Developing a Bacterial Cellulose and Kombucha Tea Waste Product Based Scaffold with an Integrated Oxygen Generating Construct for Islet Cell Transplantation

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The advent of tissue and organ engineering provides a long term treatment option for conditions previously considered chronic. However, current protocols remain complex. The purpose of this investigation was to bridge limitations by developing a cost effective, biocompatible, and customizable scaffold. The features of this scaffold were tailored to suit islet cell transplantation, a possible cure for Type 1 Diabetes. To combat hypoxia induced cell necrosis, an in situ oxygen delivery system was developed by encapsulating calcium peroxide in RTV615 polymer to temper its hydrolysis. Phase 2 experimentation optimized the structural characteristics of the pristine bacterial cellulose to aid cellular infiltration. After a one step integration of agarose, scanning electron micrographs of the scaffolds showed an open pore geometry without disrupting the blood vessel morphology intrinsic to the cellulose. Porosity of the scaffold was effectively manipulated by altering agarose concentrations. The 0.5% agarose-cellulose composite group had average pore areas of 16,927 um which permits establishment of regionalized cells islands. Surprisingly, the probiotic cultures of kombucha tea produce cellulose membranes as a product of brewing. Scobies are simply discarded but have untapped potential as a platform for tissue engineering and transplantation procedures. To verify the two sources of bacterial cellulose as biomimetic platforms, INS-1 cells were seeded onto purified cellulose. Morphological changes (such as cytoplasmic extensions and clustering) were noted, suggesting reestablishment of functional cell islands. Hence, the novel scaffold developed in this investigation eliminates the need for intensive processing and is customizable to the suit the needs of other cell types.