THE EFFECT OF SOAKING DURATION TO *KAPPAPHYCUS ALVAREZII SP*. SEAWEED POWDER

NUR ATIRAH ASNA BINTI MOHAMAD RAUS
B051710149

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
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THE EFFECT OF SOAKING DURATION TO *KAPPAPHYCUS ALVAREZII SP.* SEAWEED POWDER

Submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Hons.)

by

NUR ATIRAH ASNA BINTI MOHAMAD RAUS

B051710149

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Sesi Pengajian: **2020/2021 Semester 2**

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☑ TIDAK TERHAD

Disahkan oleh:

Alamat Tetap:
No 29 Jalan Bayu 7 Taman Seri Bayu 86200 Simpang Renggam, Kluang, Johor

Tarikh: 15 September 2021

Cop Rasmi: TS. DR. ROSE FARAHIYAN BINTI MUNAWAR
SENIOR LECTURER
FACULTY OF MANUFACTURING ENGINEERING
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Tarikh: 15 September 2021

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I hereby, declared this report entitled “The Effect of Soaking Duration to *Kappaphycus Alvarezii Sp.* Seaweed Powder” is the result of my own research except as cited in references.

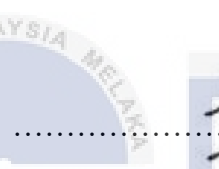
Signature : ……

Author’s Name : NUR ATIRAH ASNA BINTI MOHAMAD RAUS

Date : 15th SEPTEMBER 2021

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for Degree of Manufacturing Engineering (Hons). The member of the supervisory committee is as follow:



……

(Supervisor)

TS. DR. ROSE FARAHIYAN BINTI MUNAWAR
SENIOR LECTURER
FACULTY OF MANUFACTURING ENGINEERING
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

……

(Co-Supervisor)

DR. JEEFFERIE BIN ABD RAZAK
Senior Lecturer
Faculty Of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka

ABSTRAK

Baru baru ini, kesedaran mengenai hubungan antara diet dan kesihatan yang menyebabkan pengambilan rumpai laut semakin mendapat perhatian. Oleh itu, perkembangan serbuk rumpai laut perlu ditingkatkan di atas permintaan yang tinggi dan untuk pemasaran serbuk rumpai laut yang lebih maju. Tujuan kajian ini adalah untuk menyiasat kesan jangka masa rendaman kepada *Kappaphycus Alvarezii sp.* dalam penghasilan serbuk rumpai laut melalui kaedah rawatan rendaman. Dalam penghasilan serbuk rumpai laut, signifikasi parameter jangka masa rendaman telah dijalankan pada rumpai laut. Berdasarkan kajian terdahulu, terdapat hanya sedikit kajian berkenaan kesan jangka masa rendaman kepada penghasilan serbuk rumpai laut. Oleh itu, kesan jangka masa rendaman dikaji untuk mendapatkan jangka masa rendaman yang optimum dan menganalisis kandungan logam berat di dalam rumpai laut serta jumlah kandungan kelembapan rumpai laut yang boleh menjamin kualiti rumpai laut yang tinggi seterusnya meningkatkan jangka hayat serbuk rumpai laut. Tempoh rendaman didapati optimum pada 2 jam rendaman kerana rumpai laut menunjukkan pengembangan dan tekstur yang diinginkan. Kandungan logam berat Arsenik (As), Kadmium (Cd) dan Plumbum (Pb) dipostulat dalam pengurangan kandungan logam berat pada jangka masa rendaman yang optimum iaitu selama 2 jam berdasarkan trend grafik melalui tinjauan kritikal. Pada jangka masa rendaman yang dioptimumkan selama 2 jam juga memperoleh kandungan kelembapan yang memenuhi kehendak iaitu pada 14.67%. Imbasan Elektron Mikroskopi (SEM) analisis dijalankan untuk mengkaji struktur morfologi kesan jangka masa rendaman pada masa yang berbeza terhadap rumpai laut. Pada rendaman optimum 2 jam, struktur morfologi menunjukkan tekstur lebih halus dan berkembang sejajar dengan peningkatan kandungan lembapan serta permukaan rumpai laut yang lebih bersih kerana benda asing telah disingkirkan Oleh itu, ketersediaan rumpai laut boleh menjadi sumber bahan mentah dalam pengeluaran serbuk rumpai laut yang menyumbang kepada sektor industri, terutama dalam makanan dan produk farmaseutikal dengan cara yang lestari.

ABSTRACT

Recently, people have become more conscious of the relation between diet and health, leading to increasing attention on the consumption of seaweeds. Therefore, the development of seaweed powder needs to be enhanced due to high demand and for advanced marketing of seaweed powder. The purpose of this study is to investigate the effect of soaking duration on *Kappaphycus Alvarezii sp.* seaweed powder during soaking treatment. In order to produce seaweed powder, significant soaking durations have been carried out on the seaweed. Based on the previous study, there has only little study on how soaking duration affects the production of seaweed powder. Hence, the effect of soaking duration was studied to analyse the toxicity of heavy metal content inside seaweed and the amount of moisture content of seaweed to guarantee a high seaweed quality and increase the shelf life of seaweed powder. The optimum soaking duration was observed to be 2 hours of soaking, at which seaweed exhibits desirable expansion and texture. The heavy metal contents of Arsenic (As), Cadmium (Cd) and Lead (Pb) were postulated to be reduced at the optimized soaking duration of 2 hours, based on critical review of the graph trend. The optimized soaking duration of 2 hours also showed an acceptable moisture content of 14.67%. Next, surface morphology structure was observed by carrying out Scanning Electron Microscopy (SEM) analysis to study the effect of various soaking duration towards seaweed. At optimum soaking of 2 hours, the surface morphology indicated smooth texture and obtained desired expansion corresponding to the increased moisture content and the surface was cleaner after soaking treatment as all the impurities had been removed thoroughly. Thus, the abundantly available seaweed can provide as a source of raw materials in the production of seaweed powder which will contribute to the industrial sector, especially in food and pharmaceutical productions that favour sustainability.

DEDICATION

Only

my appreciated mother, Romsiah Binti Abdullah

my adored sister and brothers, Amirul, Syafina and Nazrul

To my kindhearted supervisor, Ts. Dr. Rose Farahiyan binti Munawar

To my co-supervisor, Ts. Dr. Jeefferie bin Abd Razak

for giving me moral support, money, cooperation, encouragement and also understandings

Thank You So Much & Love You All Forever

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TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF ABBREVIATIONS

As	-	Arsenic
Cd	-	Cadmium
Pb	-	Lead
H_20_2	-	Hydrogen peroxide
HNO_3	-	Nitric acid
ICP-MS	-	Inductively coupled plasma mass spectrometry
JECFA	-	Joint FAO/WHO Expert Committee on Food Additive
LOD	-	Loss on drying
SEM	-	Scanning Electron Microscopy

LIST OF SYMBOLS

kV	-	Kilovolt
%	-	Percent
℃	-	Degree celcius
g	-	Gram
h	-	Hour
nm	-	Nanometre
$mgkg^{-1}$	-	Milligrams Per Kilogram
ml	-	Millilitre
µm	-	Micrometre

CHAPTER 1
INTRODUCTION

This chapter explains the background of the study, problem statement, objectives, research scopes, and the significance of this research. As requested by the respective industry (Saanen Sdn. Bhd.), the *Kappaphycus Alvarezii sp.* seaweed name applied throughout the study representing the investigated seaweed species.

1.1 Research Background

Seaweeds or macroalgae are an economically viable and environmentally important part of marine habitats. Seaweed is the largest producer, a shelter and even necessities for aquatic ecosystems. They create an underwater forest as the significant food source for marine herbivores, offer protection for fish and preserve marine endophytes. Seaweed horizontal distribution is influenced by substratum, tide action, and wave amplitude and their common habitats are sandy and rocky (Zainee *et al*., 2019). Seaweed populations where most common habitats are sandy and rocky. The distribution of seaweed was studied in an area of 500 m^2 from lower intertidal levels to high intertidal regions (Babitha and Subramaniam, 2016). Moreover, macroalgae are generally classified and come in a multitude of varieties. Those three main divisions are Chlorophyta, Phaeophyta, and Rhodophyta, based on their pigmentation (Syeda Fatima Manzelat *et al*., 2018).

Over the past few years ago, tropical algae are currently attracting attention in biodiversity studies. Presently, seaweeds have drawn critical worldwide attention because of their possible use include anti-biofilm activity, biofuels, bioremediation, fertilizer, as fish feed, as food or food ingredients, in pharmacology in cosmeceutical formulation, and in such other applications as filters or for obtaining minerals (Gomez Zavaglia *et al*., 2019).

Furthermore, aquaculture cultivation with the balance produced through natural harvesting provides 96% of world seaweed production for human use and various applications. On a fresh weight, its annual basis is ca.24.9 million tons (Radulovich *et al*., 2015).

Kappaphycus Alvarezii sp. are among the largest tropical red algae, with a high growth rate (double in biomass in 15 to 30 days) (Bhuyar *et al*., 2020). Cultivation of *Kappaphycus Alvarezii sp*. has recently been found in Semporna, Sabah (Ilias *et a*l., 2017). *Kappaphycus Alvarezii sp.* are stiff, fleshy, solid, and coarse thalli with 1–2 cm diameter axes and branches that grow up to 2 m tall. It may be discovered as a flat reef 1 to 17 m deep underwater or close or unattached to fractured coral (Bhuyar *et al*., 2020). *Kappaphycus Alvarezii sp.* has the highest growth rate among other *Kappaphycus* seaweeds made it favorable for food and pharmaceutical applications (Kumar *et al*., 2015). *Kappaphycus Alvarezii sp.* is a kappa carrageenan source, a phyllocoloid generally used to stabilize and thicken in food, cosmetics, and pharmaceutical industries (Mohammad *et al*. 2019). Seaweed is stuffed with vitamins and protein and also various nutritious content. The characteristics of seaweed dietary fiber are related to its physicochemical properties made it essential to improve functional properties in food and beverages. However, this seaweed is being revalued in recent years and gradually introduced into the diet, especially for vegans and vegetarians (Penalver *et al*., 2020).

Soaking is the treatment when solid food is softened by submerging it for hours in liquid, usually water. Soaking is suitable for improving the nutritional content of the soaked food and its taste. Nonetheless, foods are often soaked to transform them into a mild shape that helps to mix seamlessly. The shortage of quantity of soaking water can contribute to a rough texture and stiff structure. However, this method is held responsible for removing a certain percentage of vital nutrients into the water. Soaking should be in proper condition because leaching of material depends on the soaking conditions, particularly on time of soaking (Siah *et al*., 2014).

Hence, this current work aims to prepare the Kappaphycus Alvarezii sp. seaweed powder by utilizing the soaking process on the raw material. The proper soaking process conditions are subjected to soaking durations with varied parameters. This is due to limited previous studies on how the soaking process would affect seaweed powder characteristics.

The effect of the soaking process is further analyzed on the seaweed in terms of heavy metal content and moisture content. Scanning Electron Microscopy (SEM) is used to characterize the morphological and structural of seaweed. Therefore, proper soaking conditions can be determined as to produce a good seaweed powder by evaluating the characteristics and structures obtained through different soaking conditions.

1.2 Problem Statement

This study points up the preparation and characterization of seaweed powder, significantly, *Kappaphycus Alverazii sp* seaweed via the soaking process. In order to convert the seaweed into powder, the seaweed must undergo several processes. Several procedures need to be conducted and start with soaking, cutting, drying and grinding. However, the soaking process is highlighted in this study. The soaking treatment is one of the methods used to improve the nutrition value of raw materials in the manufacturing of food products besides being an additional advantage towards saving energy cost and cost-effectiveness in industries. This study can help expand some good advantages of macroalgae that focus on the health benefits of seaweed and its use in various end-use industries. Furthermore, the seaweed market in world production is getting high demand from 2011 to 2015 (Ferdouse *et al.*, 2018).

However, mostly algae have absorption capability and become a great concern. They can accumulate heavy metals and are widely recognized in oil-related pollution caused by ship leakage and waste generated by local shore facilities (Tornero and Hanke, 2016). Furthermore, biosorption has developed as a viable alternative to traditional methods for removing heavy metal ions from effluents produced by various industries, which eventually reach and contaminate freshwater bodies (Kanamarlapudi *et al.*, 2018). Heavy metals are pertaining to any metal that features a comparatively high density, toxic, poisonous at low concentrations. Besides, the moisture content of the food material is vital to consider the food is suitable before consumption. Moisture content relates to the freshness and stability for storing the food for a long period and determines the actual quality of the food before consumption.

Moreover, to date, the limitation of current studies has only been considered on the soaking concentration and soaking temperature, however, its characterization with the effect of soaking duration on the seaweed needs to be exploited. To provide a vast potential market of seaweed as the main source of raw materials globally and the industrial sector, it needs to upgrade seaweed powder production through soaking treatment on seaweed. Hence, to overcome the limitations, optimization of the seaweed powder processing will be applied throughout this study. However, due to the restriction of the COVID pandemic, the heavy metal analysis study conducted via postulating the critical review analysis while moisture content and SEM analysis by experimental study. Scanning Electron Microscopy (SEM) analysis enables the characterization of material structures of the seaweed due to different parameters during the soaking process. Figure 1.1 shows a summary of the problem statement and research gap of seaweed powder.

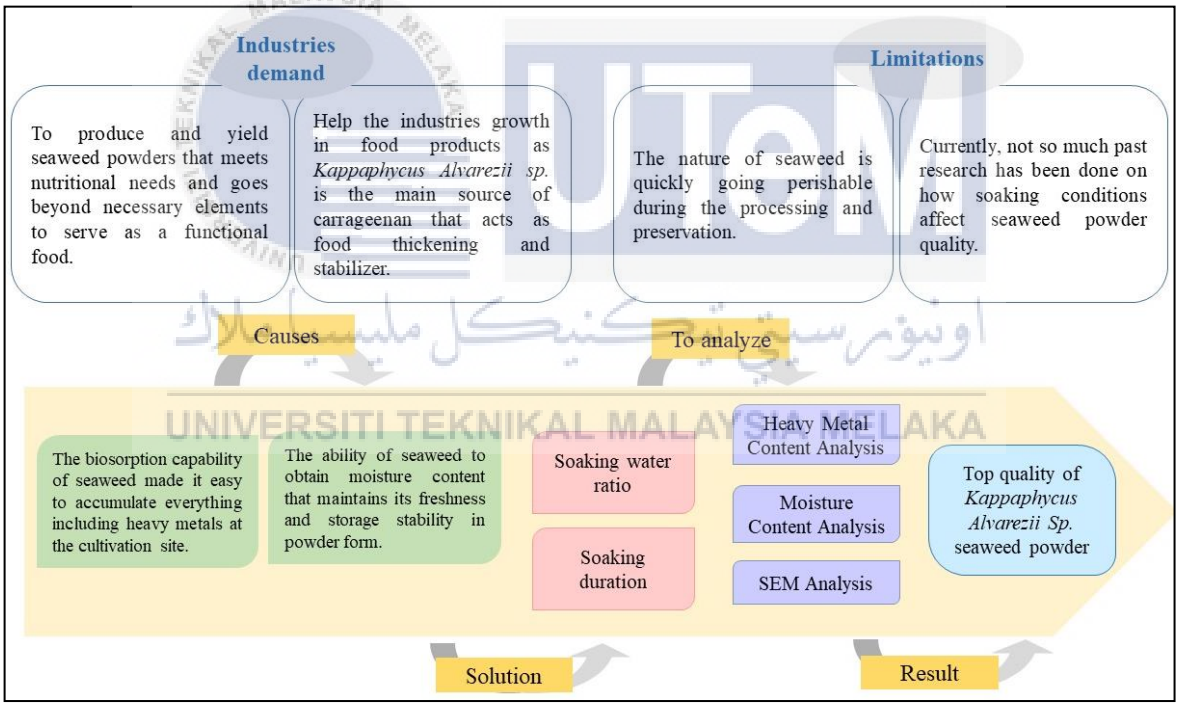

Figure 1.1: The overview of problem statement and research gap.

1.3 Objectives

The objectives are as follows:

i. To prepare *Kappaphycus Alvarezii sp.* seaweed powder with a proper soaking condition particularly soaking durations.

ii. To study the effect of soaking treatment towards heavy metal content and moisture content of *Kappaphycus Alvarezii sp.* seaweed.

iii. To characterize seaweed structure via Scanning Electron Microscopy (SEM) analysis.

1.4 Research Scopes

The study mainly focuses on soaking treatment on seaweed on how soaking duration effects the heavy metal content, moisture content and to investigate the characterization of the selected algae, *Kappaphycus Alverazii sp.* This study performs in accordance with several scopes. For the seaweed powder preparation, the soaking treatment was carried out on dried seaweed while at the same time it helps in removing impurities. The dried seaweed usually contains foreign matters and needs to sort out manually with naked eyes before the soaking process.

The focused objective of this study is to investigate the effect of soaking durations towards *Kappaphycus Alvarezii sp.* seaweed powder. The soaking process is chosen because it is environmentally friendly and does not require an organic solvent, which is very cost-effective. Before industrial processing proceeds, the seaweed must be softened by soaking due to its rough, rugged and dry texture. However, the predetermined soaking water ratio is 1 part of dried seaweed to 10 parts of distilled water (1:10). The optimized parameter in this study is soaking duration. Soaking with varied parameters of duration is used in this study.

Then, the heavy metals analysis and moisture content analysis are studied, as mention in the second objective. Heavy metals analysis has been postulated and supported via critical review analysis based on previous research. Heavy metals testing detects metals that are harmful in both small and large amounts, such as lead, mercury, arsenic, and cadmium inside seaweed. This is important towards presented *Kappaphycus Alvarezii* are safe as seaweed consumption is growing steadily in human dietary fiber intake. The purpose of analyzing the moisture content of seaweed is to measure the amount of water content of seaweed after going through a varied duration of soaking treatment. Moisture content is vital towards product shelf life, freshness, quality, and resistance to bacterial contamination. As to reach the third objective of this study, the characterization methods were using Scanning Electron Microscopy (SEM) of seaweed. Scanning Electron Microscopy (SEM) analysis was performed to study the surface morphology and structure of *Kappaphycus Alvarezii sp.* seaweed after the soaking process at different durations. The mapping matrix of the objectives and scopes describes as in Figure 1.2.

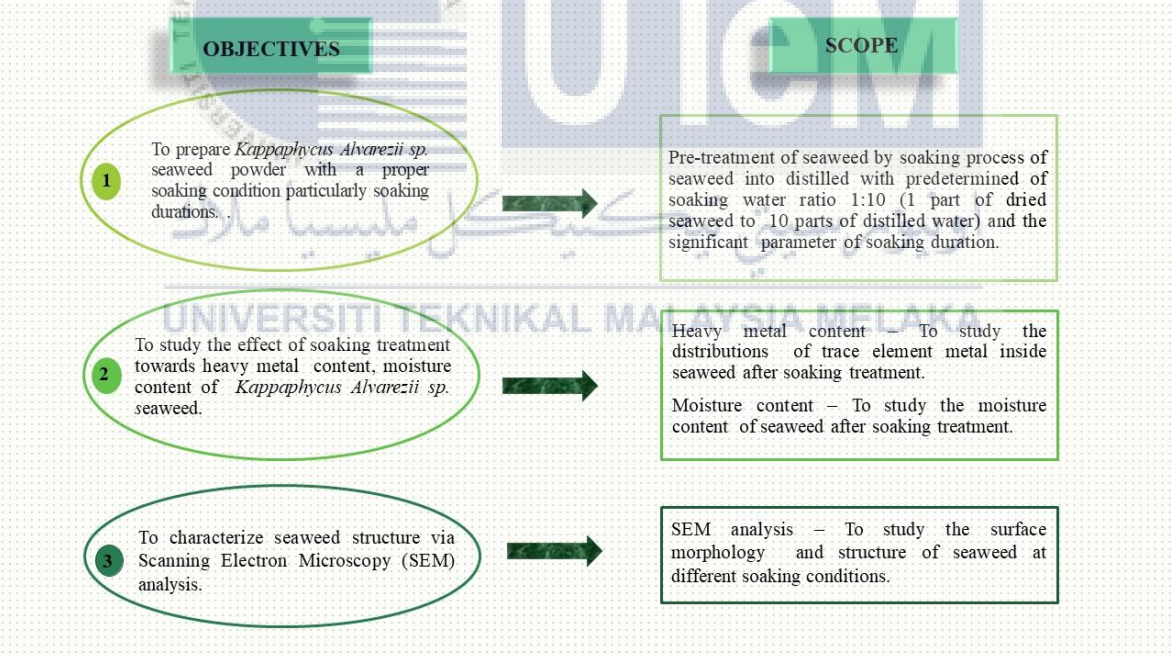

Figure 1.2: The mapping matrix of the objectives and scopes

1.5 Significant of Research

Marine life has independent of the mind of marine algae. Polysaccharides, proteins containing all necessary amino acids, polyunsaturated fatty acids, vitamins and minerals are rich in seaweeds (Wells *et al.*, 2017). Seaweed is a very multifunctional product generally used in the food indirect human consumption. In addition, the potential for seaweed development continues to grow for numerous applications. It is imperative to investigate the effective method for developing seaweed powder under proper soaking durations. In addition, a study on the processing of seaweed powder is conducted out and in order to optimized conditions to produce seaweed powder.

Thus far, a few detailed studies have been carried out on the effect of the seaweed soaking process as a raw material in the production of seaweed powder.*Kappaphycus Alvarezii,* the algae species, has various advantages and has been an attraction from the researcher. Aside from benefits to the food industry, nanocellulose extracted from seaweed is generally used as a reinforcing material for polymer composite due to good increasing abilities. Besides, a foliar spray made from seaweed extract is applied to green and fleshy vegetables, fruits, orchards, and horticultural plants to promote quicker development and production.

Today, besides the source of nutrients, seaweed is also present to treat several diseases related to bacterial infection, cancer, tumor, allergy, aging and inflammation. On the other hand, green material as the raw material is also a concentrate. Instead of other chemical sources, it provides an alternative raw material, which gives sustainable powder production. Thus, seaweed production uses mineral wealth as raw materials in the production of seaweed powder, which has a low impact on human well-being and the surroundings. It is more beneficial to optimize the analysis of natural materials for current and future applications.