



**BIBLIOMETRIC ANALYSIS & EXTRACTION OF
HYDROXYAPATITE BY UTILIZING CALCINATION METHOD
FROM FISH BY PRODUCT FOR BIOMEDICAL APPLICATION**



**BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY
(AUTOMOTIVE TECHNOLOGY) WITH HONOURS**

2022



**Faculty of Mechanical and Manufacturing Engineering
Technology**



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Muhammad Sadik Bin Mohamed Salahudin

**Bachelor Of Mechanical Engineering Technology (Automotive Technology) With
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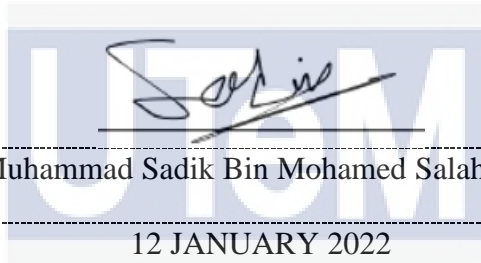
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DECLARATION

I declare that this thesis entitled “ Bibliometric analysis & extraction of hydroxyapatite by utilizing calcination method from fish by product for biomedical application” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree

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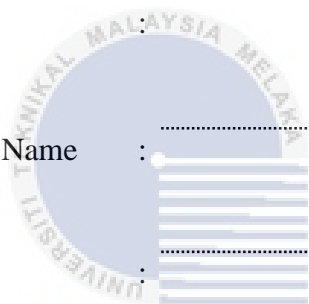
APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (BMMA) with Honours.

Signature

Supervisor Name

Date



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DEDICATION

I dedicate this thesis to my family for nursing me with affections and love and their dedicated partnership for success in my life. They were always there for me when i needed them so this thesis is not possible without you all. Also, not to forget my supervisor who continually guided me altogether in this journey of thesis completion.



ABSTRACT

Hydroxyapatite is generally utilized in tissue recovery and biomedical applications as coatings on metal embeds, bone and nerve tissue graft creation, drug discharge specialists, wound assurance, cell culture substrates, enzymatic immobilization, bone prosthesis or graft coatings, because of their phenomenal biocompatibility, osteoconduction property, and closeness with the inorganic part of bone. This thesis will give a far reaching outline of general properties of hydroxapatite, their biomedical applications, and recommend new viewpoints for future investigations with these biomaterial. Also, the purpose of this study is to analyze the potential of hydroxyapatite retrieved from (sardine longiceps) sardine fish byproducts for biomedical applications using bibliometric studies, to investigate the effect between temperature and extraction time towards hydroxyapatite production and to characterize the hydroxapatite properties using X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS) and Fourier-transform infrared spectroscopy (FTIR).



ABSTRAK

Hidroksiapatit biasanya digunakan dalam pemulihan tisu dan aplikasi bioperubatan sebagai salutan pada benam logam, penciptaan cantuman tisu tulang dan saraf, pakar pelepasan ubat, jaminan luka, substrat kultur sel, immobilisasi enzimatik, prostesis tulang atau salutan cantuman, kerana biokompatibiliti fenomenalnya, osteokonduksi. harta benda, dan kedekatan dengan bahagian tulang yang tidak organik. Tesis ini akan memberikan garis besar yang meluas tentang sifat umum hidroksiapatit, aplikasi bioperubatannya, dan mengesyorkan sudut pandangan baharu untuk penyiasatan masa depan dengan biobahan ini. Selain itu, tujuan kajian ini adalah untuk menganalisis potensi hidroksiapatit yang diperoleh daripada hasil sampingan ikan sardin (*sardine longiceps*) untuk aplikasi bioperubatan menggunakan kajian bibliometrik, untuk menyiasat kesan antara suhu dan masa pengekstrakan terhadap pengeluaran hidroksiapatit dan untuk mencirikan sifat hidroksiapatit menggunakan X -pembelauan sinar (XRD), Mengimbas Elektron Mikroskopi (SEM), spektroskopi penyebaran tenaga (EDS) dan Spektroskopi inframerah transformasi Fourier (FTIR).



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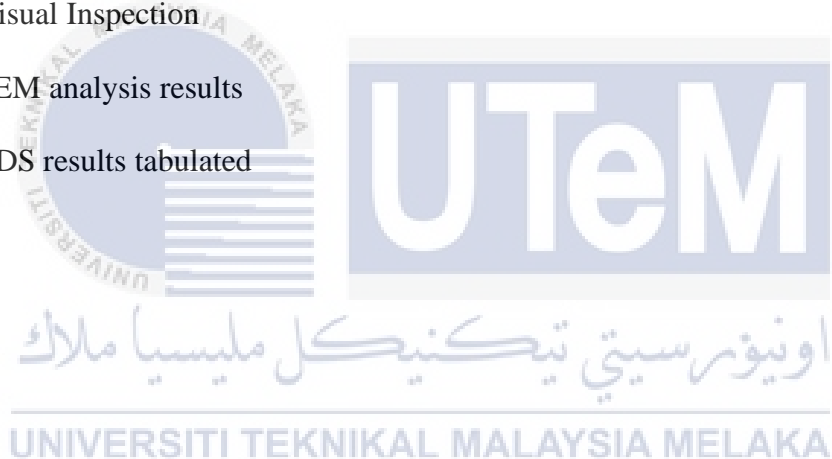


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LIST OF SYMBOLS AND ABBREVIATIONS

°C	-	Degree Celcius
HA	-	Hydroxyapatite
NaOH	-	Sodium Hydroxide
FAO	-	The Food and Agricultural Organization
BSE	-	Bovine spongiform encephalopathy
XRD	-	X-ray diffraction
FTIR	-	Fourier-transform infrared spectroscopy
SEM	-	Scanning Electron Microscopy
EDS	-	Energy dispersive X-ray spectroscopy
SJR	-	SCImago Journal Rank
FWCI	-	Field-Weighted Citation Impact
HCl	-	Hydrochloric acid
KBr	-	Potassium Bromide
Ca/p	-	Stoichiometry Ratio
IR	-	Infrared radiation
Ca ₅ (PO ₄) ₃ (OH)	-	Hydroxyapatite
K	-	Potassium
Mg	-	Magnesium
Zn	-	Zinc
Na	-	Sodium

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CHAPTER 1

INTRODUCTION

1.1 Background

Synthetic or natural hydroxyapatite (HA) has been widely used as an implant material in orthopaedic and dental applications due to its outstanding bioactivity, sufficient mechanical rigidity and structure, osteoconductivity and angiogenic properties, low toxicity, and lack of inflammatory or antigenic reactions. HA is a simple chemical compound that can be produced or taken from natural sources such as bovine bone. The design's high strength and adaptability enable it to be used in a variety of biomedical applications, for example, as a polysaccharide based on the framework definitions and as cationic replacements via metal doping, which may enhance organic properties, for example, working on the activity of battling bacterial contaminations in situ. The current requirement for long-lasting implants and bone substitutes that exhibit biocompatibility, bioactivity, and mechanical properties while avoiding immune rejection represents a significant challenge for scientists. These bone substitute structures should be customised for each patient, with all micrometer-level minutiae regulated. Similarly, nontoxic, biocompatible targeted drug delivery systems that enable precise control over the rate and duration of drug delivery while avoiding toxic and adverse effects on healthy tissues are of great interest. (Szczeń et al., 2017)

Broad endeavors have been made to foster a straightforward, productive, an green technique to shape biofunctional frameworks and embed coatings having the previously mentioned hugebiocompatibility, bioactivity and mechanical strength. Additionally, that could likewise fill in as medication conveyance frameworks. Hydroxyapatite (HA) which is

a significant mineral part of vertebrate bones and teeth is a great material for these reasons. Hydroxyapatite, HA ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$), is thermodynamically steady in its translucent state in body liquid and has a fundamentally the same as structure to bone mineral. HAp can coordinate with bone without creating any nearby or fundamental harmfulness, irritation or unfamiliar body reaction. Natural hydroxyapatite is typically separated from natural sources or squanders like mammalian bone (for example cow-like, camel, and pony), marine or sea-going sources (for example fish bone and fish scale), shell sources (for example cockle, shellfish, eggshell, and shell), and plants and green growth and furthermore from mineral sources (for example limestone)(Mohd Pu'ad et al., 2019). Along these lines, in this study, normal hydroxyapatite will be extricated from fish by-product which will bring down the assembling cost, naturally alright for human, reasonable for likely clinical applications and it will be a good alternative for whoever that applies kosher or halal diet in their lifestyles.

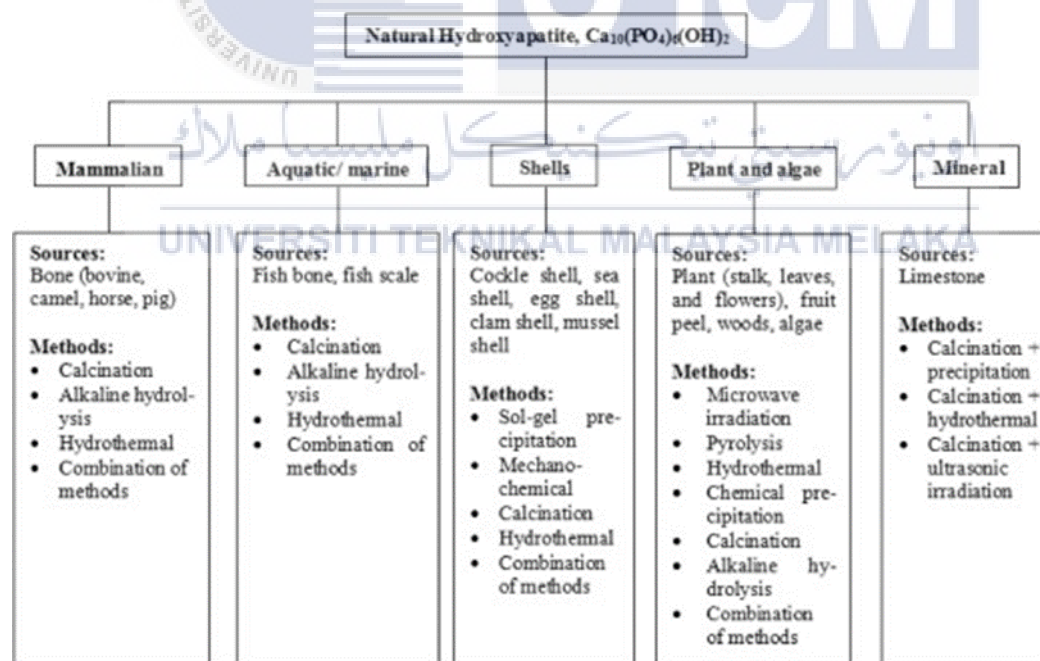


Figure 1.1 The processes for synthesising natural hydroxyapatite (Mohd Pu'ad et al., 2019)

Bone grafting is a surgery that utilizes relocated unresolved issue and remake infected or harmed bones. A bone join is a decision for fixing bones anywhere in your body. Your specialist may take bone from your hips, legs, or ribs to play out the join. In some cases, specialists likewise utilize bone tissue given from corpses to perform bone uniting. The vast majority of your skeleton comprises of bone matrix. This is the hard material that helps give the bones their solidarity. Inside the lattice are living bone cells. These make and keep up with this lattice. The cells in this framework can help fix and recuperate bone when essential. At the point when you break your bone, the recuperating system starts. However as long as the break in your bone isn't too enormous, your bone cells can fix it. Here and there, however, a crack outcomes in a huge deficiency of bone, similar to when an enormous piece of the bone disintegrates away.

Worldwide in excess of 91 million tons of fish and shellfish are gotten every year. The Food and Agricultural Organization (FAO) gauges that scarcely around 50–60% of this catch is been utilized for human consumption, while the rest is viewed as disposed of. Immense measures of results or rest of the natural substances are squandered, producing an unfortunate ecological effect. In spite of the expanding endeavors to get new merchandise from the results, the significant part is as yet utilized for creature dinner creation. To add to lessen the overexploitation just as the unfriendly ecological impacts it would be advisable to focus on the getting of items with high added esteem delivered from the rest-unrefined substance (Boutinguiza et al., 2012). Some fish species are commercialised subsequent to removing the bones like the frozen adrift filets, and the material considered disposed of is to some degree created by bones. Subsequently, an assortment of parameters will be considered in the bibliometrics investigation and study directed as a component of this undertaking to take advantage of the capability of hydroxyapatite extraction from waste fish by-products to satisfy organic exercises for biomedical applications

1.2 Problem Statement

Fast progressions in creature agribusiness and the food business have brought about enormous scope squander creation all through the world. Bones, fish shells, and eggshells, which are unpalatable side-effects of the butchering, cooking, baking, and food handling areas and have no monetary worth, are generally seen as squanders and arranged non landfills without being totally utilized. Ill-advised food squander the board has various negative ecological repercussions, including the spread of unsafe microorganisms, the development of shocking smells, and the capacity to drain synthetics into the climate. Insights show corpses (fish bones) issue an expansion dramatically on the grounds that it is assessed that between 0.97 to 2.7 trillion fish are caught and killed in the wild every year all through the world (Boutinguiza et al., 2012).

Ceramic materials are known for their fragility (absence of capacity to plastically distort). In crack mechanics hypothesis (Griffith's hypothesis) breaks inside clay materials begin from miniature breaks rather than from nuclear bond breaking. Above all, these miniature imperfections are ubiquitous (minuscule defects, including miniature breaks and interior pores, result from the cooling of the soften or during dispersion based cycles) in the body of an earthenware, and after stacking/pushing these microcracks will quite often expand. Also, on account of bioactive ceramics production, regardless of the incredible natural properties, they need slip frameworks in their gems, so at whatever point they are exposed to an outer burden, stress loosening up peculiarities, similar to plastic twisting and grain limit sliding that can happen in metals, don't happen, bringing about helpless burden bearing properties for such bioactive ceramics (Siddiqui et al., 2018).



Figure 1.2 Main features of ceramic materials (Sener, 2012)

It is a well-known fact that different faiths or ethnic groups have varying eating habits or concepts. Additionally, certain foods are restricted by specific faiths. For instance, Islam, Judaism, and Hinduism prohibit their adherents from consuming particular foods or items (Ebrahimi, 2021). All of these religions have their regulations and guidelines for the permissible type of consumed food therefore both Islam and Judaism deny the utilization of hydroxyapatite obtained from bovine, though Hinduism denies the utilization of hydroxyapatite got from cows or cattle. Furthermore, the event of distraught cow infection or bovine spongiform encephalopathy (BSE) occasions, just as nail and mouth illness, are helping the interest for extra hydroxyapatite sources. Thus, the halal issues and religion convictions were likewise the primary element that analyst are searching for different other options.

In any case, hydroxyapatite has a few impediments, like brittleness, low rigidity and break durability. In pragmatic use, If hydroxyapatite is created through coating; be that as it may, its benefits can be appropriately taken advantage of. Coatings made of hydroxyapatite composites, particularly nanocomposite coatings, are employed. Nanophase materials, by

virtue of having a higher concentration of atoms at the surface, a larger surface area, a greater proportion of surface defects (such as edge/corner sites), increased electron delocalization, and a greater number of grain boundaries at the surface, have an advantage over conventional larger grain size materials in a wide variety of biological applications. (Family et al., 2012).

1.3 Research Objective

The objective of this project is:

- To analyse the potential of hydroxyapatite for biomedical applications using bibliometric study.
- To prepare natural hydroxyapatite from fish by-product by using the method of calcination.
- To characterise the hydroxyapatite properties by using XRD, FTIR and SEM morphology analysis.



1.4 Significance of Study

The research is being investigated to obtain a technique that is applicable in order to extract hydroxyapatite from fish by-products. If the investigation is complete and the objective is achieved, it will become a breakthrough to the medical industry as there will be an analysis of how temperature of extraction time affects hydroxyapatite production

1.5 Scope of Research

In order to achieve this objective, the scope of research consists of not so broad items such as first by analyzing the trend and information in articles and citations that are responsible with quantitative features and characteristics of bibliometrics to find the right result for hydroxyapatite and fish by-products and also to investigate all current methods that are present regarding of hydroxyapatite extraction from sardine fish (*sardinella longiceps*) by-products at different time and temperature to complement the conditions and to obtain the cleaned sardine fish bones, it is done by boiling the by-products for 1 hour and washing with water afterwards and then dehydrate the fish bones by drying them in the oven for 24 hours. Calcination method is utilized for the extraction of hydroxyapatite by putting the dried fish bones inside the furnace at temperature 800 °C for 5 hours then finally the outcome will be analysed using several techniques which are Scanning Electron Microscopy (SEM) , Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD) and Energy dispersive X-ray spectroscopy (EDS).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction to Scientometrics Analysis

Since Vassily V. Nalimov authored the term 'scientometrics' during the 1960s, this term has filled in prominence and is utilized to depict the investigation of science: development, construction, interrelationships and profitability. Scientometrics is related to and has overlapping interests with bibliometrics and informetrics (Charles W. Bailey, 2012). The influence of research papers and academic journals is a major area of research, as is the understanding of scientific citations and the application of such measurements in policy and managerial contexts. In practise, scientometrics and other scientific subjects such as information systems, information science, science of science policy, sociology of science, and metascience have a high degree of overlap. Critics have argued that an over-reliance on scientometrics has resulted in an arrangement of irrational motivational forces, creating a distribute or perish climate conducive to low-quality research. Scientometrics is the science of quantifying and analysing science. Eventually, scientometrics is commonly conducted through the use of bibliometrics, which is a technique for estimating the effect of distributions. The majority of contemporary scientometrics is predicated on the work of Derek J. de Solla Price and Eugene Garfield. The latter founded the Institute for Scientific Information which is heavily used for scientometric analysis (Poonkothai, 2012). Methods of research include qualitative, quantitative and computational approaches. Scientometrics (Co-citation analysis) has a couple of various sorts in setting. Perhaps the most noticeable ones is Document Co-citation Analysis (DCA). DCA is the most remarkable in light of the fact that it assists with understanding the connection between various reports, while Author