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Title: Development of Hydroxyapatite Materials for Dental Applications

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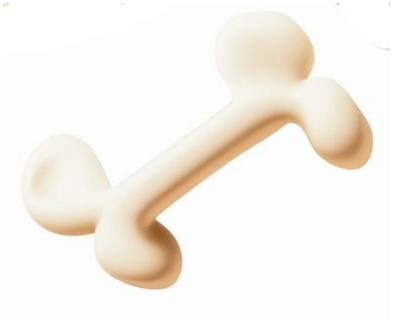
PRESENTATION CONTENT

Introduction

Annually, massive amounts of eggshells were being thrown away as garbage from homes, bakeries, hotels, and farms around the world, contributing to environmental pollution.[1] As per the FAOSTAT 2019 survey, the production of eggs is more than 2500 billion per year. The shell part of an egg has about 11% of the mass. However, only about 1% of garbage eggshells are used as fertilizer and human consumables as calcium source[2]

For years, there has been a search to obtain natural hydroxyapatite from eggshells, snail shells, bovine bones, fish bones and scales[3]. Because hydroxyapatite is considered one of the most important biomaterials due to its mimetic similarity with calcium phosphates in human bone and biocompatibility with these tissues.[4]



[1]Johnson Jeyakumar, S., Sindhya, A., Jothibas, M., Pugalendhi, P., & Sathiyamoorthy, K. (2023). Preparation and analysis of pure and surface modified nanohydroxyapatite derived from eggshells and its in-vitro studies for bone graft applications. *Ceramics International*, *49*(11), 18708–18727. https://doi.org/10.1016/j.ceramint.2023.02.248

[2]Ajay Jaswal, S. S. • A. M. (2023). Synthesis of Nanocrystalline Hydroxyapatite Biomaterial from Waste Eggshells by Precipitation Method. Trans Lndian Inst Met.

[3]M. Kalpana, & R. Nagalakshmi. (2022). Nano Hydroxyapatite for Biomedical Applications Derived from Chemical and Natural Sources by Simple Precipitation Method. *Applied Biochemistry and Biotechnology* , *195*, 3994–401

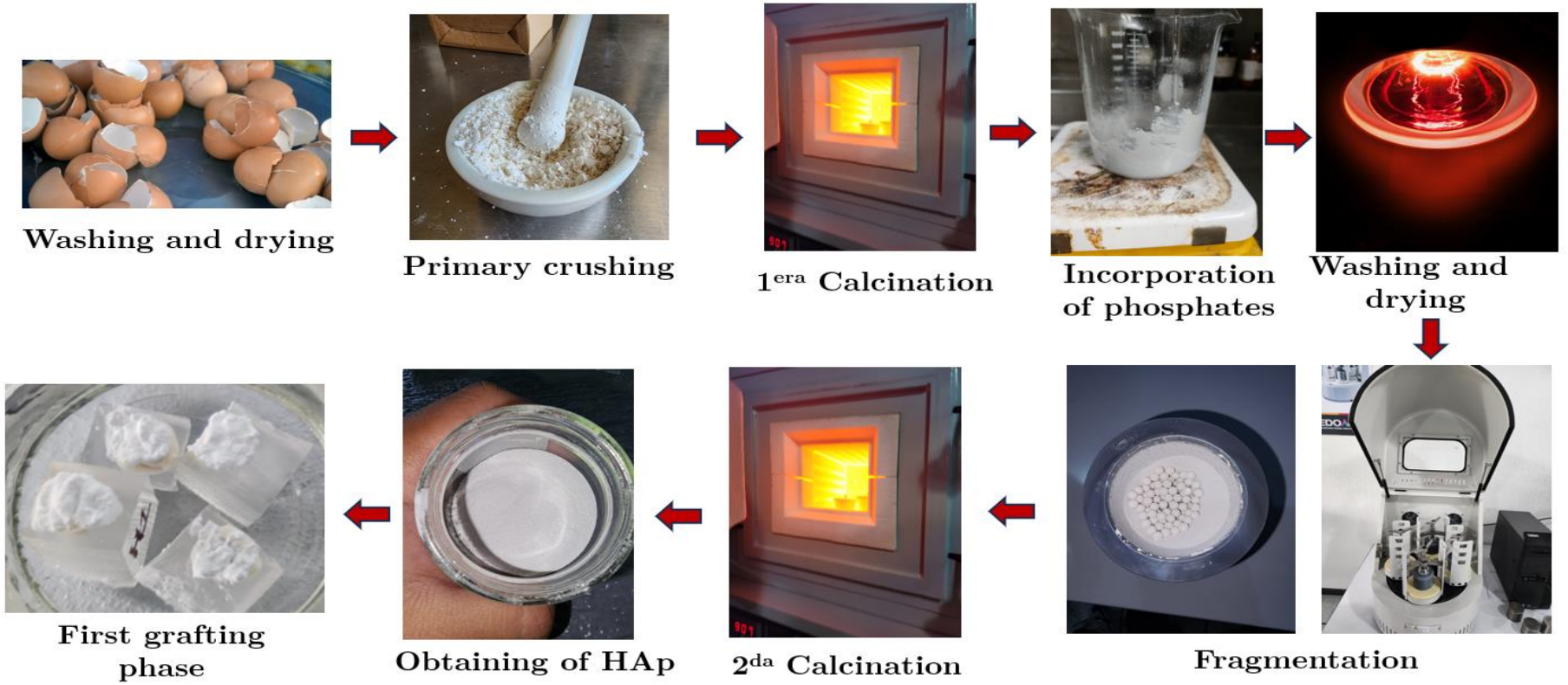
[4]Khalid, M., Jikan, S. S. B., Adzila, S., Murni, Z., Badarulzaman, N. A., Rosley, R., & Hameed, M. U. (2022). Synthesis and characterizations of hydroxyapatite using precursor extracted from chicken egg shell waste. *Biointerface Research in Applied Chemistry*, *12*(4), 5663–5671. https://doi.org/10.33263/BRIAC124.56635671

General Objetive

Obtaining hydroxyapatite powder from eggshell for dental applications

Experimental strategy

Following the synthesis of Khalid[1] and Yezdani[2], the propose the next synthesis method is proposed for obtaining hydroxyapatite.

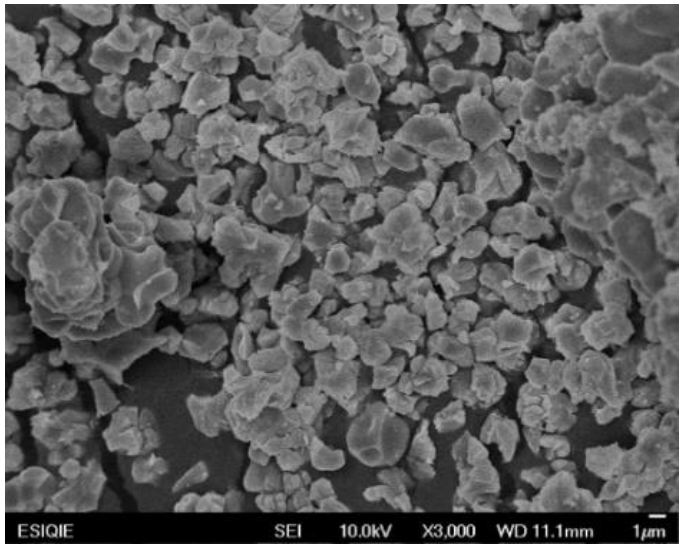


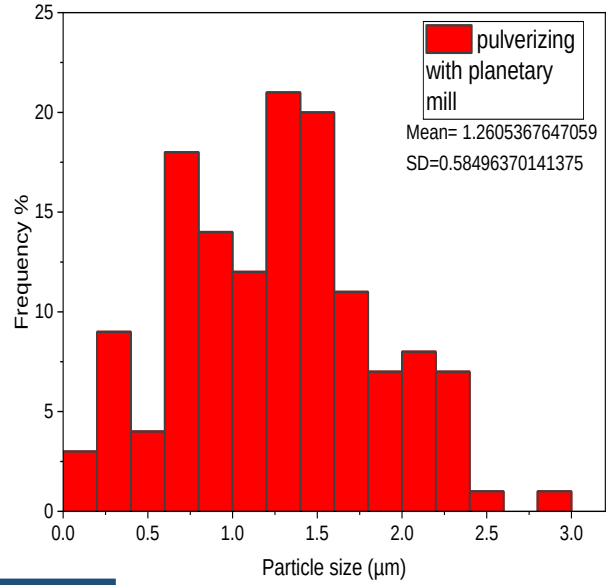
1. Khalid, M., Jikan, S. S. B., Adzila, S., Murni, Z., Badarulzaman, N. A., Rosley, R., & Hameed, M. U. (2022). Synthesis and characterizations of hydroxyapatite using precursor extracted from chicken egg shell waste. *Biointerface Research in Applied Chemistry*, *12*(4), 5663–5671. https://doi.org/10.33263/BRIAC124.56635671

2. Yezdani, S., Kothari, T., Kumar, P. S., Vidhya, S., Jayasree, R., & Mahalaxmi, S. (2023). Effect of commercial desensitizing agents and eggshell derived nano-hydroxyapatite on bond strength of a universal adhesive to dentin. *Surfaces and Interfaces*, *42*. https://doi.org/10.1016/J.SURFIN.2023.103341

Results
Characterization of particle size

The equipment was used is Planetary Ball Mill (Pulverizer) Model BIC0400-0.4



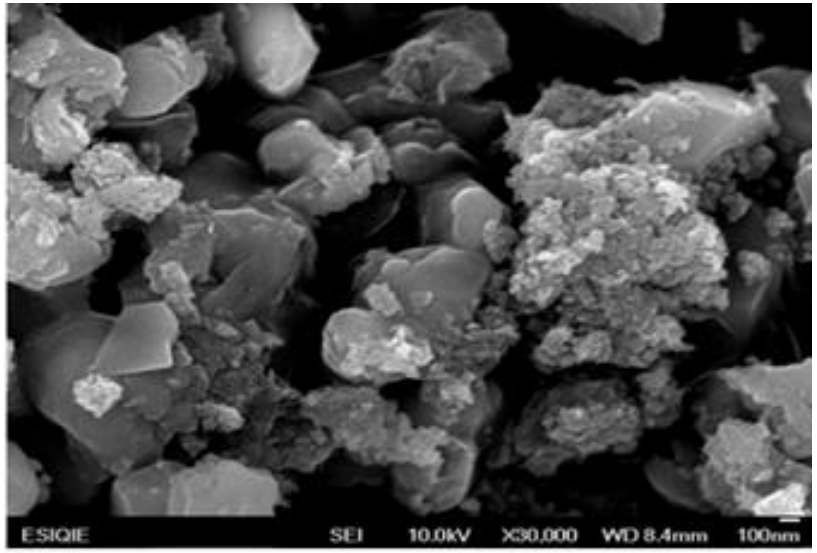


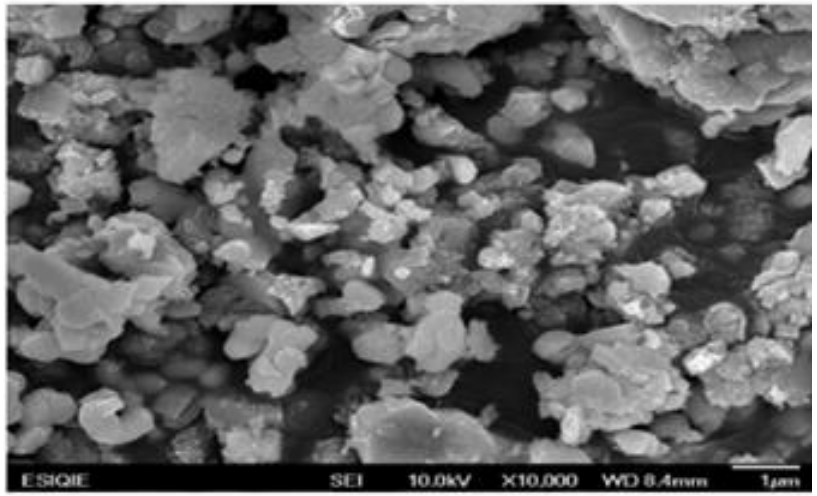
Obtaining fine powder with a rounded angular shape with a greater presence of sizes between 1.15 and 1.25 µm, with an average of 1.2605 µm and a standard deviation of 0.5849 µm.

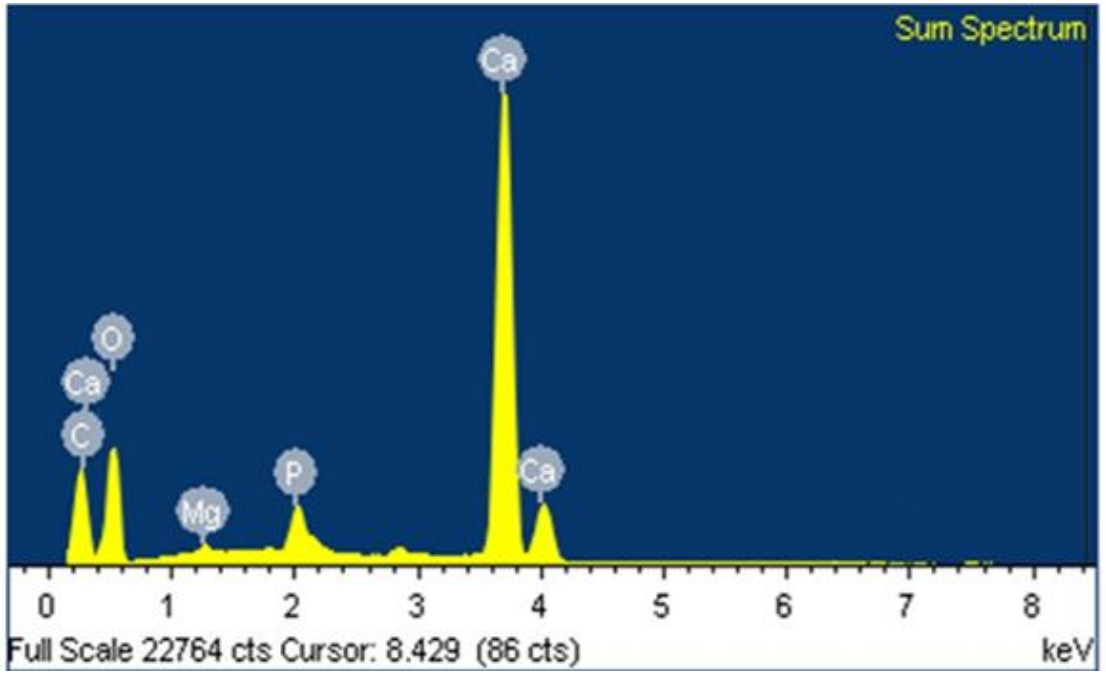
Table 1

Title Particle size distribution and change with different spraying	
σ and $\bar{x}$ with mortar spraying.	**σ and $\bar{x}$ with sputtering in the planetary.**
$\bar{x}$= 24.6913 µm σ= 10.51669 µm	$\bar{x}$= 1.15 to 1.25µm σ= 0.5849µm

Scanning Electron Microscopy
Energy Dispersed Spectroscopy

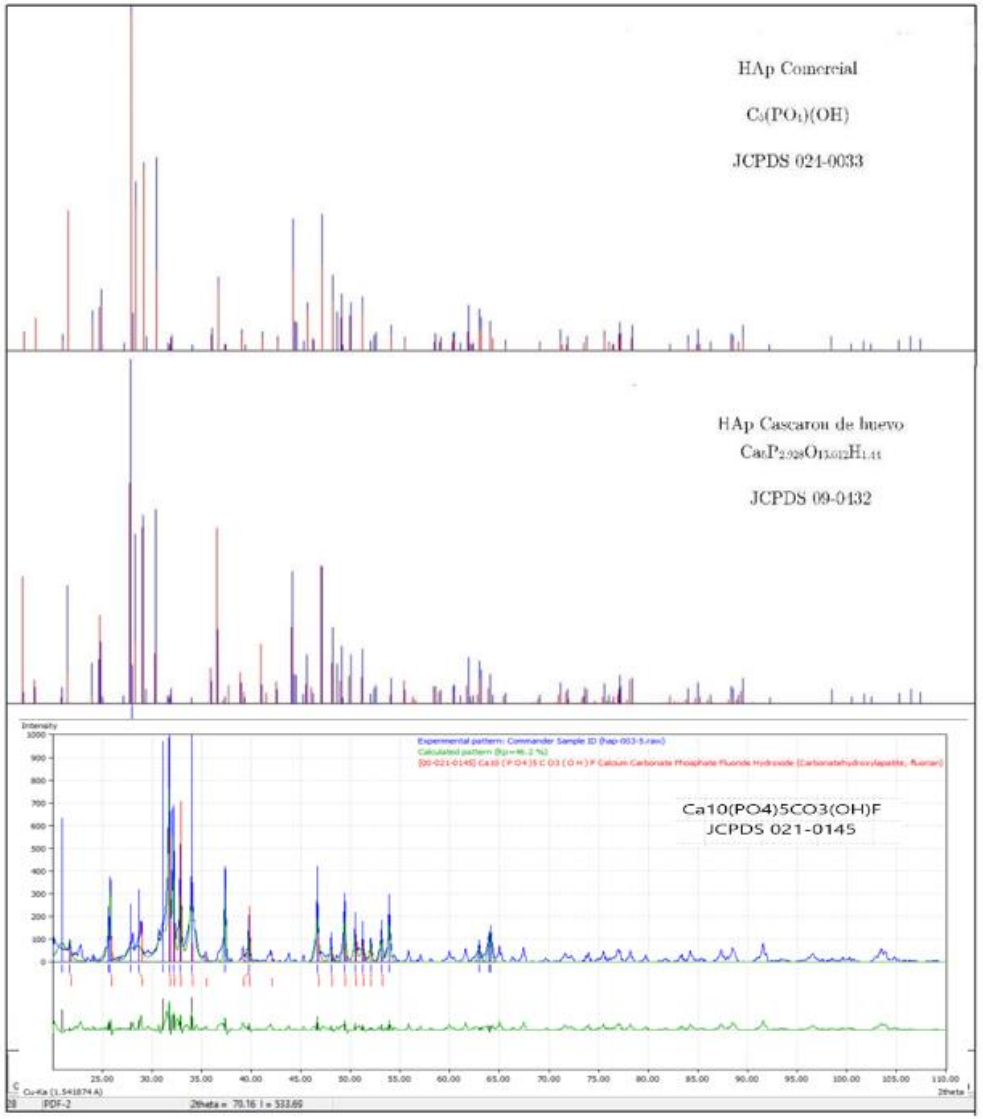




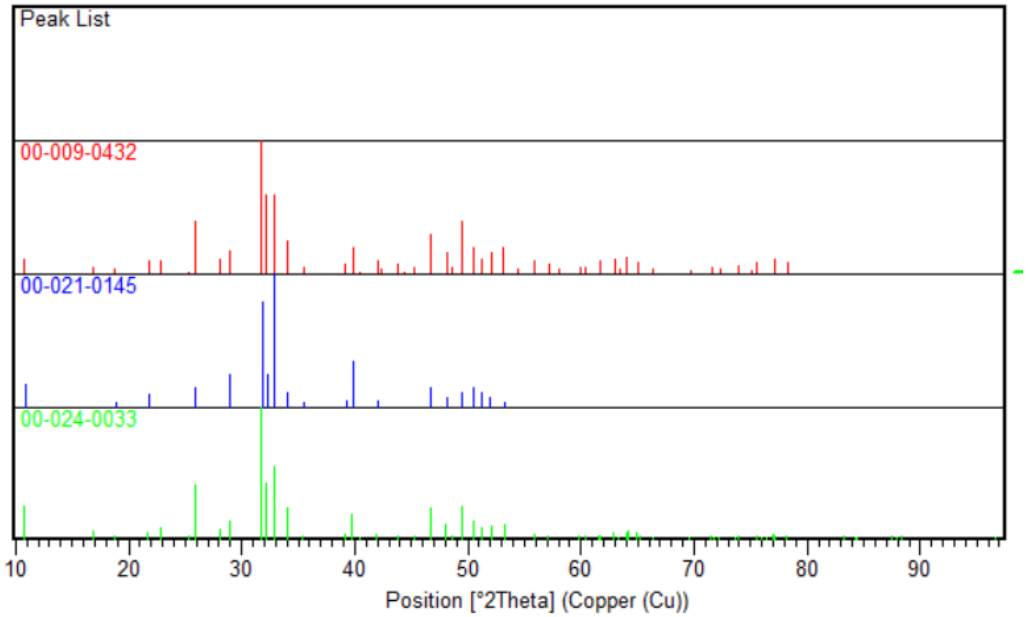


Elemento	Weight %	Atomic%
O K	42.25	52.12
P K	2.02	1.28
Ca K	38.16	18.79

X-ray diffraction spectrum



The synthetic material corresponds to the JCPDS 021-0145 letter belonging to HAp.
It presents impurities of $Ca_3(PO_4)_2$ and $CaCO_3$.
The synthetic material is similar to that obtained from eggshells.



Annexes

It is of medical interest to anchor synthetic HAp with human teeth, bones and tissues, due to its high biocompatibility for the development of prostheses/grafts.

Methodology is being explored to determine the level of anchorage, hardness and durability of the material obtained.Preliminary tests were made based on research such as Shiza's[1] , depositing a layer of HAp in an aqueous medium for a period of 20 days, which creates a hard surface of calcium phosphates on the tooth surface.

[1.]Yezdani, S., Kothari, T., Kumar, P. S., Vidhya, S., Jayasree, R., & Mahalaxmi, S. (2023). Effect of commercial desensitizing agents and eggshell derived nano-hydroxyapatite on bond strength of a universal adhesive to dentin. *Surfaces and Interfaces*, *42*. https://doi.org/10.1016/J.SURFIN.2023.103341

Conclusiones

- It is possible to obtain hydroxyapatite using the effective grinding method, using a planetary mill to improve the optimization of particle size and morphology of the material.

- A calcium phosphate layer was formed on the remineralized tooth surface, which demonstrates an adhesion of the natural PAH powder to the dentin of the tooth.

- The obtained hydroxyapatite agglomerate shows that it was indeed possible to obtain this material synthesized through eggshell according to JCPDS chart 021-0145 which shows a hydroxyapatite phase corresponding to the Ca10(PO4)5CO3(OH)F phase, which is similar to the commercial product according to chart 024-033.

- In this research work, a synthesis method is proposed that reduces the time required to obtain it in

- Reduces the time required to obtain it by approximately 50%.

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