine. The aim was to create modified biodegradable polymer compositions to be used in 3-D printed scaffolds to regenerate tissue and deliver drugs. To do this, Polylactic Acid (PLA) and Polyethylene Glycol 1000 (PEG) were selected as base polymers. A 50%-50%-PLA-PEG copolymer was first synthesized. From that, a 75%-25%-PLA-PEG ratio and a 90%-10%-PLA-PEG ratio were prepared through proper blending. 15mm x 10mm cylinders were molded and degradation profiles were measured through mass loss studies in water and Phosphate-Buffered Saline at 23°C & 37°C. UV absorption results were used to estimate degradation time, with 75-25-PLA-PEG having 16% degradation and 90-10-PLA-PEG having 6% after one week. Tissue regeneration was explored through HEp-2 and endothelial cell cultures done in my department. Results from HEp-2 cultures yielded evidence of proliferation, while endothelial cell adhesion to a filament fiber was observed. To test for drug delivery, the HIV drug Tenofovir Disoproxyl Fumarate (TDF) was loaded at 5% weight in 90-10-PLA-PEG, extruded into a filament and 3-D printed into 9mm scaffolds, with compression-molded pucks containing the drug molded. Controlled release data, received from a biological testing center at the university, for drug-infused 3D-printed scaffolds showed gradual release of TDF and a comparable HIV inhibition to free TDF. This study was done using a low-cost commercially-available 3D printer. The economical printing cost of long-lasting scaffolds for drug delivery enables this research to reach out to a broader audience by providing new and affordable means to administer medicine for patients in need.

Awards Won:
Samvid Education Foundation: Geno Second Place Award of $500