

**THESIS**

**EFFECT OF CALCINATION AND SINTERING  
TEMPERATURES ON THE STRUCTURAL AND  
MECHANICAL PROPERTIES OF PVA-  
HYDROXYAPATITE BIOCERAMICS DERIVED  
FROM DUCK AND CHICKEN EGGSHELLS**



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SURABAYA  
2026**

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**THESIS**

**Submitted to Partially Fulfill the Requirements  
In Obtaining a Bachelor of Science (S.Si) Degree  
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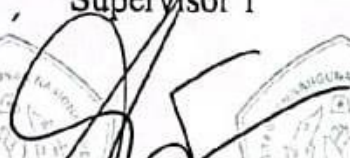
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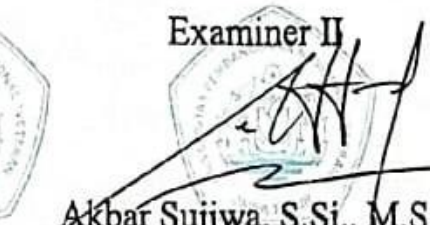
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## ABSTRACT

This study aims to investigate the effect of calcination and sintering temperatures on the structural and mechanical properties of PVA-Hydroxyapatite (HAp) bioceramics derived from chicken and duck eggshells. To improve its physical performance and broaden its applications, HAp can be combined with PolyVinyl Alcohol (PVA) as a polymer matrix. The HAp was synthesized using the wet chemical precipitation method followed by calcination and sintering processes at temperatures of 800°C, 900°C, and 1000°C. Characterization was carried out using XRD, FTIR, SEM and hardness testing using Shore A durometer. The results showed that hydroxyapatite was successfully synthesized from both chicken and duck eggshells, as confirmed by the characteristic XRD peaks and the presence of phosphate ( $\text{PO}_4^{3-}$ ) and hydroxyl ( $\text{OH}^-$ ) functional groups identified through FTIR analysis. Increasing calcination and sintering temperatures significantly improved crystallinity, phase purity, and particle homogeneity. At 800°C, a secondary whitlockite phase was still observed, whereas at 900°C and 1000°C, single phase hydroxyapatite 100% purity was successfully formed. SEM analysis revealed a denser particle distribution at higher temperatures, with particle sizes ranging from 0-500 nm and an average particle size of approximately 254.619 nm. Mechanical testing showed that the chicken eggshell sample treated at 1000-800°C exhibited the highest hardness value of 4.715 MPa, while the duck eggshell sample treated at 900-1000°C exhibited the lowest hardness value of 3.095 MPa. The porosity observed in the bioceramic structure also influenced the resulting mechanical strength. Overall, this study demonstrates that hydroxyapatite derived from chicken and duck eggshell waste combined with PVA has promising potential for biomaterial applications.

**Keywords:** Hydroxyapatite, eggshell waste, PVA, bioceramics, calcination temperature, sintering temperature, biomaterials.

## FOREWORD

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