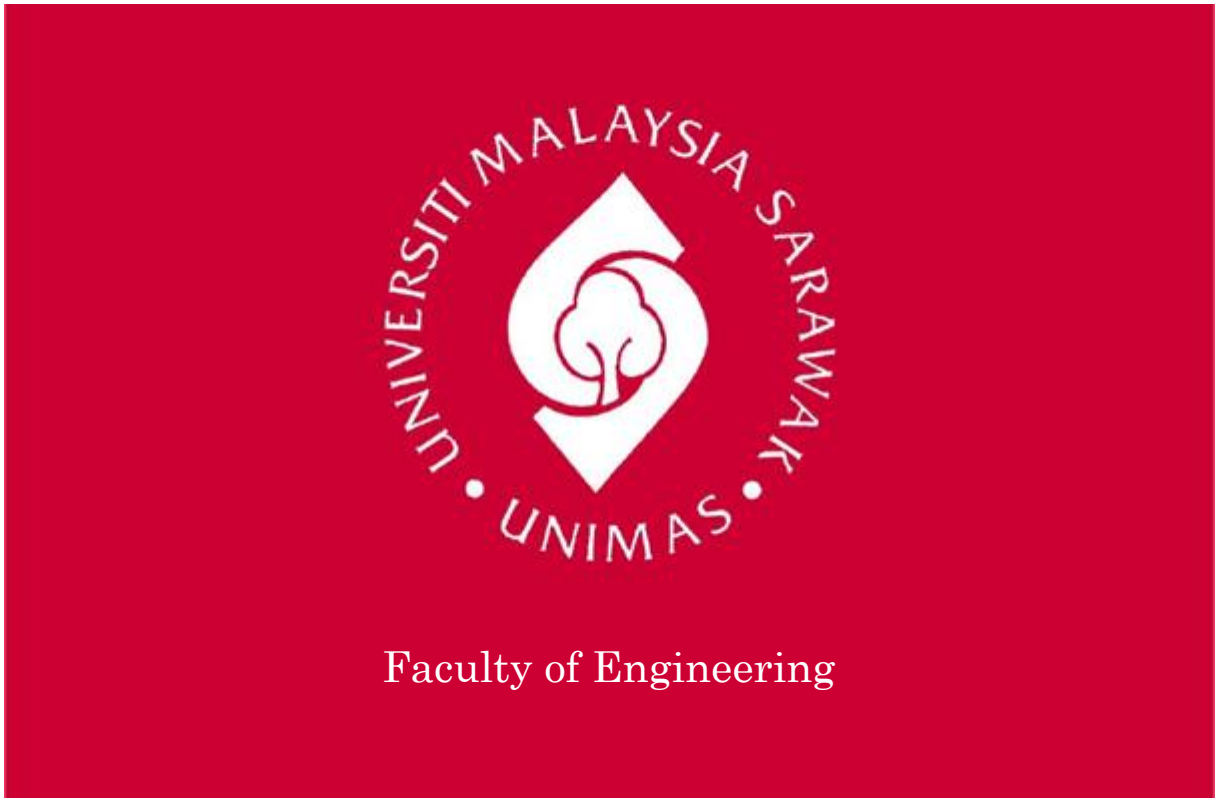

THE ANALYSIS OF MOTOR PERFORMANCE FOR PITTING *DABAI* FRUIT (*CANARIUM ODONTOPHYLLUM*)

Muhammad Na'im bin Suhaili

Bachelor of Engineering

Electrical and Electronics Engineering with Honours

2023

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

Please tick (√)

Final Year Project Report	√
Masters	☐
PhD	☐

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22th August 2023 **Muhammad Na'im bin Suhaili (72433)**
(Date submitted)

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THE ANALYSIS OF MOTOR PERFORMANCE FOR PITTING DABAI FRUIT *(CANARIUM ODONTOPHYLLUM)*

MUHAMMAD NA'IM BIN SUHAILI

A dissertation submitted in partial fulfilment

of the requirement for the degree of

Bachelor of Engineering

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ABSTRACT

Dabai fruit, known for its unique flavour, has gained popularity among food enthusiasts and those interested in Sarawak cuisine. However, the lack of an available *dabai* fruit pitting machine poses challenges for efficient processing. This study aims to investigate the performance of motors using MATLAB to construct an effective pitting system for *dabai* fruit. The project objectives involve three key aspects: conducting requirement design for *dabai* pitting, analysing motor sizing parameters (such as power, torque, and speed) using MATLAB, and creating a conceptual framework for the *dabai* pitting fruit system. The absence of a dedicated *dabai* fruit pitting machine hinders the efficient processing of this delicacy. To address this issue, the study focuses on three main objectives. Firstly, a survey or questionnaire is undertaken to gather important criteria and specifications for the *dabai* fruit pitter machine, offering a comprehensive understanding of the operating needs and issues faced by the industry. Secondly, simulation techniques in MATLAB analyse and compare the efficiency of different motor types to discover the most suitable alternative for the *dabai* pitting system, enabling exact analysis and accurate predictions of motor performance. Additionally, the study involves the design process utilizing SOLIDWORKS software to construct a conceptual model of the *dabai* pitting machine, promoting comprehension and assisting in identifying potential design enhancements or modifications. The conclusions provide significant insights into the specific needs for an effective *dabai* pitting machine and offer a complete analysis of motor performance using MATLAB. The conceptual design acts as a practical depiction of the proposed system, giving a tangible foundation for subsequent development and execution, contributing to the progress of the *dabai* fruit processing sector by streamlining the pitting process and enabling improved motor selection to enhance productivity and efficiency.

Keywords: Conceptual framework, *dabai* fruit, efficiency, MATLAB, motor performance, motor sizing parameters, pitting system, requirement design, simulation, SOLIDWORKS, survey, questionnaire.

ABSTRAK

Buah *dabai* terkenal dengan rasa uniknya telah mendapat sambutan di kalangan penggemar makanan dan mereka yang berminat dengan masakan Sarawak. Walau bagaimanapun, kekurangan mesin pengasing buah *dabai* yang tersedia menimbulkan cabaran untuk pemprosesan yang cekap. Kajian ini bertujuan untuk menyiasat prestasi motor menggunakan MATLAB untuk membina sistem pengasingan yang berkesan untuk buah *dabai*. Objektif projek melibatkan tiga aspek utama: menjalankan reka bentuk keperluan untuk pitting *dabai*, menganalisis parameter saiz motor (seperti kuasa, tork, dan kelajuan) menggunakan MATLAB, dan mencipta rangka kerja konsep untuk sistem pengasing buah *dabai*. Ketiadaan mesin pengasing buah *dabai* yang berdedikasi menghalang pemprosesan makanan istimewa ini dengan cekap. Bagi menangani isu ini, kajian memfokuskan kepada tiga objektif utama. Pertama, tinjauan atau soal selidik dijalankan untuk mengumpul kriteria dan spesifikasi penting bagi mesin pengasing buah *dabai*, menawarkan pemahaman menyeluruh tentang keperluan operasi dan isu yang dihadapi oleh industri. Kedua, teknik simulasi dalam MATLAB menganalisis dan membandingkan kecekapan jenis motor yang berbeza untuk mencari alternatif yang paling sesuai untuk sistem pengasing *dabai*, membolehkan analisis tepat dan ramalan prestasi motor yang tepat. Selain itu, kajian ini melibatkan proses reka bentuk menggunakan perisian SOLIDWORKS untuk membina model konsep mesin pengasing *dabai*, menggalakkan kefahaman dan membantu dalam mengenal pasti peningkatan atau pengubahsuaian reka bentuk yang berpotensi. Kesimpulan kajian ini memberikan gambaran yang ketara tentang keperluan khusus untuk mesin pengasing *dabai* yang berkesan dan menawarkan analisis lengkap prestasi motor menggunakan MATLAB. Reka bentuk konsep bertindak sebagai gambaran praktikal sistem yang dicadangkan, memberikan asas yang nyata untuk pembangunan dan pelaksanaan seterusnya. Hasil penyelidikan ini menyumbang kepada kemajuan sektor pemprosesan buah *dabai* dengan memperkemas proses pengasingan dan membolehkan pemilihan motor yang lebih baik untuk meningkatkan produktiviti dan kecekapan.

Kata kunci: Kerangka konsep, buah *dabai*, kecekapan, MATLAB, prestasi motor, parameter saiz motor, sistem pitting, reka bentuk keperluan, simulasi, SOLIDWORKS, tinjauan, soal selidik.

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Dabai	—	*Canarium odontophyllum*
FAMA	—	Federal Agricultural Marketing Authority
MARDI	—	Malaysian Agricultural Research and Development Institute

CHAPTER 1

INTRODUCTION

1.1 Background

Dabai (*Canarium odontophyllum*) is a fruiting plant native to Borneo that belongs to the family Burseraceae. *Dabai* fruit is an indigenous seasonal fruit in Sarawak especially Sibu and Kanowit considered a delicacy. The *dabai* fruit, often referred to as the 'wild olive fruit,' is an exceptionally rare and highly treasured fruit indigenous to the Malaysian state of Sarawak, which is situated on the island of Borneo. The fruit is well-known for having a tough, dark shell as well as a tender, white flesh that is rich in oil and has a flavour that is peculiar due to its unique balance of sweet and sour notes. The twisted, tiny trees that are typical of the Sarawakian jungle are the ones that are responsible for the growth of the *dabai* fruit. The indigenous people of Sarawak rely on the *dabai* fruit as a primary source of nutrition. It is included in a wide variety of cuisines, such as salads, curries, and snacks.

Figure 1.1 *Canarium odontophyllum* [1]

Additionally, it is utilised in the production of traditional medicines as well as cosmetics. It is claimed that the *dabai* fruit has a variety of health advantages, including the ability to improve the health of the cardiovascular system and to assist in digestion. The high nutritional value of the *dabai* fruit is one of the primary reasons for its high

value. The *dabai* fruit is not well recognised outside of Sarawak and can be difficult to locate in other regions of the world, despite the fact that it is rather popular there and holds significant cultural meaning. Those who have sampled it attest that it lives up to its reputation as a gourmet treat and places a high value on it. When ripe, the skin and flesh are hard and inedible. Thus, the fruit must be soaked for up to 10 minutes in non-warm water to soften the skin.

Due to its creamy texture and fatty flavour, the flesh tastes similar to avocado. Although edible and rich in oil, the kernel is typically discarded. Locals consume *Dabai* as a snack due to its incredible nutritional value and health benefits. Despite its abundance, the *dabai* fruit's potential has not been exhaustively explored and is regarded as an underappreciated fruit [2]

In addition to this, the shelf life of *dabai* fruit is rather limited. It can only be kept at room temperature for a maximum of three days before the skin begins to wrinkle as a result of the loss of moisture. Because of this quality, the distribution of *dabai* fruit and its sale on the worldwide market are facing increasingly significant challenges. The Malaysian Agricultural Research and Development Institute (MARDI) has developed *dabai* pickles and frozen *dabai* pulp to ensure a continuous supply even during the off seasons in order to accelerate the expansion of the *dabai* market [3]. This is being done in order to accelerate the expansion of the *dabai* market. The manufactured goods enable continuous processing of *dabai* fruit throughout the year, which both increases the fruit's exploration potential and allows for more consistency.

Figure 1.2 *Dabai* Fruit [2]

It is a seasonal fruit that can only be harvested between July and August and November and December, depending on the local climate. The plant can be cultivated from seeds on the Southeast Asian Island of Borneo [2].

There are around one hundred distinct species of Canarium L., all of which may be found in the tropical forests of Africa, Asia, and Australia. The *Canarium odontophyllum* plant can only be found in the tropical forests of Sumatra (which is part of Indonesia), Borneo (which is part of Indonesia and Malaysia), and the Philippines, more especially Mindanao and Luzon. According to Leenhouts et al.[2], out of the 52 species that have been identified as belonging to the genus Canarium L., eight of them can be found on the Malay Peninsula, while fourteen of them can be found in Borneo. The names of species, such Canarium perlisanum and Canarium sumatranum, are typically taken from the locations where the species was first discovered [2]. In some circumstances, the plant is also considered to be indigenous to a number of other places.

Up to ten kilos of *dabai* can be harvested from a young tree, while a mature tree that is at least ten years old can produce anywhere from eighty to one hundred kilogrammes. As a consequence of this, it was projected that the yearly production would be somewhere between 200,000 and 500,000 kg. The tree has an expected lifespan of roughly 40 years and has the potential to grow to a height of between 30 and 40 metres [4].

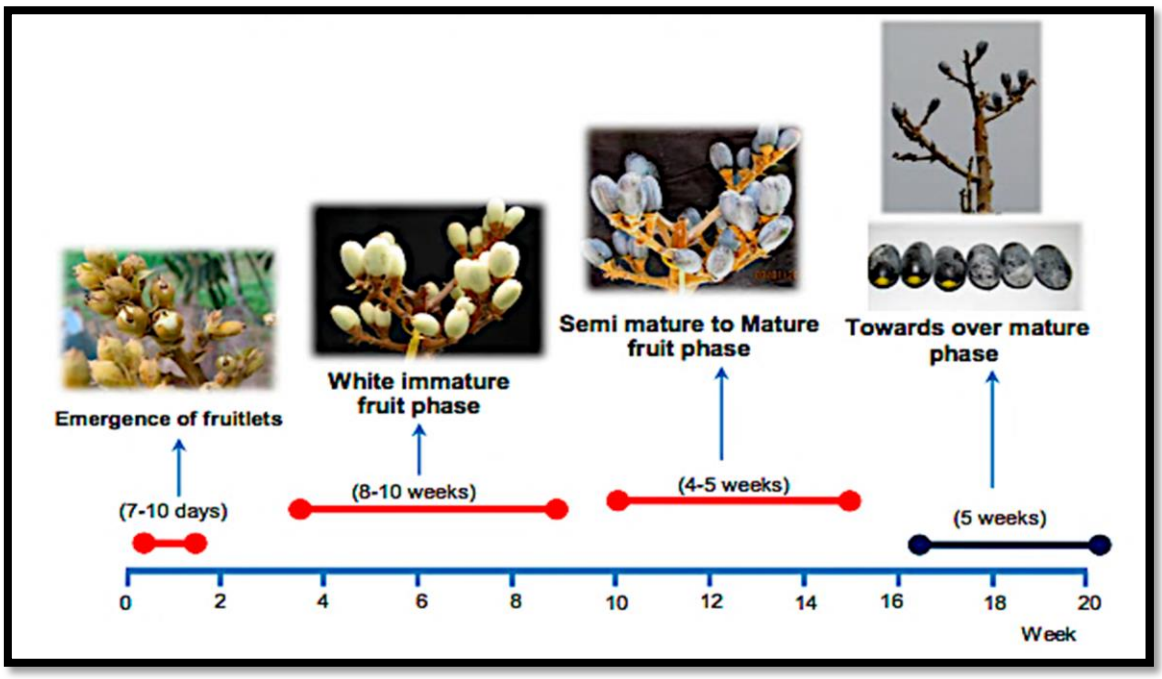

Figure 1.3 Timeline Chart of *Dabai* Maturation Process [2]

The plant will begin to bear fruit after five years, and a fully mature tree may produce up to 800 kg of fruit all at once. Canarium L. species are adaptable, meaning

they may thrive in a wide range of natural soil conditions. The ideal soil for these plants is one that is wet, rich, deep, crumbly, organically sandy loam with a pH range of 4.5 to 6.5. These circumstances allow for optimal plant growth. In addition to this, they are able to survive in alkaline environments with a pH of up to 7.4 and can be confined in wooded settings that have poor drainage.

The *dabai* fruit can take on an oblong shape, have a thin and edible peel, and either white or yellow flesh, however these characteristics vary according on the type. In addition to that, it possesses a flavour that is unique [5]. When the *dabai* fruit has reached its peak of ripeness, the colour of the skin on the fruit is somewhere in between black and blue. The pigment's colour comes from an ingredient known as anthocyanin, which is a cyanine-3-glucoside [6], [7]. The shape of the *dabai* fruit ranges from oval to spheroid, and it can be anywhere from 3.5 to 4.0 centimetres in length and 2.0 to 2.5 centimetres in breadth. Pulp, skin, and kernel make up the three main components of a *dabai* fruit's structure [8]. It's possible for a single *dabai* fruit to weigh as much as 18 grammes. In the past, Prasad et al. [9]observed that it has an oblong shape, that its length ranges between 3 and 4 cm, and that each one weighs between 10 and 13 g. The *dabai* fruits have a texture and look that is comparable to that of olives. When it is unripe, this fruit has a light green colour, but as it approaches maturity, it darkens to a deep purple or almost a black colour. The flesh of this fruit is brilliant yellow, and the seed it produces has three distinct angles. The progression of the *dabai* fruit toward maturity is shown in Figure 1.3, beginning with the formation of fruitlets and continuing all the way until the overripe stage.

1.2 Problem Statement

In the absence of contemporary technology for the *dabai* fruit pitting procedure in the past, extracting the flesh from thirty kilograms of *dabai* fruit would require around eight hours of labour. The traditional method of manually pulping the *dabai* fruit is not only labour-intensive but also time-consuming. The method involves a large amount of labor, with workers needing to focus their concentration and energy on removing the seeds from thirty kilograms of *dabai* fruit. This arduous procedure further necessitates the worker's patience in removing the pits from the *dabai* seeds. Additionally, the

quantity of *dabai* fruit that may be pitted relies on the number of staff or workers available on a given day.

Figure 1.4 Manual Pitting of *Dabai* Fruit [10]

The second problem experienced by the entrepreneur is the time it takes to fulfil the daily target for *dabai* fruit pitting. The difficult operation of physically extracting the seeds from thirty kilograms of *dabai* fruit involves at least eight hours of labor. While hand-pitting *dabai* fruits is a traditional practise, it takes continual attention and concentration from the worker throughout the lengthy eight-hour labor period. This time-intensive method leads to a longer product development cycle for the entrepreneur, hindering their overall productivity and efficiency. On the other hand, adopting machines for pitting can enhance the efficiency and consistency of the process, leading to increased production rates. This innovation permits *dabai* fruit to compete more effectively with similar products in the market. By migrating from manual to machine methods, the production of *dabai* fruit may be greatly enhanced, ensuring larger yields and improved competitiveness in the food business.

To overcome these problems and enhance output, it becomes important for the entrepreneur to add machinery into the process. Implementing proper machinery would assist automate and streamline the *dabai* fruit pitting process, considerably lowering labor requirements and increasing overall production. By tackling these issues through technical developments, the entrepreneur can increase operational efficiency, optimize production, and attain higher daily output levels.

Compared to using machines, traditional methods for pitting *dabai* fruit result in much lower production rates. Manual extraction of the seeds is time-consuming and

involves a lot of labour, which limits the amount of fruit that can be processed within a given timeframe. Additionally, manual pitting often leads to more waste due to potential fruit damage, resulting in decreased yields and overall production capacity.

When manually pitting *dabai* fruit, hygiene is a critical consideration. The manual method includes using a knife or other sharp equipment to extract the seeds, which can be labour-intensive and unclean. This is a risk of spreading germs and contaminants from the fruit to the worker and the surrounding environment. Moreover, there is a danger for unintended injuries from handling sharp equipment during the manual pitting procedure. This risk occurs in any manual procedure. Additionally, manual pitting often leads to significant fruit waste due to probable damage, making it unsuitable for sale. These factors raise the risk of foodborne illnesses and diminish the overall product quality, harming both the food business and consumers.

The lack of an available *dabai* fruit pitter machine presents an opportunity to explore the potential of a specially designed motor for this task. Since there is no existing machine to compare it to, we can evaluate the motor's performance based on industry norms and benchmarks. This gives us more flexibility in the design and testing process, without being constrained by pre-existing limits. Moreover, we can tailor the motor's performance evaluation to consider the unique characteristics of *dabai* fruit, like its size, shape, and texture, ensuring accurate results. However, the absence of a *dabai* fruit pitter machine also poses a challenge. There is no established standard for efficiently pitting the fruit, and building such a machine requires a deep understanding of the fruit's physical qualities. Developing, creating, and testing the machine demands significant time and resources.

Overall, the absence of an existing *dabai* fruit pitter machine presents both opportunities and obstacles. It allows for the development of a motor customised to the individual needs of the fruit, but also requires careful consideration and expenditure to assure its effectiveness.

1.3 Research Objectives

The objectives of this project are as follows:

1. To conduct the requirement design for *dabai* pitting
2. To analyse the selection motor sizing such as power, torque and speed for *dabai* pitting using MATLAB
3. To design the conceptual of *dabai* pitting fruit system

1.4 Project Scope

The goal of this project is to develop an advanced pitting machine specifically designed for processing *dabai* fruit. To achieve this objective, a thorough analysis will be conducted to understand the specific requirements and challenges involved in pitting *dabai* fruit effectively. Utilizing MATLAB, the optimal motor specifications, including power, torque, and speed, will be determined, considering the size, texture, and desired pitting speed of the fruit. Based on these findings, the conceptual design of the pitting machine will be formulated, outlining its structure and operation, incorporating the motor, mechanical components, and control system. In addition, a new pitting algorithm will be synthesized that uses a predictive approach to optimize the pitting process and enhance the machine's efficiency. This algorithm will ensure precise pitting while controlling the output voltage. The next step involves creating a simulation model of the pitting machine using MATLAB/Simulink. The model will be validated, and the machine's performance will be analyzed under various operating conditions. The effectiveness of the predictive pitting algorithm will be assessed and compared with existing techniques to ensure its robustness. By leveraging the capabilities of MATLAB/Simulink, this project aims to design an innovative and efficient pitting machine for *dabai* fruit, resulting in improved overall processing performance and meeting the specific demands of *dabai* fruit pitting. The simulation results will guide the optimization of the machine's design and achieving accurate and reliable pitting results, contributing to the advancement of fruit processing technologies.

1.5 Thesis Outline

This report on the project is divided up into five chapters, and it also includes an appendix that contains different attachments and references. The following is the sequence in which each project section is presented: introduction, literature review, methodology, findings and discussion, and conclusion. The following is a description of the synopsis for each chapter.

The background research for the proposed project is covered in Chapter 1, which is the introduction. This research is related to the general information about the *dabai* fruit, also known by its scientific name, *Canarium odontophyllum*. The problem statement of the problem, the project's objectives, and its scope are all included in this chapter. The evaluations and research done to understand better the planned project are explained in Chapter 2, titled "Literature Review."

Chapter 3 is the proposed methodology and process involved in the project accomplishment. The further simulation used will be discussed in Chapter 3. This chapter also consists of the project flowchart and simulation used throughout the project completion.

Chapter 4 focuses on providing the results of the motor efficiency simulation undertaken in the study. The simulation process, including setup, settings, and motor models, is explained. The efficiency performance of each motor type is studied and compared based on the simulation findings. Visual representations, such as graphs and charts, are offered to aid understanding. The discussion part interprets the findings, considers their ramifications, and acknowledges any limitations. Overall, Chapter 4 presents a complete review of motor efficiency in the study.

Chapter 5 serves as the conclusion of the thesis. It summarizes the important findings from each chapter and their importance in respect to the research objectives. The implications and recommendations based on the findings are explored, along with any limitations or biases observed throughout the study. The chapter comments on the whole research process, discusses the value and practical applicability of the results, and offers areas for further research. Chapter 5 gives a succinct wrap-up of the study, allowing possibility for additional exploration and discussion in the area.