Methodology and Procedural Optimization for Plant-Based Scaffolds in Tissue Engineering Imaging

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Presently, tissue engineering is the most feasible solution to fulfill the global need for healthy tissues and organs. However, there are difficulties in developing a suitable tissue scaffolding material which meets all ideal criteria including accessibility and biocompatibility. Further, it is difficult to recapitulate the native structure of human tissues in scaffold substrates. Plant tissue may be an ideal candidate for this purpose. It is highly abundant and closely resembles the structures of human tissue specifically in porosity and vasculature, which are essential for gas exchange and cell proliferation. Because plant tissue is a novel material for tissue engineering, it presents its own unique challenges in methodology. Further, different plant species vary in their physical properties and these mechanical stimuli can modulate cell behavior. Thus the plant tissue type used as a substrate must be determined based on the respective structure of that plant. Typical methodologies for decellularization, cell culture and imaging must be adapted slightly in order to better suit the nuances of plant tissue. Therefore this study establishes a precedent of suitable methodologies for plant-based tissue engineering. Further mesenchymal stem cells cultured on this material demonstrate interaction with the porous plant tissue in a manner that modulates their morphology. For instance, the moderate porosity of celery tissue correlated with more spreading and less circularity in mesenchymal stem cells. Both of these geometric properties correspond with increased propensity for osteogenic differentiation. Understanding the interaction between MSCs and plant scaffolds establishes a critical precedent to demonstrate how the mechanical stimuli of plant scaffolds can modulate MSC behavior. These results and described methodologies are especially important due to the ubiquity of plant tissue and its ability to regulate MSC morphology and guide osteogenic differentiation.