Synthesis of multi-substituted hydroxyapatite using a continuous flow method

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INTRODUCTION: Hydroxyapatite is a calcium phosphate mineral synthesized physiologically by cells in bone. Synthetic and natural-material derived hydroxyapatites are used for bone regeneration, as bone fillers or as coatings to improve the attachment of bone to metal implants. However, the slow degradation rate of hydroxyapatite compromises its bone forming capacities. In this project we aim to create a multi-substituted HAP (sHAP) with Mg and Sr to increase its solubility, osteogenic integrity and bioactivity with a continuous flow method.

METHODS: HAP was synthesized by a wet, continuous method using a mixing column. Different substitution degrees were examined (Table 1).

Table 1 Tested concentrations of Mg and Sr

	Mg	Sr
Conc 1	20	20
Conc 2	5	20
Conc 3	20	5
Conc 4	5	5

Laminar flow in the column induced hydroxyapatite precipitation. Reagents used for the synthesis were orthophosphoric acid, calcium hydroxide, magnesium nitrate and strontium nitrate. Synthesis was carried out at room temperature and incubated overnight at 37 °C under continuous stirring. The hydroxyapatite powder was washed and dried. The synthesis of HAP was tested via Fourier-transform infrared spectroscopy (FTIR) and inductively coupled plasma optical emission spectrometry (ICP-OES). Crystallinity was assessed via X-ray diffraction (XRD).

RESULTS: The results showed that the synthesis method used could successfully achieve the formation of multi-substituted hydroxyapatite and the incorporation of a high amount of ions. However, higher amount of Sr reduced the incorporation of Mg.

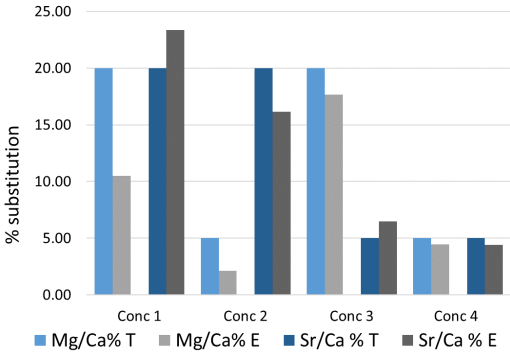

Figure 1 Theoretical (T) and experimental E amount of substitutions.

XRD analysis showed that only Conc 2 and 4 have a high amount of HAP, with Conc2 being the highest amount of HAP achieved (100%). Biological properties and physio-mechanical properties on sHAP-PCL are currently being investigated.

DISCUSSION & CONCLUSIONS: The continuous wet method seems to lead to the successful substitution of hydroxyapatite. However, high amounts of strontium reduced the incorporation of Mg, whereas high amounts of Mg, reduced the incorporation of Ca resulting in excess incorporation of Sr.

ACKNOWLEDGEMENTS: This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 766012

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