Improving Bone Regeneration Using Nanohydroxyapatite

Introduction

Hydroxyapatite (HA) features a high level of biocompatibility and bioactivity because of its similarity with the bone's mineral component. It is a calcium phosphate ceramic.

Once it is implanted in the body, this ceramic can form strong and stable chemical bonds with bone tissue. Microscale HA has been used extensively by the healthcare industry in bone graft substitutes and prosthetic coatings. Also with nanotechnology emerging, nanoscale HA has been produced and studied to enhance HA properties.

nanoXIM - Nanocrystalline HA Powders

FLUIDINOVA has developed the nanoXIM HAp200 product series, which are high purity, single-phase, nanocrystalline HA powders. These products are suited for medical applications as they present chemical and structural similarity with natural bone. The nanoXIM HAp200 series has an increased specific surface area of more than $100m^2/g$ and a precise stoichiometry of calcium/phosphate ions resulting in a Ca/P ratio always near to 1.67.

Enhanced Cell Viability and Proliferation

Figure 1 shows that the substrates produced with nanoXIM HAp202 showed improved cell viability and proliferation when compared with microscale HA substrates. There was an increase in cell proliferation from 65% to 76% on the nanoscale HA as opposed to the microscale HA with an increase of 37% to 40%.

Improved proliferation and cell viability is related to nanoscale HA higher surface area. Also cultured cells show typical osteoblastic phenotypes indicating a bone related behavior [1]. In order to produce collagen and nanoscale HA composite scaffold, the product nanoXIM HAp202 was also used and by its presence proliferation, cell viability and alkaline phosphatase (ALP) production improved as shown in Figure 2 [2].

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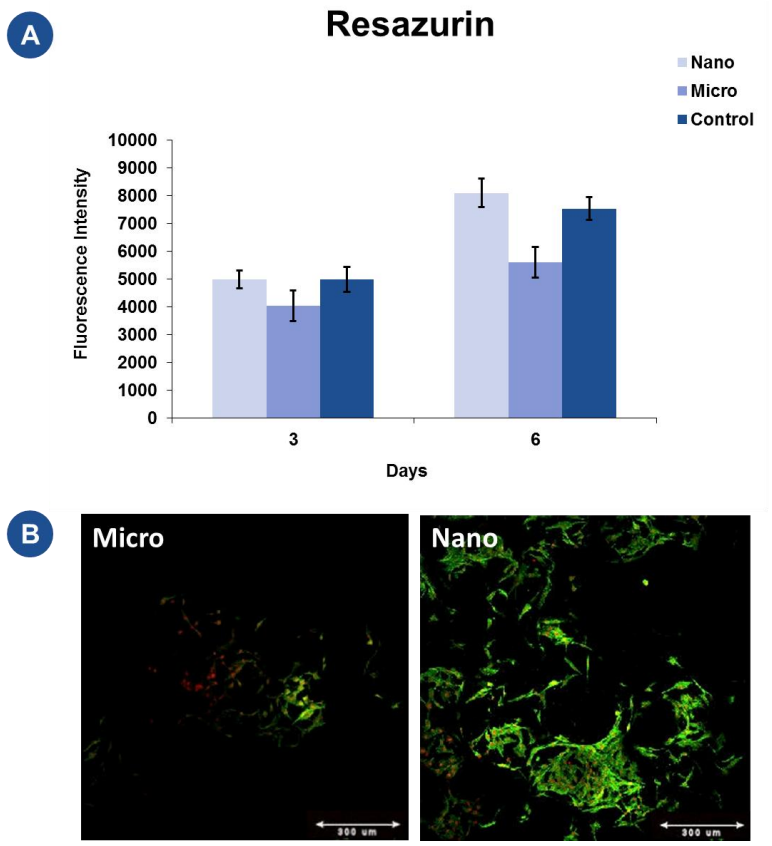

Figure 1: MG63 osteoblast-like cells cultured on micro and nanoscale HA substrates. (A) Cell proliferation for 3 and 6 days estimated by resazurin assay; (B) Confocal microscopy images of cells cultured for 6 days on the two different materials. Data kindly provided by Marta Laranjeira.

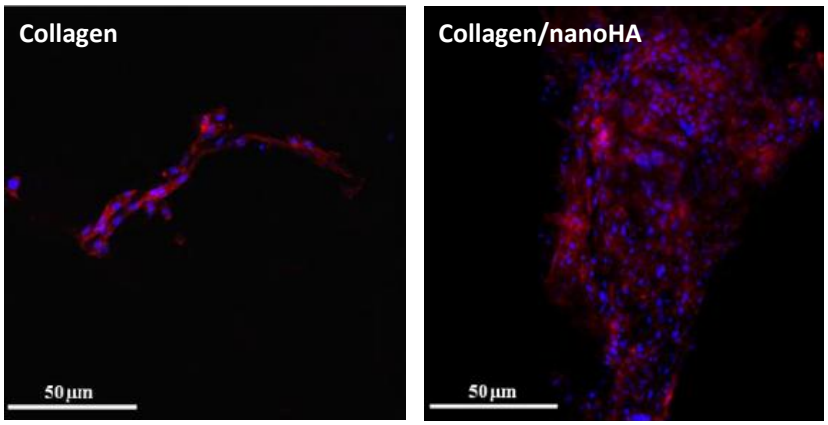

Figure 2: Confocal-laser scanning microscopy images of MG63 osteoblast-like cells after 21 days of culture on collagen and collagen/nanoscale HA biocomposite scaffolds. Adapted from [2]

Conclusions

The nanoXIM HAp200 product series are promising materials that can be used in tissue engineering and bone regeneration applications as its presence improves proliferation and cell viability. The substrates produced with the products offer a suitable environment for cells to adhere, proliferate and improve their response.

References

1. Laranjeira MS, Fernandes MH, Monteiro FJ. Innovative macroporous granules of nanostructured-hydroxyapatite agglomerates: Bioactivity and osteoblast-like cell behaviour. Journal of Biomedical Materials Research Part A. 2010;95A(3):891-900.
2. Rodrigues S. Preparation and characterization of collagen-nanohydroxyapatite biocomposite scaffolds by cryogelation method for bone tissue engineering applications. MSc Thesis in Biomedical Engineering, Faculty of Engineering, University of Porto (2011).

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