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Comparison of porous collagen scaffold produced by CPD and freeze dried for tissue engineering

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Objectives:

Popular processes to produce porous collagen scaffold include freeze drying (FD) and critical point drying (CPD). The aim of this investigation is to study the effects of the two processing routes on the porosity, mechanical properties and effect on collagen tertiary and quaternary structure of the resulting scaffolds.

Method:

1.8% bovine collagen type I aqueous dispersions (Devro plc) were frozen at -20°C follow by two drying methods (i) the frozen structure was dehydrated in ethanol followed by CPD using CO₂; (ii) the frozen structure was directly dried using a freeze dryer with the ice condenser temperature at -55°C. both scaffolds were characterized by differential scanning calorimetry (DSC), Fourier Transform Infra-Red spectrum (FTIR), atomic force microscopy (AFM), low voltage SEM (JSM-840F JEOL) and Dynamic mechanical analyser(Perkin Elmer DMA 7e).

Results:

The pore size distribution shows the FD scaffold 50 to 300 μm and the CPD scaffold range between 10 and 200 μm. The AFM, FTIR and DSC data shows both processing route had little effect on the collagen structure. The FD scaffold exhibit Young's modulus greater than CPD scaffold with 400kPa and 4000kPa respectively.

Conclusions:

The collagen scaffold produced by the FD and CPD preserved their natural collagen polymer structure. The CPD process shows decrease in pore size compare to the FD process. The effect of CPD has shown significant less mechanical strength on the scaffold compared to FD. Future work on the wall thickness and mechanical properties of the pore walls can provide some insight into the effect of the mechanical property change.