POLY EPSILON-LYSINE HYRDOGEL-HYDROXYAPATITE COMPOSITE AND BIODEGRADABILITY

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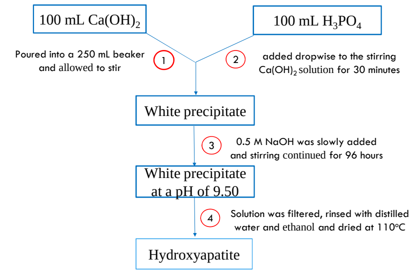
INTRODUCTION

Naturally occurring Hydroxyapatite (HA) has the chemical formula $Ca_{10}(PO_4)_6(OH)_2$. HA is a major component of bone and teeth matrix and it gives them their rigidity. Because of the close chemical similarity of hydroxyapatite to natural bone, there has been a lot of new efforts to try and use synthetic hydroxyapatite as a bone substitute and replacement in biomedical applications. The objectives for this research are to synthesize the Hydrogel-Hydroxyapatite composite, where the hydrogel is used for self-mineralization and the hydroxyapatite is used for osteogenesis (formation of bone) and look at its biodegradability.

HYDROXYAPATITE SYNTHESIS



HYDROGEL SYNTHESIS

REACT PULLULAN WITH NaOH AND EPICHLOROHYDRIN AND STIR TO OBTAIN A CLEAR SOLUTION

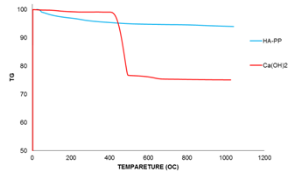
ADD POLYEPSILON LYSINE AND TRANSFER TO A 20 mL VIAL AND LEAVE GEL TO SET

WASH GEL WITH DISTILLED WATER AND LEAVE TO AIR DRY

RESULTS

HYDROXYAPATITE ANALYSIS

THERMAL GRAVIMETRIC ANALYSIS

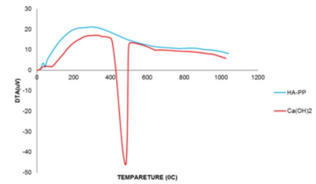


$Ca(OH)_2$
22.3 % Decomposed

$$Ca(OH)_{2\,(s)} \xrightarrow{444\,^0C} CaO_{(s)} + H_2O$$

HYDROXYAPATITE:
6% decomposed since hydroxyapatite decomposes at 1300 ^0C

DIFFERENTIAL THERMAL ANALYSIS



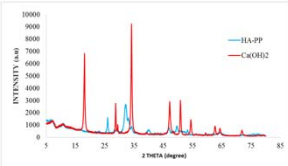
$Ca(OH)_2$

The DTA curve has a minimum at 459°C which corresponds to an endothermal efeect.

HYDROXYAPATITE

The DTA curve has two maxima at 226°C and 298°C which corresponds to an exothermal effect.

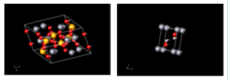
X-RAY POWDER DIFFRACTION RESULTS



The peaks for the $Ca(OH)_2$ and that for the Hydroxyapatite are completely different.

Confirms that a pure phase of Hydroxyapatite was obtained.

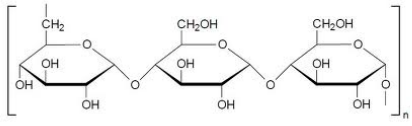
MODEL OF THE CRYSTALS



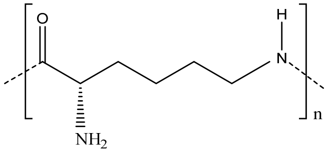
HA-PP　　$Ca(OH)_2$

The crystallite size of $Ca(OH)_2$ is 17.7 nm which is higher than that of Hydroxyapatite which 2.93 nm.

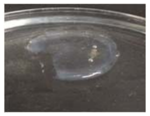
HYDROGEL ANALYSIS



PULLULAN



POLYEPSILON LYSINE

DAY 1	DAY 5	DAY 10	DAY 15	DAY 20
 Hydrogel in Trypsin and Water	 Hydrogel in Trypsin and Water	 Hydrogel in Trypsin and Water	 Hydrogel in Trypsin and Water	 Hydrogel in Trypsin and Water
 Hydrogel in a buffer solution of pH 7.40	 Hydrogel in a buffer solution of pH 7.40	 Hydrogel in a buffer solution of pH 7.40	 Hydrogel in a buffer solution of pH 7.40	 Hydrogel in a buffer solution of pH 7.40

- For the hydrogel in trypsin and water, over the 20 day period there was some degree of degradation.
- For the hydrogel in the buffer solution, over the 20 day period there was no apparent degradation.

CONCLUSION: We successfully prepared the components of the hydrogel-hydroxyapatite composite. The Thermal Gravimetric analysis and the Differential thermal analysis confirmed that hydroxyapatite is stable below 1300 ^0C and the transition is exothermic. From the hydrogel analysis, we observed some degree of degradation for the hydrogel in trypsin and water. The next phase will be to incorporate the hydroxyapatite into the hydrogel.

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