

Studies on electrospun chitosan based nanofibres reinforced with cellulose and chitin nanowhiskers

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INTRODUCTION

Electrospinning has gained popularity in the field of fibre-reinforced nanocomposites as a technique capable of producing polymer nanofibers with diameter in the range from several micrometers down to tens of nanometers¹. The potential of nanofibres reinforced with polysaccharide nanowhiskers has been reported to enhance the thermomechanical properties and structural morphology of electrospun nanofibres. In this paper, we fabricate chitosan nanofibres reinforced with chitin and cellulose nanowhiskers and determine the nanowhiskers loading effect on the morphology and thermomechanical properties of electrospun chitosan nanofibres^{2,3}.

METHODS

Crab shell chitin in form of flakes was purchased from Sigma-Aldrich GmbH (Germany) and used to produce chitin nanowhiskers (CNW). Microcrystalline cellulose (VIVAPUR[®] 105), by JRS Pharma was used as the starting material to produce cellulose nanowhiskers (CNW). Cellulose nanowhiskers were produced by the 63% sulphuric acid hydrolysis of microcrystalline cellulose (MCC) using the procedure reported by Bondeson et al⁴. Loadings of concentrations of 1.25 – 5% of CNW and CLW were incorporated into the chitosan (CH) solution and electrospun at 20cm and applied voltage of 15kV (0.75kV/cm), respectively. Nanofibre characteristics were determined by Scanning Electron Microscopy (SEM), Thermogravimetric Analyser (TGA) and Fourier Transform Infrared Spectroscopy (FTIR).

RESULTS

The chitin and cellulose nanowhiskers were incorporated into a chitosan polymer matrix and electrospun to form nanofibres. Figure 1 shows the structural morphology of chitosan electrospun nanofibres prepared with 5% CNW and 5% CLW contents. The SEM examination revealed that a homogeneous morphology with potentially good interfacial adhesion seems to have been achieved for the composites studied. When the concentrations of the CH, CH-CNW and CH-CLW solutions were varied, noteworthy changes were observed in the structural morphology and diameter of electrospun nanofibers. These changes were prominent when the CNW and CLW

were added to the CH polymer solutions which led to a decrease in fibre diameter.

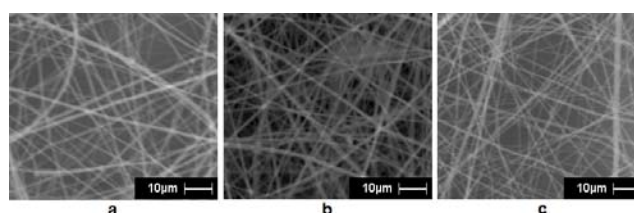


Fig. 1: SEM micrographs showing the effect of chitin and cellulose nanowhiskers on the structural morphology and diameter of electrospun nanofibres a) CH b) CH-CNW5 c) CH-CLW5.

Table 1. Relationship between the Concentrations of CH, CNW and CLW and the Fibre Diameter of Electrospun Nanofibres at 20cm and Applied Voltage of 15kV (0.75 kV/cm)

Sample	Concentration (%)			Mean Diameter (nm)
	CH	CNW	CLW	
CH	100			213
CH-CNW5	95	5		143
CH-CLW5	95		5	160

RESULTS AND DISCUSSIONS: Chitosan-based nanofibre composites containing chitin and cellulose nanowhiskers as functional components were successfully prepared by electrospinning. The results indicated a good interaction between the matrix and both the chitin and cellulose nanowhiskers, which in turn led to improved structural morphology, fibre diameter and thermomechanical properties of electrospun nanofibres.

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