

Microstructure and bioactivity of bone cements for prosthetic surgery

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INTRODUCTION: Porous materials have been used in surgical implant design to fabricate devices or augment soft or hard tissues, as coatings on prostheses to accommodate tissue ingrowth for biological fixation and as scaffolds to facilitate the regeneration of tissue. Polymer-ceramic composite are widely used in orthopaedics as suture materials and fixation devices due to their biocompatibility-ability to support bony growth (osteoconductive) and also bone bioactive (to form a calcium fosfat layer on its surface) [1]. Our approach is to compare the microstructure, bioactivity and biocompatibility of two different types of biocomposites: BIOLOS 3 and ANTIBIOTIC SIMPLEX (containing erythromycin and colistin) from in vitro study in simulated body fluid.

METHODS: Electrochemical measurement were performed using Na⁺ and Ca²⁺ selective electrodes for different time intervals, during 34 days incubation in SBF. The study is focused on microscopic (SEM) analysis of the graded layer structure before and after immersion in SBF, as the development of an active layer is expected [2]. The FTIR spectra of the grown hydroxyapatite layer have been recorded after different times intervals in the range 500-3000 cm⁻¹ and compared with those of the native materials. Hemolysis tests and osmotic fragility of red blood cells were performed, as the blood compatibility is dictated by the manner in wich the material surface interact with blood constituents (red blood cells, platelets, proteins) [3]. Spectrophotometric measurement were performed at 540 nm to quantify the hemoglobin released in order to estimate the extent of red cell lysis. The absorbance of blood samples (following exposure to both biomaterials) were normalised with that of control blood.

RESULTS AND DISCUSSION: A considerable diminution of Ca²⁺ has been obtained in SBF after 14 days incubation, for both types of biocomposites, the Na⁺ concentration being less affected during the times (fig.1). FTIR measurements showed typical vibration modes of P-O stretching vibration at 987 cm⁻¹ and C-O asymmetric bending from CO₃²⁻ at 812 cm⁻¹, wich can be used to estimate the relative layer thickness

using the Buger-Lambert-Beer' law for the optical density at these wavelengths. The SEM images shows regular, cuasi-spherical aggregates with an average size of 10 μm, grouped homogeneously, the densisy of the aggregates being greater for the ANTIBIOTIC SIMPLEX (fig.2). During the hemolysis tests, the blood sample exposed to BIOLOS 3 exhibited the maximum value of absorbance, suggesting the maximum lysis of red cells.

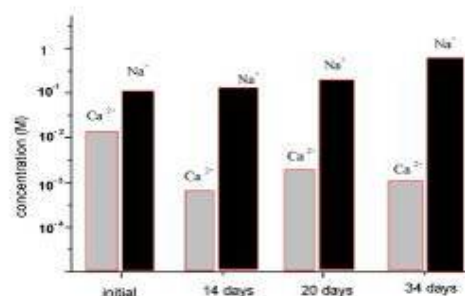


Fig.1: Effect of Simulated Body Fluid incubation on Ca²⁺ and Na⁺ concentration, after different time intervals.

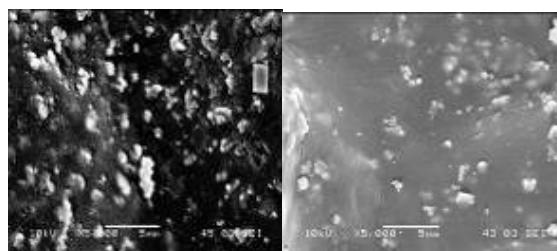


Fig.2: Morphology of hydroxyapatite crystals after 14 days incubation at ANTIBIOTIC SIMPLEX surface(left) compared to BIOLOS 3(right) in the same conditions.

CONCLUSIONS: Upon hemolysis tests and osmotic fragility of red blood cells and comparation of the results obtained with the above techniques, one can suggests that ANTIBIOTIC SIMPLEX is a better material than BIOLOS 3.

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