Development of PVA/polypyrrole Scaffolds by Supercritical CO_2 for Its Application in Biomedicine

Authors : Antonio Montes, Antonio Cozar, Clara Pereyra, Diego Valor, Enrique Martinez de la Ossa

Abstract : Tissues and organs can be damaged because of traumatism, congenital illnesses, or cancer and the traditional therapeutic alternatives, such as surgery, cannot usually completely repair the damaged tissues. Tissue engineering allows regeneration of the patient's tissues, reducing the problems caused by the traditional methods. Scaffolds, polymeric structures with interconnected porosity, can be promoted the proliferation and adhesion of the patient's cells in the damaged area. Furthermore, by means of impregnation of the scaffold with beneficial active substances, tissue regeneration can be induced through a drug delivery process. The objective of the work is the fabrication of a PVA scaffold coated with Gallic Acid and polypyrrole through a one-step foaming and impregnation process using the SSI technique (Supercritical Solvent Impregnation). In this technique, supercritical CO_2 penetrates into the polymer chains producing the plasticization of the polymer. In the depressurization step a CO_2 cellular nucleation and growing to take place to an interconnected porous structure of the polymer. The foaming process using supercritical CO_2 as solvent and expansion agent presents advantages compared to the traditional scaffolds' fabrication methods, such as the polymer's high solubility in the solvent or the possibility of carrying out the process at a low temperature, avoiding the inactivation of the active substance. In this sense, the supercritical CO_2 avoids the use of organic solvents and reduces the solvent residues in the final product. Moreover, this process does not require long processing time that could cause the stratification of substance inside the scaffold reducing the therapeutic efficiency of the formulation. An experimental design has been carried out to optimize the SSI technique operating conditions, as well as a study of the morphological characteristics of the scaffold for its use in tissue engineerings, such as porosity, conductivity or the release profiles of the active substance. It has been proved that the obtained scaffolds are partially porous, conductors of electricity and are able to release Gallic Acid in the long term.

Keywords : scaffold, foaming, supercritical, PVA, polypyrrole, gallic acid
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