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THE EFFECT OF TEMPERATURE ON THE HYDROTHERMAL SYNTHESIS OF CARBONATED APATITE FROM CALCIUM CARBONATE OBTAINED FROM GREEN MUSSELS SHELLS

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ABSTRACT

Hydroxyapatite (HAp) refers to a bioceramic broadly employed in bone tissue engineering since it has bioactive and osteoconductive properties. The synthesis of HAp will be more economically viable using waste materials because it is cheap, easy to find, and available in large quantities. Therefore, this study aimed to synthesize and characterize HAp from green mussel shells by hydrothermal method at various temperatures. Precipitated calcium carbonate (PCC), made from green mussel shell powder, is employed in this study. Utilizing a hydrothermal reactor for 14 hours at 120℃, 140℃, as well as 160℃, a combination of PCC and $(NH_4)_2HPO_4$ with a Ca/P molar ratio of 1.67 was synthesized to form HAp. Note that the synthesis findings were categorized using scanning electron microscopy (SEM), Fourier transforms infrared spectroscopy (FTIR), as well as X-ray diffraction (XRD) tests. Apart from that, the FTIR test showed the formation of HAp in all test variations because the results of –OH, and $–PO_4$ were found. XRD results that have been analyzed using HighScore Plus software show the percentage of weight (%) and crystal size of HAp increases with increasing hydrothermal temperature. Other than that, HAp produced at hydrothermal temperature variations of 160℃ has a hexagonal crystal system with a percentage of weight (%) as well as a crystal size of 46.43 nm and 99.3%, whilst the amount of impurity (%) produced is 0.7%. The higher the hydrothermal temperature, the weight percentage (%), and the crystallite size in HAp are getting bigger while the number of impurities gets smaller.

Keywords: precipitated calcium carbonate (PCC), green mussel shells, hydrothermal, hydroxyapatite.

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INTRODUCTION

Food waste, such as egg shells, bones, and seafood shells, is generally disposed of in landfills. Improper management of food waste will have several negative environmental consequences, such as the emergence of pathogens, the emission of strong odors, and environmental pollution. Motivated by environmental and economic concerns, a significant amount of research effort has been directed into the proper management and recycling of these by-products to reduce waste output. In many circumstances, these by-products can be used as a potential precursor to being turned into value-added goods, such as calcium phosphate materials [1], [2]. Hydroxyapatite (HAp) is a member of the calcium phosphate family [1]. Hydroxyapatite (HAp) refers to one of the biomaterials employed as biomedical materials, for instance, drug delivery systems, bone tissue repair, bioactive implant coatings, as well as bone fillers [3]. It happens because HAp is known to have good biocompatibility, bioactivity, and osteoconductivity. Furthermore, HAp can accelerate the healing of damaged bone tissue because it is easily accepted in bone tissue (immunogenic), is non-toxic, non-inflammatory, and has a chemical content similar to human bone [4].

Green mussel is a marine species that the majority of Indonesians consume. In many Indonesian coastal regions, the cultivation of green mussels is prevalent. The significant public interest in consuming mussels makes them a marketable commodity [5]. However, in Indonesia, it is still uncommon to utilize