Coaxial wet-spun fibrous systems for chronic wound care

Catarina S. Miranda, PhD student**,** catarina.miranda@2c2t.uminho.pt

A.Francisca G. Silva, Sílvia M.M.A. Pereira-Lima, Susana P.G. Costa, Natália C. Homem, Helena P. Felgueiras; University of Minho, Portugal

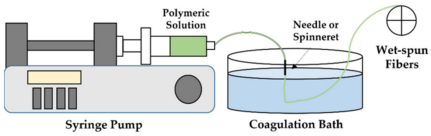
Nanotechnologies

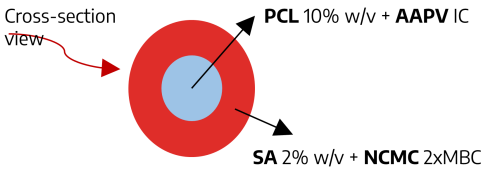
INTRODUCTION

Chronic wounds (CW) are a worldwide concern, affecting a vast portion of the population, and compromising the health and quality of life of patients. The tetrapeptide Ala-Ala-Pro-Val (AAPV) has the ability to inhibit the activity of the enzyme human neutrophil elastase (HNE), which levels, in case of excessive inflammatory processes, remain abnormally high. Incorporation of peptides within polymeric structures (e.g. coaxial fibers) is very attractive to protect the payload from the surrounding environment and allow its controlled release for a sustained action. The outer layer (sheath) of the microfibers was made from blends of sodium alginate (SA) and N-carboxymethyl chitosan (NCMC), a chemically modified version of chitosan, responsive to basic pH (characteristic of CW) and endowed with antimicrobial action. Whereas the inner layer (core) was constituted by polycaprolactone (PCL) combined with AAPV. To the authors knowledge, this is the first report on coaxial wet-spun systems loaded with AAPV for CW care.

PRODUCTION OF COAXIAL WET-SPUN FIBERS

Wet-spinning: technique based on a non-solvent-induced phase inversion process, including a polymeric solution extrusion into a coagulation bath composed by a poor solvent or a non-solvent/solvent mixture to form a coagulating filament that will solidify as a continuous polymeric fiber.





MBC – Minimum Bactericidal Concentration
IC - Concentration providing maximum % of inhibition of HNE activity

FIBERS MORPHOLOGY

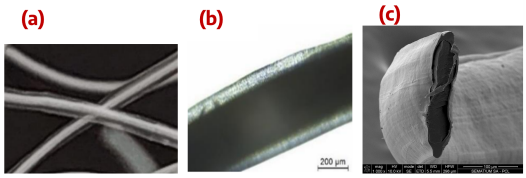
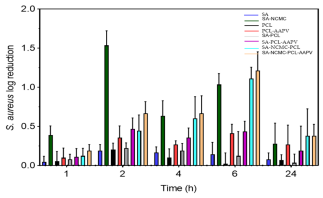


Figure 1. Macroscopic (a), microscopic (b) and scanning-electron microscopical (SEM) (c) observations of coaxial wet-spun fibers.

ANTIMICROBIAL ACTIVITY



NCMC-loaded fibers inhibited the most bacteria growth.
S. aureus activity was reduced by 90-99% at the 6 h mark.

CONCLUSIONS

The potential of the engineered coaxial fibers to serve as **controlled release platforms** for NCMC was demonstrated, along with their **inhibitory effect of HNE and antibacterial activity** against S. aureus. Data confirmed the potential of this system to function as a **stepwise, pH-triggered delivery platform**, suitable for wound healing applications. With this investigation, a step further was taken in establishing wet-spun constructs for drug delivery in CW care.

UTAustin Portugal FCT Fundação para a Ciência e a Tecnologia TEXAS ciimar