EFFECT OF COLD DRAWING ON THE ANTIMICROBIAL AND PHYSICAL PROPERTIES OF PCL/CHX MONOFILAMENTS

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Bacterial contamination is a problem that concerns a wide variety of materials used for biomedical applications. Commonly, inserting an alien material in the body provokes an immune and/or inflammatory response at different intensity levels. This is particularly true for surgical suture threads. In order to contrast these processes, appropriate therapies (antibiotics, anti-inflammatory) must be assumed even if their systemic action is often scarcely tolerated. Alternatively, the active drug could be part of the suture thread, being effective on-site with no systemic consequences. Providing a suture thread or, generally, a polymeric article with antimicrobial properties can be achieved by different routes, including or less the modification of the polymer structure

Polycaprolactone (PCL) is synthetic biodegradable aliphatic polyester widely used for biomedical applications, such as controlled-release drug delivery systems, absorbable surgical sutures and three-dimensional scaffolds for use in tissue engineering.

Chlorhexidine (CHX) is a broad-spectrum antimicrobial agent belonging to the bis(biguanide) family. It is used primarily as a topical antiseptic/disinfectant in wound healing, at catheterization sites, in various dental applications and in surgical scrubs.

In this work we prepared PCL monofilament with antimicrobial properties for surgical suture applications by incorporating CHX during the melt extrusion of the PCL monofilament. The effect of CHX content and of the cold drawing on antimicrobial and mechanical properties of the prepared monofilaments was investigated. Moreover, the possibility to control the release of CHX from the fibres was investigated too.

PCL has been compounded with CHX at different concentrations (1%, 2%, 4% by weight) by using a counter-rotating twin screw compounder. The

fibres were spun by using a capillary rheometer operating under a constant extrusion speed; under these conditions the final diameter of the as spun fibres was about 250 µm.
The antimicrobial activity of filaments was determined by agar diffusion method to evaluate the presence of inhibition zones against two Gram-positive and a Gram-negative. Moreover, bacterial growth in presence of the antimicrobial fibres was determined by plate counting test.
All the filaments containing CHX showed a clear zone of inhibition against both Gram-positive and Gram-negative bacteria as shown in figure 1.
The measurements of the bacterial growth revealed, in full agreement with the agar diffusion tests, that pure PCL did not show any antibacterial activity. On the contrary all the samples added with CHX inhibited the growth of the bacterial mass.

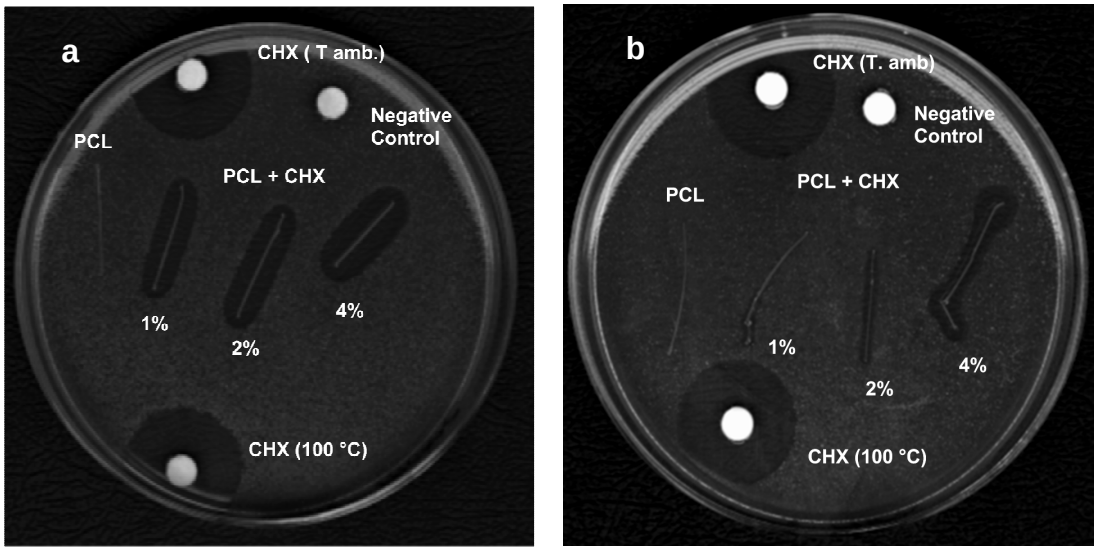

Figure 1 Agar diffusion test performed on *M. luteus* overlay: a) as spun fibres; b) drawn fibres.

The off-line cold drawing of the fibres induced an obvious decrease of their diameter and an increase of the mechanical properties with particular reference to the load at break. Both inhibition tests showed that also the drawn fibres clearly exhibit a strong antibacterial activity.
The evaluation of CHX release showed that, as expected, the amount of released antimicrobial agent raised on increasing the content added to the fibres. Moreover, the drawn fibres released a lower amount of CHX if compared with as spun ones.