BIOLOGICAL PROPERTIES OF FIBROUS MEMBRANES MODIFIED WITH NATURAL AND SYNTHETIC ANTIBIOTICS

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Introduction

Regenerative medicine and tissue engineering for scaffolds preparation focus on achieving the most accurate reproduction of the native environment, which is beneficial for cell proliferation. However, because of the specificity of the process of seeding cells on the scaffold as well as the subsequent implementation of biomaterial in damaged tissue the concurrent processes must be taken into consideration that always accompanies the adhesion of cells - bacterial colonization and the formation of bacterial biofilm on the surface of the scaffold. Thus, a permanent or temporary scaffold should have microstructure and physicochemical properties similar to the extracellular matrix (ECM), stimulating cells to initiate repair processes with a high degree of air permeability and suitable properties reducing the possibility of bacterial infection [1].
The emergence of antimicrobial resistance (AMR), has focused attention on the searching of natural products continue to provide new chemical structures with high levels of antibacterial activity.
There are many literature reports informing about the antibacterial, anti-inflammatory and antioxidant activity of curcumin [2,3].
In this work examples of natural (curcumin) and chemical (gentamycin) bioactive molecules that have been loaded on polymeric electrospun fibers are presented. This molecules highlighting the antibacterial properties and their capable of enhancing the healing process (anti-inflammatory molecules).

Materials and Methods

The PLA 3251D polylactide from Nature Works was used in the research as a base material for electrospinning. Analytically pure reagents provided by Avantor SA: dichloromethane (DCM), dimethylformamide (DMF), were used as solvents for the preparation of spinning solutions. polymer fibers were modified with gentamicin (Polfa SA), in the form of gentamicin sulfate and Curcumin (from Curcuma longa (Turmeric), Sigma Aldrich). The measurement of diameters of PLA submicrofibers with additives was made using the scanning electron microscope NOVA NANO SEM 200. Surface wettability of the tested materials was determined by means of direct measurements (DSA 25E, Kruss) at room temperature using high purity water (UHQ, PURE Lab, Vivendi water) as a measuring liquid. The free surface energy was determined by the Owens-Wendt method using diiodomethane as a non-polar liquid. The durability of biomaterials (scaffold) was tested in in vitro condition: PBS/37°C/CO_2. The presence of biomolecules in membranes were confirmed by FTIR. Antibacterial properties were checked in contact membrane with E.coli (Hilton Muller test). The basic biocompatibility of the fibrous scaffolds (cytotoxicity, viability, adhesion to the scaffold) in contact with the fibroblasts and macrophages were tested.

Results and Discussion

Non-woven fibrous mats can be successfully modified with natural or synthetic active biomolecules. Additives have impact on fibers morphology. Expected result on cellular response: biocompatible materials for curcumin and gentamicin. Antimicrobial activity depends on concentration of bioactive molecules in polymer solution.

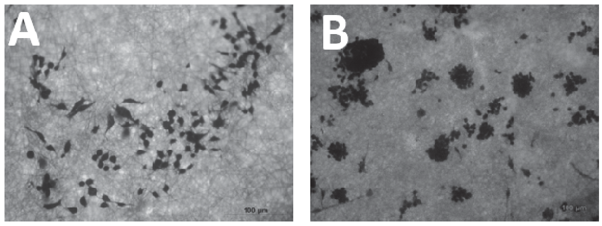

FIG. 1. Macrophages on PLA membranes with: A – gentamycin, B – curcumin, after 3 days magnification 20x.

Conclusions

The microstructure of fibrous membranes can provide unique microenvironment to cell proliferation. The antibiotic content in the fiber inhibits bacterial growth. Both materials pose a potential wound patch dressing for dermis and epidermis defects.

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