Polycaprolactone/Sodium Alginate Coaxial Wet-Spun Fibers Loaded with Ceftazidime for the Treatment of Chronic Wounds

Elina Marinho*, Catarina S. Miranda, Helena P. Felgueiras

Centre for Textile Science and Technology (2C2T), University of Minho, 4800-058 Guimarães, Portugal;

* Correspondence: elinamarinho@2c2t.uminho.pt

Chronic wounds (CW) are growing rapidly, affecting 1–2% of the world's population, imposing a huge burden on healthcare systems and (urgently) needing dressings capable of aiding a more effective healing process. Infection is a complex problem in CW, and it is also known that wounds with intense bleeding prevent a rapid response, often resulting in patient morbidity and mortality. Polycaprolactone (PCL) is a synthetic, biodegradable, biocompatible polymer, with elastic performance and excellent mechanical properties. On the other hand, sodium alginate (SA) is also a biocompatible, biodegradable and non-toxic polymer capable of retaining large amounts of water. Here, a flexible and non-adhesive fibrous structure (made of hydrophobic components that limit blood loss), easily recognized by the skin's extracellular matrix (which fibrous architecture is organized in a similar way), and loaded with hemostatic agents (carbon nanofibers, CNFs) and antibiotics (ceftazidime), was engineered for overcoming the previous problems and promote rapid blood clotting, and consequent tissue regeneration.

Wet-spun coaxial fibers were produced with a shell made of 10 wt.% PCL modified with CNFs (50, 100, 150 μg/mL) and a core of 2 wt.% SA loaded with Ceftazidime (128 μg/mL) using a 2 wt.% $CaCl_2$ coagulation bath. The coaxial structure was confirmed via brightfield microscopy, and the elements composing the fibers were detected by Fourier-transform infrared spectroscopy (FTIR) and thermogravimetric analyses (TGA). Antimicrobial testing was conducted against *Staphylococcus aureus* and *Pseudomonas aeruginosa* revealing great efficacy over a period of 24h. The ability of the fibers to induce blood coagulation was verified using recalcified plasma. In the end, the coaxial fibers were identified as potentially effective for CW care.

Keywords: chronic wounds; antimicrobial action; coaxial fibers