World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:10, No:05, 2016

# Preliminary Design, Production and Characterization of a Coral and Alginate Composite for Bone Engineering

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**Abstract :** The loss of functional tissue is a ubiquitous and expensive health care problem, with very limited treatment options for these patients. The golden standard for large bone damage is a cadaveric bone as an allograft with stainless steel support; however, this solution only applies to bones with simple morphologies (long bones), has a limited material supply and presents long term problems regarding mechanical strength, integration, differentiation and induction of native bone tissue. Therefore, the fabrication of a scaffold with biological, physical and chemical properties similar to the human bone with a fabrication method for morphology manipulation is the focus of this investigation. Towards this goal, an alginate and coral matrix was created using two production techniques; the coral was chosen because of its chemical composition and the alginate due to its compatibility and mechanical properties. In order to construct the coral alginate scaffold the following methodology was employed; cleaning of the coral, its pulverization, scaffold fabrication and finally the mechanical and biological characterization. The experimental design had: mill method and proportion of alginate and coral, as the two factors, with two and three levels each, using 5 replicates. The coral was cleaned with sodium hypochlorite and hydrogen peroxide in an ultrasonic bath. Then, it was milled with both a horizontal and a ball mill in order to evaluate the morphology of the particles obtained. After this, using a combination of alginate and coral powder and water as a binder, scaffolds of 1cm3 were printed with a SpectrumTM Z510 3D printer. This resulted in solid cubes that were resistant to small compression stress. Then, using a ESQUIM DP-143 silicon mold, constructs used for the mechanical and biological assays were made. An INSTRON 2267® was implemented for the compression tests; the density and porosity were calculated with an analytical balance and the biological tests were performed using cell cultures with VERO fibroblast, and Scanning Electron Microscope (SEM) as visualization tool. The Young's moduli were dependent of the pulverization method, the proportion of coral and alginate and the interaction between these factors. The maximum value was 5,4MPa for the 50/50 proportion of alginate and horizontally milled coral. The biological assay showed more extracellular matrix in the scaffolds consisting of more alginate and less coral. The density and porosity were proportional to the amount of coral in the powder mix. These results showed that this composite has potential as a biomaterial, but its behavior is elastic with a small Young's Modulus, which leads to the conclusion that the application may not be for long bones but for tissues similar to cartilage.

**Keywords :** alginate, biomaterial, bone engineering, coral, Porites asteroids, SEM
**Conference Title :** ICBE 2016 : International Conference on Biomaterials Engineering
**Conference Location :** Berlin, Germany
**Conference Dates :** May 19-20, 2016