OPTIMISATION OF PORTED YIELD OF HEMI-SPHERICAL, PORTED POLY(ε-CAPROLACTONE) MICRO-PARTICLES FOR SOFT TISSUE AUGMENTATION

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ABSTRACT

The use of biodegradable polymers in temporary surgical and pharmacological applications has become a prominent part of polymer research[1]. Poly(ε-caprolactone) is well suited to act as a tissue-engineering scaffold due to its relatively suitable degradation period and biocompatibility[2]. We have reported previously a method to manufacture novel micro-porous ported hemi-spherical poly(ε-caprolactone) micro-particles[3]. Micro-porous particles are useful in tissue engineering applications due to their relatively low density and high degree of porosity[3]. The use of ported hemi-shell particles in tissue augmentation is postulated to enhance cell growth and regeneration of tissue due to cells preferentially attaching and proliferating into the ports which serve as a protective harbour for the cells against shear forces and other biological stresses. The hemi-spherical particles are manufactured via an oil in water emulsification process. The oil phase consists of the polymer poly(ε-caprolactone) dissolved in dichloromethane, together with the porogen, sodium bicarbonate. The oil phase is then emulsified in an acidic polyvinyl alcohol (PVA) aqueous phase, and the subsequent addition of glacial acetic acid and a controlled solvent evaporation step leads to the formation of micro-porous hemi-shells[3]. The formation and subsequent release of CO2 causes particles with a porous exterior shell and a large internal cavity to be formed. Ported particles can be identified visually through the use of an optical microscope and a digital camera.

In this study optimisation of the yield and surface texture of ported particles was investigated. The parameters studied included the stirring speed during solvent evaporation, the amount of porogen and acid added and the composition of the aqueous phase by altering the amount of PVA added. Additionally, a preliminary investigation based on the work of Yang and colleagues[4] into the inclusion of different concentrations of nano-sized magnetite into the particles for magnetic particle separation was also conducted. Each experiment was done in triplicate. The effect of varying the different parameters was then measured by comparing the percentage of ported particles counted for the different experiments. Statistical analysis of the ported particle yield was performed to test the validity of the results as well as the repeatability of the experiments. Initial results indicate that the addition of an excess of acetic acid to the solvent evaporation step changed the porosity of the particles as well as the ported particle yield. Addition of 120mg of magnetite showed a slight improvement in ported particle separation. Further optimisation of the magnetic separation step is still required.

References:

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