Effects of carrier polymers on chloramphenicol-loaded electrospun matrices intended for the treatment of infected wounds

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Introduction

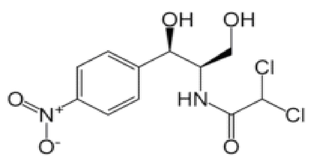
Antimicrobial drug-loaded electrospun nanofibrous dressings are of major interest as novel topical drug delivery systems for managing chronic wound infections. Electrospinning is a simple and versatile process by which polymer nanofibers can be produced using an electrostatically driven jet of polymer solution or polymer melt (**Fig. 1**). Electrospun nanofibers have many useful properties for wound care applications, including oxygen permeability, high porosity and surface-to-volume ratio that can promote haemostasis and absorb wound exudates. Morphology of electrospun nanofibers is similar to natural extracellular matrix in the skin that promotes cell adhesion, migration and proliferation [1,2].

Aims

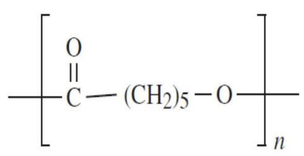
To develop antibacterial electrospun nanofiber mats for the treatment of infected wounds and understand the effect of different carrier polymers on the relevant physicochemical, biopharmaceutical and antibacterial properties.

Materials and Methods

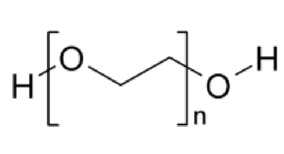
Model antibacterial drug – Chloramphenicol (CAM)
Electrospinning solutions:
I. PCL 12.5% in chloroform and methanol (3:1 V/V)
II. PCL 10%, PEO 2% in chloroform and methanol (3:1 V/V)



CAM



PCL



PEO

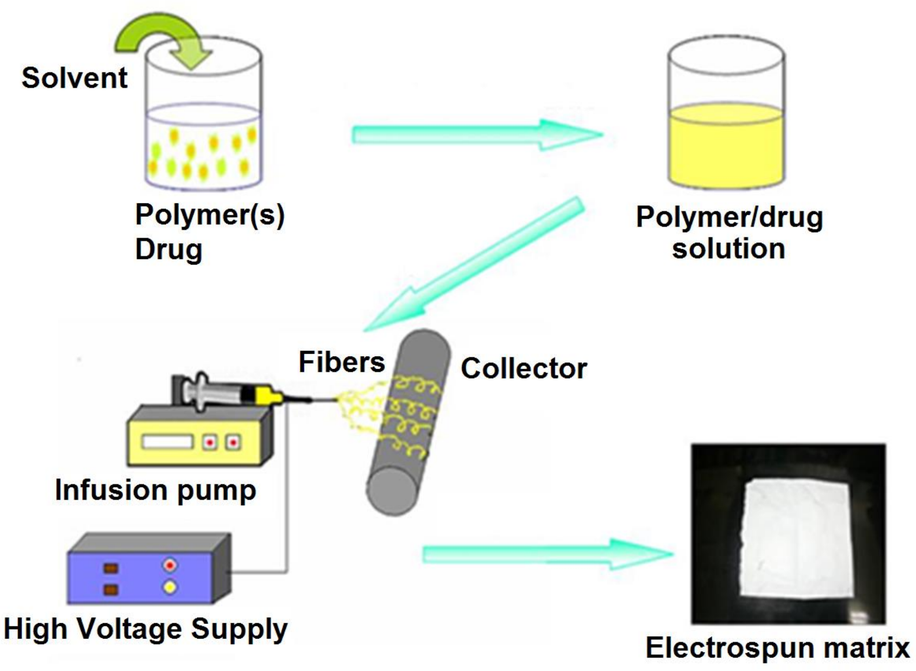


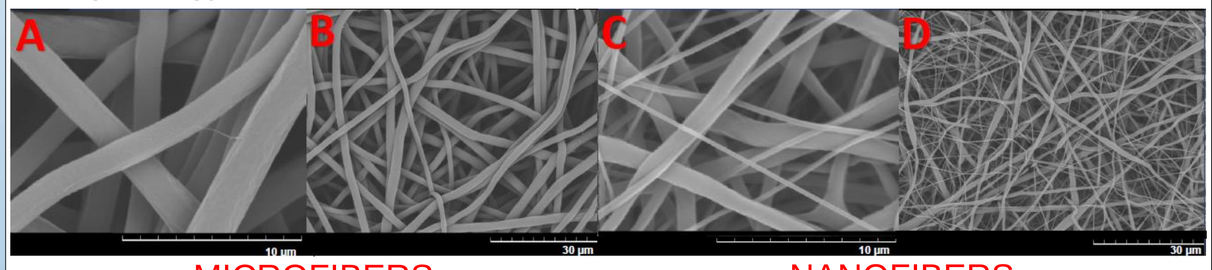
Figure 1: Experimental setup for preparing electrospun nanofibers [3].

Characterization of electrospun matrices:

- Physicochemical:
  - Scanning Electron Microscopy (SEM)
  - X-ray Powder Diffractometry (XRPD)
  - Differential Scanning Calorimetry (DSC)
- Biopharmaceutical:
  - Drug-release: Modified dissolution test
  - Antibacterial activity: Diffusion test on agar plates (*E. coli* MG1655, LB plates)

Results

Morphology of the fibers



MICROFIBERS NANOFIBERS

Figure 2: SEM micrographs of PCL + PEO + CAM 4% microfibers x10 000 (A), x2000 (B) and PCL + CAM 4% nanofibers x10 000 (C), x2000 (D).

Absense of characteristic diffraction reflections of CAM in the XRPD patterns of electrospun fibers suggests amorphous state of the drug (**Fig. 3**).

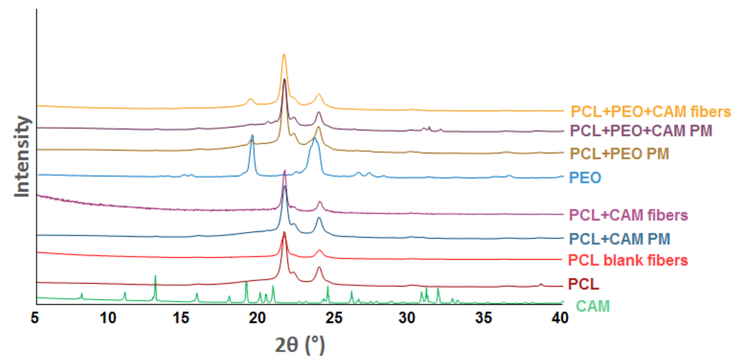


Figure 3: XRPD diffraction patterns of pure substances, physical mixtures and electrospun fibers.

Amorphous state of the drug in both fibers was further confirmed with DSC (**Figs. 4a** and **4b**).

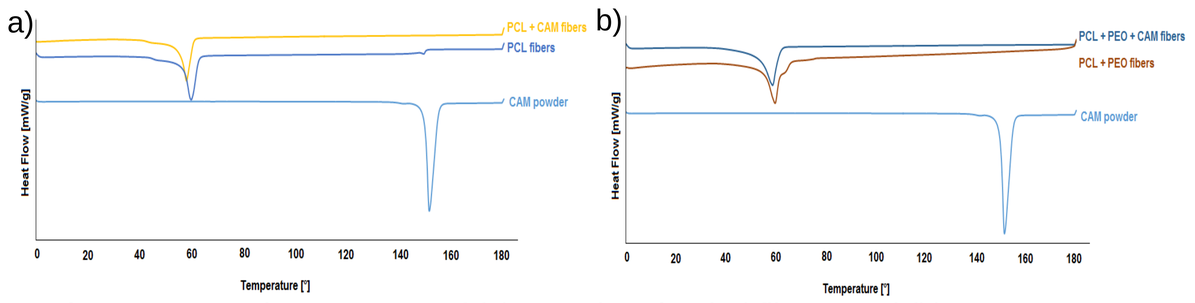


Figure 4: DSC thermograms of (a) PCL drug-loaded fibers and (b) PCL-PEO drug-loaded fibers, both with curves of blank fibers and CAM powder.

Dissolution studies showed that PCL fibers have inital burst release and following slow release of the drug, whereas PCL+PEO fibers release the drug remarkably faster (**Figs. 5a** and **5b**).

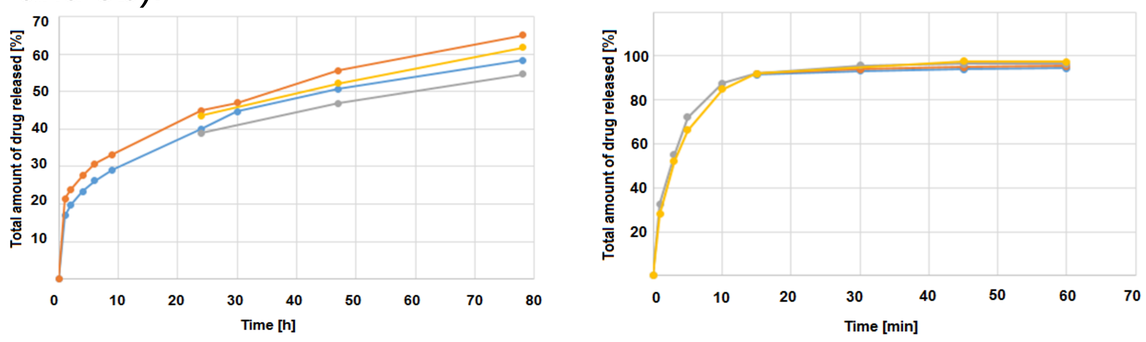


Figure 5: Drug release profiles of (a) PCL drug-loaded fibers and (b) PCL-PEO drug-loaded fibers.

Clear areas of inhibition formed around all drug-loaded fibers (**Fig. 6**).

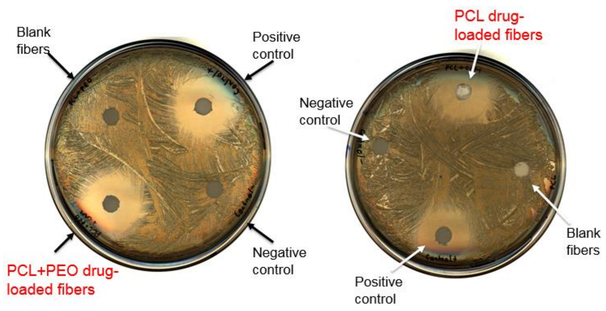


Figure 6: Disc diffusion test on agar plates.

The developed mats have great potential to be used for successful wound therapy.

References

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