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PLA/PLGA nanocarriers designed for tissue engineering application and fabricated by Supercritical Emulsion Extraction

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The controlled release of growth factors to promote differentiation of stem cells, during their three-dimensional cultivation into a synthetic scaffold, is a major challenge for modern tissue engineering [1, 2, 3, 4]. Among biopolymers, suitable for protein encapsulation, poly-lactic acid (PLA) and poly-lactic-co-glycolic acid (PLGA) seem most promising, even if the preliminary step for their application in tissue engineering protocols is the kinetic and cytotoxic characterization.

In this study, the microencapsulation of two human growth factors such as growth differentiation factor-5 (hGDF-5) and transforming growth factor β1 (hTGF-β1), used respectively to induce tenogenic and chondrogenic commitment, was tested using an innovative process based on emulsions and supercritical fluids. Specifically, this technique, known as Supercritical Emulsion Extraction, employs supercritical CO_2 to remove the organic solvent from emulsions, obtaining carriers with suitable sizes and low solvent residual. For this purpose, several double emulsions have been processed, using both conventional solvent evaporation (SE) and the supercritical emulsion extraction (SEE) technology, to establish the better composition in terms of polymer molecular weight, surfactant amount and phases mixing rate in order to develop carriers with a suitable loading.

Carriers cytotoxicity was evaluated with MTT assay both on ovary cell line from hamster (CHO-K1 cells) and human peripheral blood mononuclear cells (hPBMC) in order to obtain more information about the toxic effects of carriers on replicating and terminally differentiated cells.

The results indicated a suitable loading coupled with reduced toxicity for SEE carriers and suggested Supercritical Emulsion Extraction as an effective technology for both micro/nano system formulation and their use for controlled delivery in 3D synthetic matrix.

References

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