Development of Decellularized Peppermint Leaf Functionalized Biomimetic Scaffolds for Cardiac Tissue Engineering: An Investigation of Physico-Chemical and Mechanical Properties

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Tissue engineering (TE) aims to repair and regenerate damaged tissue by optimal combination of the patient's own cells with an appropriate biomaterial. In this work, a novel biomaterial for potential cardiac TE applications was developed. Peppermint leaves were decellularized and functionalized with peptide X and the conductive polymer polypyrrole. Peppermint leaves were selected as the base biomaterial because they are a rich source of cellulose, have an inherent vascular network, and relatively unlimited supply. Peptide X, hypothesized to promote angiogenesis and cell adhesion, was investigated for the first time in TE applications. Polypyrrole was incorporated for its electrically conductive properties important in cardiac TE for impulse propagation and synchronous cell contraction. Complete decellularization was confirmed by DNA and protein quantification. Incorporation of the peptide-X and polypyrrole was confirmed by FTIR spectroscopy. The decellularized mint-peptide-polypyrrole (DC-pep-ppy) scaffolds were characterized through DSC and rheological analysis. Cyclic Voltammetry (CV) confirmed electrochemical properties of the scaffold. Poly-L-lysine coated PCL matrices were combined with the DC-pep-ppy scaffold and seeded with co-cultured cardiomyocytes and vascular smooth muscle cells to form 3D scaffolds. The scaffold promoted cell proliferation and adhesion. Troponin T and actinin immunofluorescence studies indicated sarcomere formation and cell spreading and motility. Thus, we have developed a novel scaffold for possible applications in cardiac TE.

Awards Won:
Second Award of $2,000