Applications of Supercritical Fluid in Alloplastic Bone Graft

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Abstract

In this study, supercritical fluid (SCF) technology is discussed in relation to biomaterial processing, especially the fabrication and processing of alloplastic bone graft. SCF offers excellent extraction properties for some compounds because of its favorable diffusivity, viscosity, zero surface tension, liquidlike density and solvating power, and other physical properties. The most desirable SCF solvent for extraction is supercritical carbon dioxide (SCCO2), which is nontoxic, nonflammable, inexpensive, friendly to mankind, and environmentally benign and has mild supercritical conditions (Tc = 31.2 °C, Pc = 7.386 MPa). For the porous structure of porcine vertebra with its content of lipids, proteins, and inorganic substances in the cells and intercellular matrix, SCCO2 combined with ethanol or glutaraldehyde (GA) is used to prepare novel porcine-derived bone grafts in three supercritical settings and one subcritical condition for control comparison. The biocompatibility of these novel bone grafts was tested with human MG63 osteoblast-like cells and mouse fibroblast 3T3 cells by MTT assay. The results revealed that materials processed by SCCO2 combined with both ethanol and GA were not cytotoxic and allowed the differentiation and proliferation of test cells. The good performances of these novel bone grafts can be explained by the characteristics of SCF. Applications of SCF in biomaterials are very promising for bone regeneration and tissue engineering. Additional advanced in vitro and in vivo studies must be performed in the future for optimization.