11th International Conference
on Advanced Materials

ICAM 2009

Rio de Janeiro Brazil
September 20 - 25

Zinc-containing hydroxyapatite: synthesis, physico-chemical characterization and *in vivo* behaviour

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Abstract – Zinc is an essential trace element able to stimulate bone formation *in vitro* and *in vivo* and inhibit osteoclastic bone resorption *in vitro*. Physico-chemical characterization of cylinders (2x6mm) produced from powder of synthetic 0.5% zinc apatite (ZnHA) occurred before and after *in vivo* implantation. X-ray fluorescence analysis and bone repair around cylinders implanted into left tibia of New Zealand rabbits showed the presence of zinc in the ZnHA and in the bone around the materials, that ZnHa presented greater osteoconductivity and bone formation than stoichiometric HA cylinders, taken as control on right tibia.

Zinc is known to play a relevant role in growth and development, has stimulatory effects on bone formation *in vitro* and *in vivo* [1,2] and an inhibitory effect on osteoclastic bone resorption *in vitro* [3]. The inorganic component of the bone tissue is nonstoichiometric apatite; changes in the composition of hydroxyapatite (HA) are subject of studies in order to improve the tissue response after implantation [4].

The objective of this study was to investigate the effect of 0.5% zinc-containing hydroxyapatite (ZnHA) in comparison to hydroxyapatite (HA, control group), on osseous repair of rabbit's tibia. Cylinders (2X6mm) of both materials were produced according to the specification of the International Organization for Standardization (ISO). Ethics Commission on Teaching and Research in Animals approved this project (HUAP-195/06). Fifteen White New Zealand rabbits were submitted to general anesthesia and two perforations (2X6mm) were made in each tibia for implantation of ZnHA cylinders (left tibia) and HA cylinders (right tibia). After 1, 2 and 4 weeks, the animals were killed and one fragment of each tibia with the cylinder was collected, demineralized and 6-μm thick semi-serial sections were done for histomorphometric analysis. The second fragment of each tibia were collected and embedded in a methacrylate-based resin and cut into slices (~200 μm thickness) aiming the center of the implant along its long axis with a precision diamond saw. The specimens were analyzed by Scanning Electron Microscopy (Backscattered Electrons, Secondary Electrons and Energy Dispersive Superficial), Transmission Electron Microscope, X-Ray Microfluorescence with Synchrotron Radiation and Infrared Spectroscopy. In both groups, the area of new bone increased from 7 to 14 days ($p<0.05$). After 28 days the ZnHA group showed greatest area of new bone and smallest area of connective tissue, ($p<0.05$). Both biomaterials are biocompatible, osteoconductive, but zinc-containg HA enhanced the osteogenesis in relation to HA at 28 days.

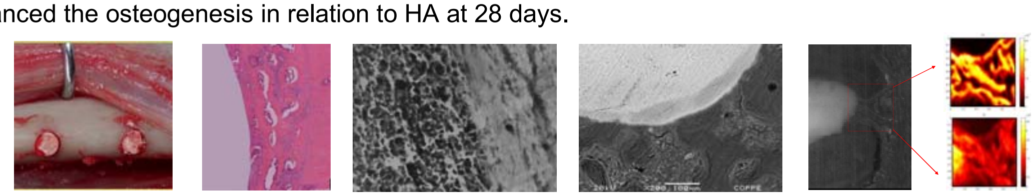

Figure 1.A. Implantation site; B. Histological section (HE); C. TEM image; D.SEM image; and E. X-Ray Microfluorescence bidimensional images of ZnHA after28 days.

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Acknowledgments

This work was partially supported by CNPq, FAPERJ and LNLS (Project XRF-8066).