Vancomycin controlled release from Sapelli Biomorphic SiC

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Abstract

Biomorphic silicon carbide (BioSiC) obtained from natural resources is a new ceramic material suitable as bone substitutes due to its excellent mechanical properties and biocompatibility[1,2]. The final material mimics the original precursor with high porosity and interconnectivity. This smart hierarchical structure also allows the inclusion of therapeutic molecules which lead the prevention of infections after the surgical process.

Disks of BioSiC from sapelli wood were produced. The wood was dried at 60ºC during 24 hours and pyrolized at 1000ºC for 10 minutes in nitrogen atmosphere to obtain a carbon perform. After that process, samples are infiltrated with molten silicon in vacuum at 1550ºC for 30 minutes[3]. The exothermic reaction gives a high strength material that can be mechanized to produce implants with specific shapes. The BioSiC and its carbon perform were characterized by helium pycnometer, mercury intrusion porosimetry and nitrogen adsorption. Disks topography was evaluated by Scanning Electron Microscopy. The cell viability tests were carried out using BALB/3T3 and the cell survival was determined by confocal microscopy after calcein/propidium iodide staining. Vancomycin was used as a model drug with high solubility and different cellulosic derivatives (hydroxypropyl methyl cellulose of various molecular weights, HPMC) were used as retardant polymers. The vancomycin release profiles were determined by placing the dried drug-loaded disks in vials with phosphate buffer (PBS) at 37ºC under mechanical shaking and testing the amount of vancomycin released at preset times by UV-visible spectroscopy.

The infiltration process leads a material with a high density but with lower porosity and surface area due to the formation of silicon carbide crystals, but still sufficient to load the solutions of vancomycin or the dispersions HPMC-vancomycin (Figure 1).
After 24 hours of contact with the BioSiC disks the cell viability was higher than 80% as it is observed in the confocal microscopy. As a function of its rheological properties, cellulosic polymers modify the release kinetics of vancomycin. Neither the vancomycin nor the polymers affect cell viability results, being able to develop adequate scaffolds for controlled vancomycin release for long period of time (Figure 2).

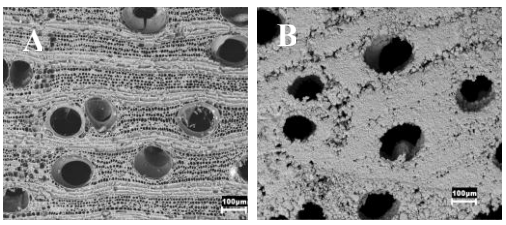

Figure 1.- SEM micrographs of A) sapelli carbon preform and B) sapelli BioSiC

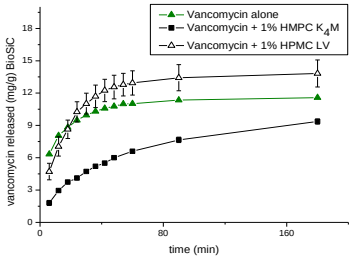

Figure 2.- Vancomycin release kinetics with high (K4M) and low viscosity (LV) polymers.

We were able to obtain a new generation of ceramic material with several interesting properties, which also can load therapeutic molecules and modulate its release due to the addition of cellulosic polymers.

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