Cold Atmospheric Plasma Surface Modification of PCL/CMC Scaffold for Cartilage Tissue Engineering

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ABSTRACT

Introduction: Surface modification is a crucial aspect in tissue engineering (TE) applications. This study aimed to use cold atmospheric plasma (CAP) for the surface modification of polycaprolactone (PCL) and carboxymethyl chitosan (CMC), creating a practical scaffold for cartilage TE.

Materials and Methods: The morphology and chemical properties of the PCL/CMC scaffolds were evaluated by scanning electron microscopy, contact angle measurements, and Fourier-transform infrared spectroscopy. The biocompatibility of the treated scaffold was assayed on human mesenchymal stem cells (hMSCs) using MTT at 72 hours. The chondrogenic differentiation of hMSCs was studied using *SOX9* and *COL2* gene expression through polymerase chain reaction and by detecting COL2 protein using immunocytochemistry tests.

Results and Discussion: Electrospinning of PCL/CMC produced a structure resembling the natural extracellular matrix. CAP treatment improved the surface properties of PCL/CMC, introducing functional groups. Based on the *in vitro* results, PCL/CMC was biocompatible, and specific genes related to chondrogenic differentiation, *SOX9* and *COL2*, were expressed. In addition, the detection of chondrogenic differentiation of hMSCs was confirmed by COL2 protein.

Conclusion: PCL polymer exhibits hydrophobic characteristics and has a limited capacity for cellular recognition. The combination of PCL and CMC effectively addresses these limitations. Thus, plasma surface modification could enhance the overall performance of the scaffold.

Keywords: Chondrogenic differentiation, Cold atmospheric plasma, Surface modification, Tissue engineering

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