ECA 2021

sciforum

Conference Proceedings Paper

PVA-based electrospun mats modified with piperine and curcumin for prospective wound healing applications

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Abstract: The prevalence of chronic wounds (CW) is growing at an accelerated rate, as such wound dressings capable of assisting towards an effective healing process are desirable. To that effect, nanofibrous dressings with a structure resembling the extracellular matrix have been engineered via eletrospinning and functionalized with natural extracts, curcumin and piperine, endowed with antimicrobial, anti-inflammatory and antioxidant properties, highly desirable to an effective treatment of CW. To this day very little research has been presented on the use of piperine in healing processes.

In the present study, combinations of poly(vinyl alcohol) (PVA) and cellulosic compounds such as, cellulose acetate (CA) and cellulose nanocrystalline (CNC) were processed via electrospinning to guarantee porous, highlight intricated and flexible, biocompatible, biodegradable, and mechanically stable mats. PVA/CA and PVA/CNC mats were prepared at different ratios, 100/0, 90/10 and 80/20 v/v%, at 10 w/v% concentration in 75/25 v/v% acetic acid/water for PVA/CA and only in water for PVA/CNC. Processing electrospinning conditions were optimized to obtain uniform, continuous, bead free mats, with a flexible structure. The instant solubilization of the PVA portion of the mat in aqueous media was surpassed via crosslinking with glutaraldehyde (GA) vapor (less cytotoxic approach) during 7 h at 60ºC. Antimicrobial efficacy of selected biomolecules was evaluated against *Staphylococcus aureus*. The biomolecules were initially screened for their antibacterial efficacy by the determination of minimal inhibitory concentrations (MICs). Curcumin was the most effective biomolecule, requiring only 7.8-31.2 μg/mL to inhibit the grown of *S. aureus*, while piperine needed 31.2-125 μg/mL to induce the same effect. Mats were then functionalized with the antimicrobial agents at 2xMIC value and their antimicrobial action access. Data was very promising in revealing these biomolecules as potential substitutes of antibiotics in the fight against *S. aureus* bacteria.

Keywords: biomolecules functionalization; cellulosic compounds; sustainability; antimicrobial action