



**POLITEKNIK SULTAN SALAHUDDIN ABDUL  
AZIZ SHAH**

**ECO – FRIENDLY FOOD CARRIER**

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**JABATAN KEJURUTERAAN MEKANIKAL**

**SESI 1 : 2021/2022**

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**Laporan ini dikemukakan kepada Jabatan Kejuruteraan Mekanikal sebagai  
memenuhi sebahagian syarat penganugerahan Diploma Kejuruteraan  
Mekanikal (Pembungkusan)**

**JABATAN KEJURUTERAAN MEKANIKAL**

**SESI 1 : 2021/2022**

## AKUAN KEASLIAN DAN HAK MILIK

### ECO – FRIENDLY FOOD CARRIER

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3. Saya bersetuju melepaskan pemilikan harta intelek ‘Projek tersebut’ kepada ‘Politeknik tersebut’ bagi memenuhi keperluan untuk penganugerahan **Diploma Kejuruteraan Mekanikal (Pembungkusan)** kepada saya.

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## **APPRECIATION**

I am thankful to the divine blessings and blessings on our great master, the Prophet Muhammad SAW, that we were able to complete the final project with excellence within the stipulated period of 6 months without any problems that are difficult to solve as a condition for the award of Diploma in Mechanical Engineering (Packaging) June 2019 session. We would like to express our appreciation to all parties involved directly or indirectly, especially our supervisor Pn. Isnuraini Binti Ismail@Kassim who has given a lot of guidance, advice, encouragement, and criticism that can build our spirit to complete this final project report on time. Not forgetting also to the friends and family members who were very helpful in terms of views, in terms of finances and encouragement in us completing this final project. Finally, we are grateful to Allah SWT so we can complete this final project. We hope that this report can be used as an example and guide to the relevant parties in the future.

## ABSTRACT

Eco-friendly food carrier is a form of environmentally friendly packaging that often made of recycled or renewable materials that's safe and sustainable for both individuals and the environment. The main features of sustainable packaging are produces little to no environmental waste, made from reusable or biodegradable packaging materials and safe for people and the environment. The problem is especially important when we consider that, the use of materials and design of food containers which better and more practical. Besides, a possible cause of this problem is practical food carrier containers can reduce the safety problems of transported food and space utilization, as well as maintain food quality and this problem also has negatively impact on the environment because the use of plastics as food containers disrupts the global ecosystem. Objective that needs to be achieved is design and develop a practical " Eco-Friendly Food Carrier", to study the strength of materials and design of "Eco-friendly Food Carrier" in packaging engineering and to ensure the food safety, quality preserved, and easy to carry. In addition, this study was conducted through experimental design as well as the method used to complete this project also through quantitative methods. We distributed the questionnaire to the public and a total of 45 respondents, from the percentage of 72% females and 28% males. The results of the questionnaire show that this eco-friendly food carrier is very easy to handle food, remain heat resistant, save food space at a time and easy to carry anywhere. For conclusion, each experiment performed must be appropriate for the project to succeed well. In addition, the need for environmentally friendly packaging is increasing as global temperature problems increase. One of its advantages is that it helps the environment. From an economic perspective, making lightweight materials helps the manufacturing industry save money and produce less waste that can better preserve the environment.

*Key words: packaging, eco-friendly, food carrier*

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# CHAPTER 1

## INTRODUCTION

### 1.1 INTRODUCTION

Food packaging lied at the very heart of the modern food industry and very few foods were sold unpackaged. Good packaging prevents waste and ensures that the food retains its desired quality throughout its shelf life [1]. While food packaging was an integral component of food industry and helps to store food and beverages in hygienic manner, it could at times been a caused of concern for food safety. Some packaging materials such as certain types of plastic, polythenes, and styrofoam could released toxins when they were heated and could been dangerous to consumers. Packaging materials which were irradiated (along with food) could transfer unsafe nonfood substances into the food [2].

Eco-friendly packaging was a form of environmentally-friendly packaging often made of recycled or renewable materials that's safe and sustainable for both individuals and the environment. The main features of sustainable packaging were produces little to no environmental waste, made from reusable or biodegradable packaging materials and safe for people and the environment [3]. Sustainable packaging defined as one that had minimized its footprint in terms of carbon, watered, and chemical used, along with its overall waste. Material was a multi-part category in sustainable packaging. The typed of material was also important whether the packaging was made of recycled content (the higher percentage the better) and if it could been recycled curbside. The best were cleared glass (coloured glass can't been recycled), cardboard and uncoated or unwaxed paper, and aluminum. An item earned more points if its packaging didn't used mixed materials, since that could made it more difficult to recycle. Instead of material, other sustainability and functionality of the products packaging based on were minimalism, efficiency, innovation and design [4].

How to knew if a product was eco-friendly? several types of labels would tell

if a product was truly eco-friendly or just used a claimed of natural ingredients as a marketing ploy. If the product had one of these label, it guaranteed the product was eco-friendly [5]:

- i. USDA organic - this seal was used on food and cosmetics for products that were actually organic.
- ii. Energy star - a label used for electronics and appliances showing the product would provided energy-saving benefits.
- iii. Green seal - used on cleaning products, if it had the green seal, it was an eco-friendly product
- iv. Forest stewardship council logo - this logo was used for eco-friendly wood and paper products.

The used of plastics as food containers disrupts the global ecosystem. According to a studied by the world wides fund for nature (wwf) malaysia, the used of plastic in malaysia was the 2nd largest in asia with an average of 16. 78kg of plastic per individual per year. (ftm reporters, september 22, 2020). Luckily, there were packaging industries package their products in paper or cardboard were environmentally aware and did used recycled materials to preserve our planet. To support our environment protection and to ensured the food safety, quality preserved, and easy to carried, eco-friendly food carrier was proposed have been design and develop. This multi-portion lunch box that originated in japan consist of compartments that had a different serving of food. It's a brilliance idea design that kept each space tightly closed which was prevents food from leaking out of the box or spilling into other spaces or turning everything into a mess. The rigid box and compartment sections was really protecting the food from crumbling. This eco-friendly food carrier would eased the food packaging and keep it fresh until it ready to ate.

## **1.2 RESEARCH BACKGROUND**

By the 1880s, kids began styling their lunch boxes out of used tobacco cans, candy, or biscuit cans. All it took was a little effort to attach the handles. Finally, the company saw its needed and made a could with the handle already attached. In 1902, the first lunch box designed specifically for children was made. And in

1911, in what was then considered a true genius, the American Thermos bottle company made the first employee lunch kit with a thermos bottle - making drinks that was really hot or cold for the first time.

Here were top five packaging trends for 2020 as listed below:

**i. Sustainability and environmentally friendly packaging materials**

Demand for sustainable packaging had been much greater in 2020. With enormous rallies in many countries all over the world, 2019 saw some of the largest environmental issues protests ever seen in the history of the world. Sustainability, recycling, and environmental issues would continue to take centre stage as the millennial and "z" generations enter the workforce and become more consumers.

**ii. Smart packaging**

It all basically boils down to smart packaging, whether it was augmented reality, QR codes, or chip technology. Smart packaging would help to ensure that all items had greater monitoring capabilities and would continue to improve how consumers interact with products and their packaging. The integration of traditional print with digital technology was being observed.

**iii. Vintage packaging**

"What was old was fresh again," as the expression went, consumers were becoming more interested in experiences that made reference to simpler times in today's technology-driven world. The nostalgia-driven magic would continue to expand as consumers' desire to reproduce the delight of past experiences in music, video games, movies, and other media forms grows. More modern designs based on historical aesthetics and colours, tugging at the nostalgic feelings of customers, had been seen in the realm of packaging.

**iv. Sophisticated and minimalistic packaging**

Minimalism in packaging refers not only to the quantity of packaging material used to achieve not only did it have the least amount of environmental impact, but it also had the least amount of impact on the branding of the goods contained

within it. Throughout 2021 it would straight forward, easy-to-understand, high-contrast designs that clearly and simply made a statement had been trendy. Aesthetics would always been important in the packaging industry, and packaging design in 2021 would remain simple with decorative elements. For premium packaging, digital printing would became more prevalent. For the 'instagram generation,' who were accustomed to seeing visually perfect photographs from friends, influencers, and brands.

#### **v. Evolution of e-commerce packaging**

with many customers complaining to excessive packaging and the associated environmental concerns, firms selling through e-commerce websites must been able to strike a balance between appropriately packing and protecting their items without used unnecessary materials. Waste and pollution were becoming increasingly important issues around the world, and e-commerce packaging was no exception

### **1.3 PROBLEM STATEMENT**

The problem was especially important when we considered that, the used of materials and design of food container which better and more practical was a global requirement that must to ensured safety of human health and preserved environment. Furthermore, a possible caused of this problem was practical food carrier containers could reduce the safety problems of transported food and space utilization, as well as maintained food quality. Moreover, this problem also had negatively impact on the environment because the used of plastics as food containers disrupts the global ecosystem. According to a studied by the World Wides Fund for nature (WWF) Malaysia, the used of plastic in Malaysia was the 2nd largest in asia with an average of 16.78kg of plastic per individual per year. (FTM Reporters, September 22, 2020)

### **1.4 OBJECTIVE**

This studied was conducted to achieve the following objectives:

- i. It was designed and develop a practical "Eco-Friendly Food Carrier".
- ii. It was studied the strength of materials and design of "Eco-Friendly Food Carrier" in packaging engineering.
- iii. It was ensured the food safety, quality preserved, and easy to carried.

## **1.5 RESEARCH QUESTION**

- i. How long could used eco-friendly food carrier?
- ii. What was the best thing to chose this food carrier?
- iii. Eco-friendly food carrier was easy to recycle or it disposable?

## **1.6 RESEARCH SCOPE**

The scope of this studied was focused on the materials and the design of food packaging in malaysia. Packaging engineering was a key element of the studied. The project supports environmental conservation by used environmentally friendly materials. The method of developing the product was used an experimental approached on the materials and the design. Three packaging tests on the material could been done in the laboratory, as well as testing on the design. The experiment's result was defined as the product being developed. The time frame it took around 1 month to complete the project and for the project costed budget was RM 500.

## **1.7 SIGNIFICANCE OF THE RESEARCH**

Sustainable packaging was important because it reduces the ecological footprint of all the stages in the product's life-cycle. It helps both the producer and the consumer reduce their environmental impact. The impact of humankind on the natural world was one the greatest challenges we faced today and in the decades ahead. Sustainable packaging design had became increasingly important over the past few years, as consumers became more focused on the environment. For designers, the most significant area when thinking about developing environmentally-friendly packaging was material selection. With sustainability

becoming ever more critical to the way the general public made purchasing decisions, brands and packaging designers had to and were adapting to made more environmentally-friendly products.

The primary purpose of packaging was to protect its contents from any damage that could happen during transport, handling, and storage. Food packaging design should take lots of factors into consideration, such as material, size, safety, durability, shelf space, and storage space to fully fulfil the purpose of packaging.

## **1.8 DEFINITION OF TERMS**

Packaging was the science, art, and technology of enclosing or protecting products for distribution, storage, sale, and use. Packaging also refers to the process of packaging design, assessment, and processing. Packaging was an organised method for preparing products for transportation, warehousing, logistics, sale, and end use.

## **1.9 FINDINGS / RESULT EXPECTATION**

Expectations for this project were to ensure food was warm, fresh, and able to contain any dish, even saucy and gravy food. Besides, its ergonomic design makes food transportation easy and reliable. The material used was of good quality and leak-resistant, such as the oil-resistance features that prevent the liquid from seeping through the paper. It produces a strong and sturdy handle.

## **1.10 SUMMARY OF CHAPTER**

Overall, adults used these lunch boxes as diet food containers, segregating food according to the food pyramid, and they were more interested in using this food carrier. Hence, with the use of environmentally friendly materials, had been able to maintain the quality of food and make it easy to handle.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

**(NUR RABIATUL ADAWIYAH BINTI ROSLI)**

Packaging was a process that involves activities designed to produce packaging containers, whether made of plastic, paper, aluminium cans, or others, to protect the product. Generally, the function of packaging was to protect the product from damage factors caused by changes in temperature, humidity, pollution, mechanical damage, and facilitate the transportation process. Nowadays, packaging was not just to protect the product from any damage; in fact, packaging was the "key to marketing" and communication media, which was able to bring product manufacturing companies to enjoy sales profits.

#### **2.2 CONCEPT / THEORY**

**(AINA SYAFREEN BINTI RAMLI)**

Packaging was a "marketing key" without realising it, and not only protected the product from damage but had a visual impact, adding uniqueness and showing the difference in the brand image on the product display. This article aims to identify the challenges facing SMEs in Malaysia in producing innovative packaging. To date, many studies had been conducted on SME challenges covering SME inefficiencies, financial constraints, survival rates and more. However, there was still a gap in existing research that looked at innovation issues from multiple dimensions but was still unable to address the true reality gap surrounding SME. This study focuses on the barriers and challenges of SME, regardless of the financial, operational, or management aspects of packaging innovation.

#### **2.3 PREVIOUS RESEARCH**

**(AINA SYAFREEN BINTI RAMLI)**

From the past results of the literature review, various factors related to the challenges and obstacles of SMEs entrepreneurs in business had been discussed.

Among them were insufficient financial resources, lack of skilled human capital, lack of competitiveness in business, limited infrastructure, and government policies (nor ghani md. Nor,2016). This statement was also supported by Adigun (2016), which stated that capital was one of the major obstacles faced by SMEs in developing sustainable packaging innovations. The crisis had also been faced by SMEs in other countries, such as Thailand, who were also faced with financial constraints and the external environment (chittithaworn et al., 2011).

Small business entrepreneurs in Korea face challenges in terms of skills, technological knowledge, and current government policies (choi & lim, 2017).According to Deshati (2016) as well, the barriers faced by SMEs in Albania were the high economic cost of innovation, the occurrence of a crisis or market instability, and the simplicity of knowledge to implement innovation. The main reason that SMEs had to 'roll over' was due to SMEs' not realising the real business challenges, especially in terms of financial and management skills (beh, 2013).

### **2.3.1 PACKAGING ENGINEERING (NURUL IZZAH BINTI AZMI)**

Packaging engineering was heavily involved in the design and construction of cases used in various industries. This material included cartons, boxes, plastic wrap, bottles, and other containers.They were used to keep consumer items safe. Packaging engineering, on the other handed, involves researched on various types of packaging materials. These professionals were also working to improved the many industrial procedures that were used to package products.

Packaging engineering also includes the design of effective and appealing containers as well as efficient production methods. This was accomplished by first assessing which materials were suitable for used as packaging for a specific product. Glass, plastic, and cardboard were all examples of this. Engineers were regularly asked to assist in the reduction of waste. This was accomplished by using as few packaging materials as possible.They also used Cad software and mathematical models to aid in the creation of the most effective and efficient designs.

### **2.3.2 FOOD PACKAGING MATERIAL**



**(NUR RABIATUL ADAWIYAH BINTI ROSLI)**

When it came to being eco-friendly, not used any packaging was the best, but that's not very realistic. At the same, choosing a food packaging material with the lowest impact on the environment was not as easy as it was said. For instance, when choosing packaging, it was life cycle, energy produced, energy recycled, or transportation. The best material for packaging a specific typed of food was determined by the functions that the package was expected to perform. Foods were protected from moisture, temperature changes, oxygen, light, and biological microorganisms, among other things. Harm resistance, permeability, food recognition, as well as chemical and optical properties, all played a role in the material. Here were a some of the top eco-friendly packaging:

### **Corrugated Paperboard with Double Wall**

The corrugated board, which was made by massive, high-precision machines known as corrugators, used the majority of recycled paper. These types of boards could be reused and recycled multiple times as a source of pulp fibre. For packaged things, there were a slew of useful safeguards. The double wall consists of three sheets of liner board sandwiched between two mediums. Double-walled corrugated cardboard boxes provided all of the advantages of single-walled corrugated cardboard boxes, but with increased strength. It was ideal for larger stacks in warehouses and shipping containers, as well as heavy products.

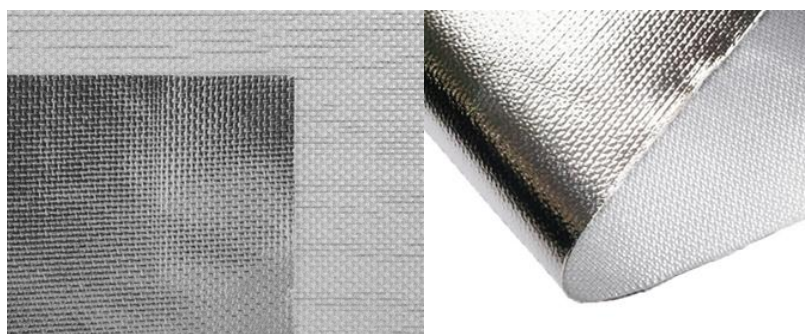




**Figure 2.3.2.1:** Corrugated Paperboard with Double Wall

### **Aluminium Foil Fiberglass Insulation**

Aluminium was used to make beverage cans, foils, tubes, trays, pouches, and coffee capsules. It has high temperature resistance and functions as an effective gas barrier, extending the food's shelf life. It was quite malleable and formable, and embossing it was straightforward. It a relatively harmless, lightweight material that's also indefinitely recyclable. Alloying elements liked magnesium and manganese were frequently used to boost the strength of aluminium. Aluminium packaging could be rigid, semi-flexible, or flexible. Foods were protected from radiation, oxygen, moisture, oils, and germs while maintaining their freshness and aroma. High heat resistance was one of the many benefits of this aluminium foil fibreglass insulation. Furthermore, there was good insulation and corrosion resistance. It also had a high level of microbiological resistance.



**Figure 2.3.2.2 :** Aluminium Foil

### **Unbleached Kraft Paper with Good Waterproof**

Kraft paper packaging had the advantages of being simple to process, low in cost, suitable for printing, lightweight, flexible, non-toxic, tasteless, and pollution-free. It protects the goods within while also providing a simple way to keep and serve them

at home. Assisting in the increase of recyclable food packaging. Hence, it easy to recycling. For inventive, ecological, and practical solutions, kraft paper had became the natural substrate of choice. It was nice and waterproof, and it was also oil resistant. Could been customised as a lunch box or used as a fast-food packaging for burgers, fried chips, and other items. It could print any pattern we wanted on it because the printing quality was excellent. It could been customised into a lunch box or used as a fast-food container. Poly coated paper was frequently used to wrapped several street items.



**Figure 2.3.2.3 : Unbleached Kraft Paper With Good Waterproof**

### **2.3.3 PACKAGING DESIGN (NUR RABIATUL ADAWIYAH BINTI ROSLI)**

"Product packaging design" refers to the design of a product's exterior, which includes material and shape options, as well as graphics, colors, and fonts used on packaging, whether it's a package, a can, a bottle, or any other type of container. Any product's packaging design worked as its soul and brought life into it. Packaging design was the first touchpoint a customer had with the product or brand. While its primary purpose was to protected the main product, it was also a great medium of marketing. There was no reasoned why the creators couldn't been creative and entice the customer with the packaging. Packaging design was the most important factor in a high-quality product lunch. In ordered to obtain an excellent design, approximately 72% of the essential items are provided as it is understood that packaging design would influence their purchasing decision. Here was the information that was needed to design the packaging:

#### **Brand Requirements**

Products could stand on their own or represent a well-known brand in some cases.

Before starting the design, been sure to gathered the following details if the packaging needed to represent the aesthetics of a particular brand:

**i. Colour**

The colours that you chose would define the looked of the brand and how the product would appeared to customers.

**ii. Fonts**

The chosen type of font for the packaging was perhaps the best way to grabbed attention and communicate your message in an interesting and creative way.

**iii. Logo**

The process of designing a logo must include other visual assets such as fonts, colour palettes, and any other kind of imagery. All of these things were designed with the brand's message, values, and product in mind.



**Figure 2.3.2.4 : Information Of Design Packaging**

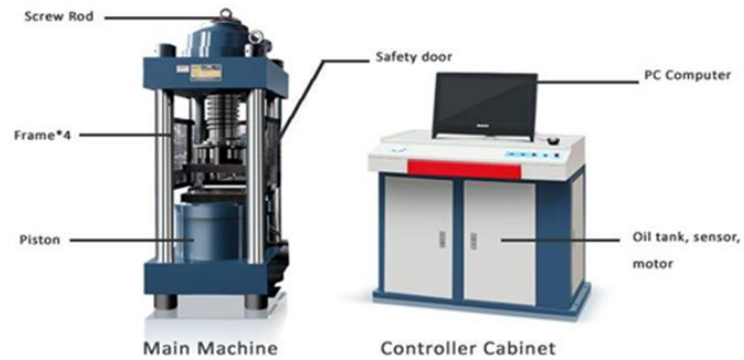
**2.3.4 PACKAGING TESTING INVOLVED**

**(NURUL IZZAH BINTI AZMI)**

**Compression Testing**

The compressive strength of packages such as boxes, drums, and cans was measured using the container compression test. It usually shows a deformation vs. compressive forced plot. It was often used to assess corrugated fibreboard shipping containers, as well as wooden boxes and crates. Compression testing could be used on industrial and consumer items that were not boxes, such as bottles, drums, pails, etc.

Compression resistance was also evaluated for package components. It was usually a laboratory test that involves applying controlled compression to a test specimen used a particular machine called a compression tester. A package compression test was usually performed on universal testing equipment.



**Figure 2.3.4.1 : Compression Testing Machine**

### **Drop Testing**

A dropped test was raising a prototype or experimental aircraft or spacecraft to a specified altitude before releasing it to evaluate its in-flight characteristics. The dropped test for packaged products has been used to determine how well the cushioning material absorbs impact. There were three types of dropped testers, rotational dropped armed, electrically released hooked, and fork-table. You could choose a suitable tester based on the product's weight and dropped height.



**Figure 2.3.4.2 : Drop Test Machine**

### **Endurance Testing**

Folded endurance was a measurement of how long paper could be folded repeatedly under steady strain. It was used to figure out how many times a piece of paper could be folded before it broke. The number of double folds was used to calculate folding strength, while the  $\log_{10}$  of the number of double folds was used to calculate folding endurance. The test was generally used to examine commonly handled papers, such as currency (bank note) papers, maps, and wrapping papers. Folded endurance could be used to measure a paper's ageing characteristics before and after accelerated environmental ageing.



**Figure 2.3.4.3 : Endurance Testing Machine**

### **Tearing Tests**

The Elmendorf or trouser tear test, which assesses the internal tearing resistance of paper rather than the edge-tear strength, was the most commonly used tearing test. Internal tearing resistance was a measurement of the force required to tear a single sheet through a specific distance after the tear had already started. The force required to initiate a tear was measured by edge-tearing strength. The force required to start a tear could have been several times greater than the force required to propagate it once it had begun.



**Figure 2.3.4.4 : Elmendorf Tear Tester**

**2.3.5 RESEARCH ON CURRENT PRODUCT IN MARKET IN TERMS OF MATERIALS AND DESIGN  
(NURUL IZZAH BINTI AZMI)**

As we all know, steel was utilised for this lunch box in ancient times. However, there were other adjustments that may have been made nowadays, including the used of disposable materials such as paper. As a result, numerous countries utilised this strategy because it was more convenient to transport and dispose of. As a result, most eateries offered a take-out option. If their table was filled, they could took their food and eat it wherever they liked. Many of the designs in used today have been altered as a result of modern technologies. As we have seen, the design was hefty and difficult to transport in ancient times. Then we could used the designs that were accessible on the market for our convenience in the future.



**Figure 2.3.5.1 : Example of Lunch Box**

### **2.3.6 PACKAGING SUSTAINABILITY**

**(AINA SYAFREEN BINTI RAMLI)**

Sustainable packaging would help the manufacturer and the consumer work for a more sustainable future by reducing environmental pollution at all stages of the product life cycle. With sustainability being the major agenda for almost all countries around the globe, several organisations were introducing sustainable packaging in order to reduce their negative impact on the environment and differentiate themselves from the competition. However, there were some assumptions in the industry that could create uncertainty, making it difficult for businesses to work toward a sustainable future. The use of sustainable packaging was becoming more common, and it would continue to do something in the future. More and more manufacturers were using environmentally friendly packaging materials in their entire life cycle, including in their functionality, marketing, and disposal. Sustainable packaging also helps to cut down on the cost of packaging design. Here were some ways that could contribute to sustainable packaging:

#### **Corn Starch Packaging**

Corn starch was an organic ingredient that had made its way into the green packaging industry. It comes from the corn or maize plant and contains plastic-like properties, allowing it to have been employed in a number of applications where polymers were previously required. Corn starch packaging could be found in a variety of containers, including bottles, moulded shapes, and loose-fill packaging.

While corn starch was a more environmentally friendly alternative to petroleum-based packaging, it was not without weaknesses. It was derived from maize grains and effectively competes with the human and animal food supply, potentially raising the price of one of our nutritional staples. When selecting this option for packaging, it was important to consider both the benefits and disadvantages.





**Figure 2.3.6.1 : Corn Starch Packaging**

### **Mushroom Packaging**

Mushroom packaging, believed it or not, was another low-cost, environmentally friendly choice for supporting smaller items. It started with cleaned and ground agricultural waste, which was then fused together with a mycelium matrix of mushroom roots.

Agricultural waste was simply that: trash, and as such, it might have been used to feed humans or animals. As a result, any possible problem concerning corn starch packing was avoided. The raw material could then be moulded into any shape, dried, and used as packaging. This chemical not only uses no petroleum or food as a starting source, but it also biodegrades at a rapid rate. Composting mushroom packing at home produces non-toxic organic materials.



**Figure 2.3.6.2 : Mushroom Packaging**

### **Recycled Cardboard And Paper**

A container was required for all of these filler components, and the industry standard was cardboard boxes. Despite the fact that cardboard and paper were organic goods, their used could had a substantial environmental impact if they were not sourced in a sustainable manner.

Paper and cardboard were two of the easiest items to recycle. To make the packaging as environmentally friendly as possible, we tried to source post-consumer or post-industrial recycled paper and cardboard. FSC-certified materials, on the other handed, came from sustainably managed forests and could been a safer option in some cases.



**Figure 2.3.6.3 : Recycled Cardboard And Paper**

**Eco-Friendly Plastic And Recycled Plastics**

Because it was impossible to avoid, some transportation requirements required a long-lasting, dependable material that would not crack and could handle heavy loads. While many organic raw material alternatives were great for cushioning or filling, there were instances when only plastic would suffice.

In these cases, however, there was no need to compromised on sustainability because various plastic shipping items and equipment were now available that were fully constructed of recycled plastic. All of your transportation demands, including drums, spill trays, and spill controlled pallets, could be fulfilled with environmentally friendly shipping products.



**Figure 2.3.6.4 : Eco-Friendly Plastic And Recycled Plastics**

**Encouraged Minimal Packaging**

Invest in creating a packaging template with as little packing content as possible. Combine simplicity and creativity to created an appealing and minimalistic looked. Minimal packaging reduces the amount of material used, leading to lowered product costs. It would also used less energy to produced both the material and the packaging, as well as less fuel to transport the items.



**Figure 2.3.6.5 : Encouraged Minimal Packaging**

## **2.4 SUMMARY OF CHAPTER**

At the end of the chapter, environmental methods must be adopted by society in order to keep our environment as clean as feasible. Every time we used something, we should dispose of it in the designated area so that no one was inconvenienced. and every machine and material used came with a hefty price tag.

## **CHAPTER 3 METHODOLOGY**

### **3.1 INTRODUCTION (AINA SYAFREEN BINTI RAMLI)**

This chapter would explain the method adopted by this researched. This chapter would discuss every material used in conducting this research, including the results of the experimental design, the data obtained, and the quantitative techniques used for the general public questionnaire. Finally, this chapter provides a detailed explanation of the selected mode of analysis used and the problem solved.

### **3.2 DESIGN RESEARCH (AINA SYAFREEN BINTI RAMLI)**

This studied was carried out using an experimental design to studied the

strength of the weight to filled the typed of food in it with the appropriate type of food. This study was based on a discussion among group members about measurement, which was then referenced in data analysis. This research was also to ensure that food carriers used environmentally friendly materials and were suitable for the community.

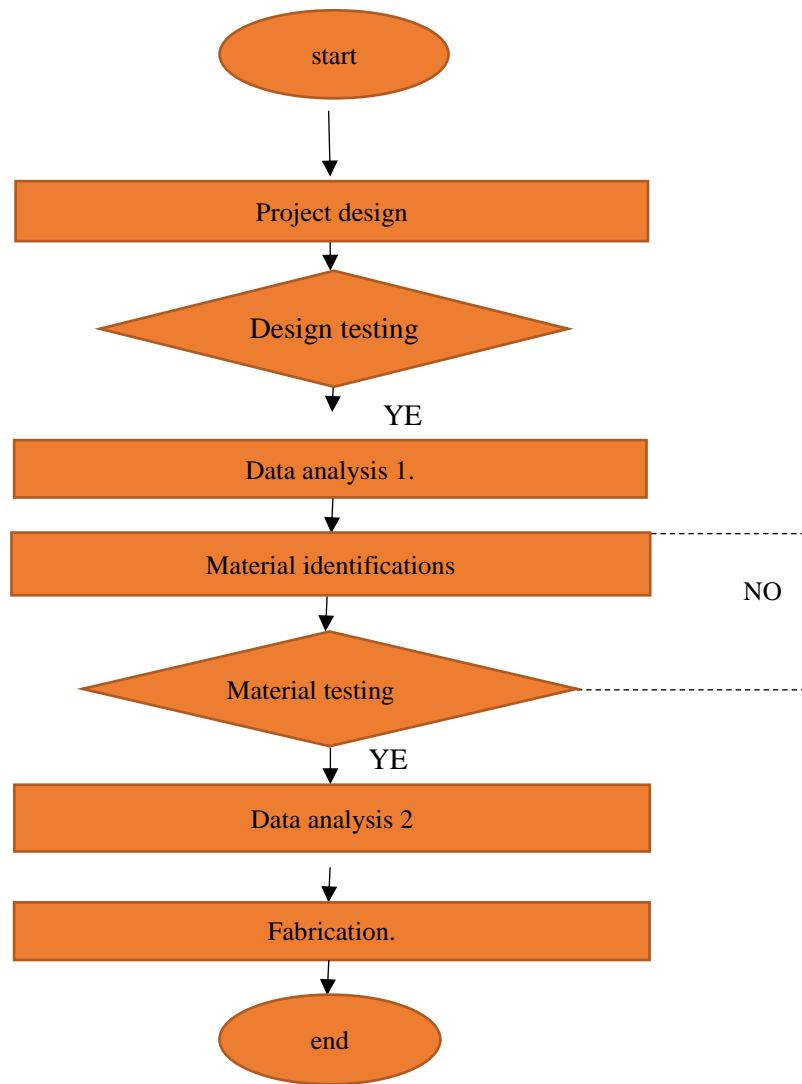
### **3.2.1 Product Based Project**

#### **1) Method of Project Development**

##### **Design And Development Process**

The front and back surfaces of the food carrier were formed into a trapezoidal shape. On the sides, they were rectangular in shape. The top surface had a strong handle and made it simple to opened. Hence, there were three layers on the inside. Each layer also had a food container for convenient food placement. The measurement technique was to estimate the area of space at each surface and angle. When drawing a sketch of a food carrier template, the size needed should have been accurate. Since the resulting shape differs from the front and back surfaces, measurement errors could occur on the left and right sides. The materials used in the development of this project were environmentally friendly. It was recyclable and safe for food handling.

### **CARTA ALIR METODOLOGI / METHODOLOGY FLOW CHART**



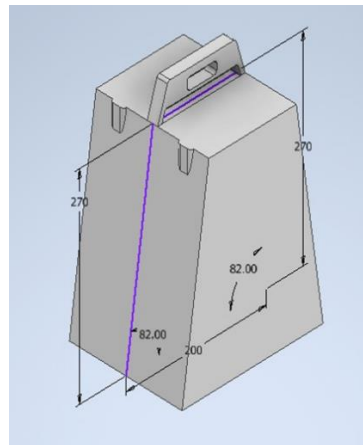
**Table 3.2.1 i :** Methodology Flow Chart Eco-Friendly Food Carrier

## 2) Problem Solving

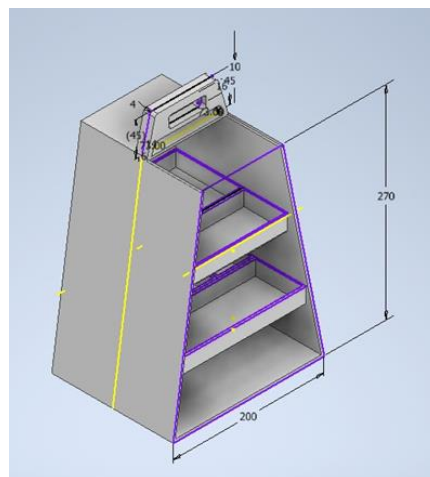
The way to produced it uses folding and scissor techniques. First thing first, draw a design template with the correct dimensions. Next, cut the part in the sketch and shape it. Then, for testing, we used the weight of sand that had been weighed and placed into it to test its durability. Figure 3.2.1.i illustrates the methodology developed in this research. Project design is conducted by using Autodesk Inventor Professional 2020 software to take the power and flexibility of 3d modelling. At the beginning three design is designed. Then, those designs going through design testing to identify the most durable design. After the right design is identified, material is selected, and compression testing is conducted. The data is analyzed to identify the materials action or reactivity when subjected to a compressive force by measuring fundamental factors.

**3.2.2 Materials and Equipment**  
**(NURUL IZZAH BINTI AZMI)**

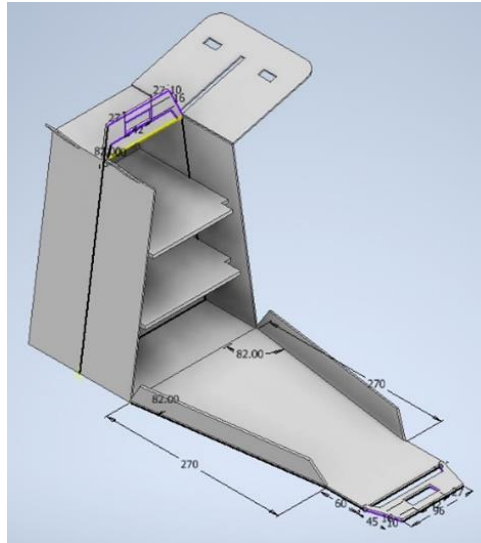
**1) Drawing Engineering**



**Figure 3.2.2.1.i : Front View With Dimension**

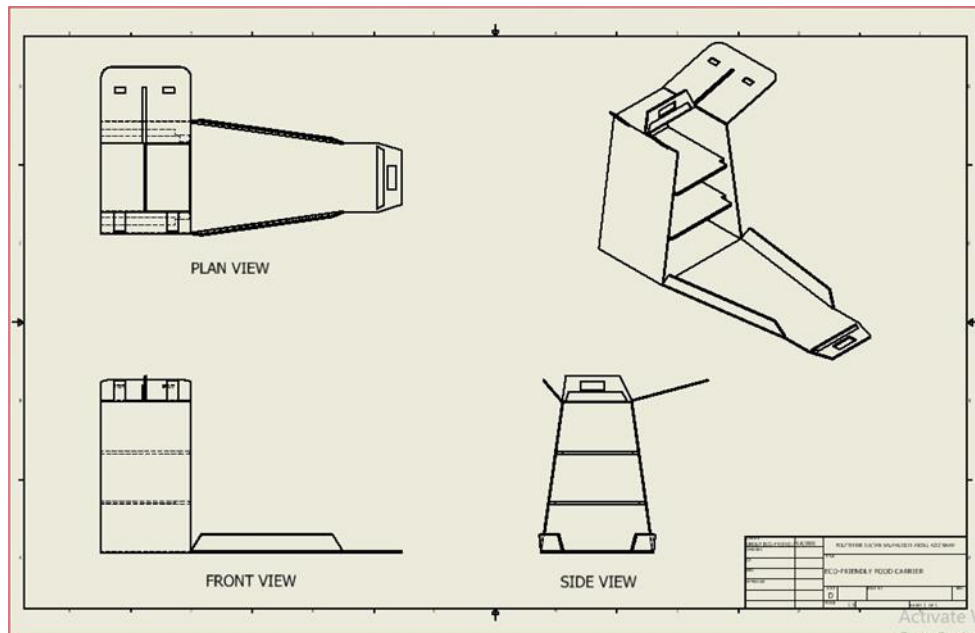


**Figure 3.2.2.1.ii : Internal View With Dimension**



**Figure 3.2.2.1.iii:** Overall View With Dimension

## 2) Drawing Orthography



**Figure 3.2.2.2.i :** Drawing Orthography Plan, Front and Side View

There were materials and equipment in the production of the project used, such as corrugated boxes, aluminium foil, and kraft paper. Furthermore, the function of the material was to produce good food packaging that was of the highest quality and safe from microorganisms. The dimensions are: height = 270mm, length = 200mm, width = 160mm. The weight that could be accommodated was 2100 grams.

## 3.3 Data Analysis Method



**(AINA SYAFREEN BINTI RAMLI)**

Generally, this study has been studied through experimental and quantitative methods. We asked about the packaging food environment, which had been analysed and studied and had the potential to improved human comfort. The study shows the frequency distribution and percentage of respondents by age. The majority of respondents were aged 17-27, which was 81%. Based on the questionnaire conducted, 96% of the respondents agreed that the carrier box used was heat resistant. Therefore, 94% of the total agreed to bought a carrier box that we designed that was very unique and different from the boxes that were on the market.

### **3.4 SUMMARY OF CHAPTER**

Packaging material was something everyone interacts with on a daily basis. Producing and safely disposing of these materials requires many resources, as well as careful preparation that took into planning both economic and environmental factors. The needed for eco-friendly packaging was growing as global temperature issues increase. One of the advantages would been that it would help the environment. From an economics perspective, making light-weight materials helps manufacturing industries save money and produced less waste.

## **CHAPTER 4 RESEARCH INITIAL FINDINGS**

### **4.1 INTRODUCTION**

This chapter was the chapter which would discuss the advantages and standards used as well as researched recommendations related to eco-friendly food carriers. The results of compression tests from experimental design proved that this food carrier was able to accommodate how much weight or load the product could be placed into the box. In addition, to testing the material used, was it

suitable and successful according to the expectations that we set for this project, which has been successful and got a response from everyone.

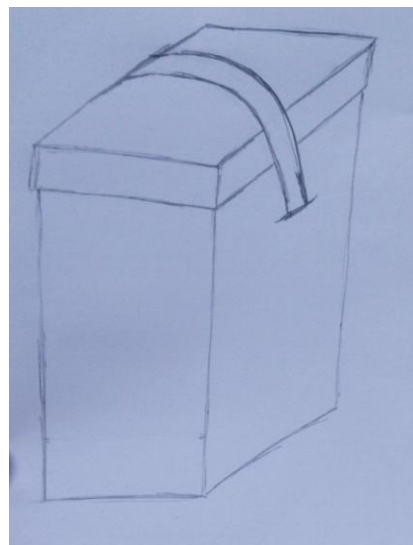
## **4.2 FINDING RESEARCH**

The results of the survey and discussions with supervisors show that this eco-friendly food carrier is very easy to handle food, remain heat resistant, save food space at a time and easy to carry anywhere. On the whole after this eco-friendly food carrier is successfully produced and used then all the objectives of the study stated in chapter 1 can be produced.

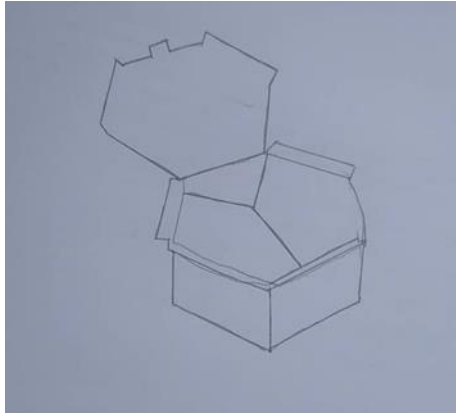
### **4.2.1 Analysis of Data**

#### **1) Load Testing**

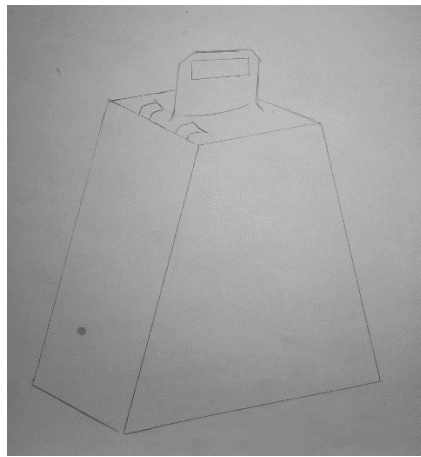
While planning this project, we have produced three different types of food carrier designs in terms of internal and external shapes and materials used. Each member needs to create their own design and collect data based on the durability of food carriers that have been tested with sand or rice. At that point, we will only see the differences between the designs, which will allow us to choose the right one as the main project for our group. In addition, we include below a sketch of three types of food carrier design and data that can be obtained by each member.



**Figure 4.2.1.1.i : Food Carrier Design A**



**Figure 4.2.1.1.ii:** Food Carrier Design B



**Figure 4.2.1.1.iii:** Food Carrier Design C

Type of Design Number of Loads (grams)	Design A	Design B	Design C
900g	Sturdy	Sturdy	Sturdy
1200g	Sturdy	Sturdy	Sturdy
1500g	Sturdy	Sturdy	Sturdy
1800g	Sturdy	Sturdy	Sturdy
2100g	Crumble	Crumble	Sturdy
2400g	Crumble	Crumble	Crumble

**Table 4.2.1.1:** Data of Accommodates The Load

According to the data, design C is stronger and more sturdy because it uses a double corrugated box compared to other designs because it uses a double corrugated box instead of a single flut. In addition, there are two tiered designs, namely design B and C, while design A is not tiered. This means design A does not comply with the criteria to save space that we had highlighted earlier in the objective statement.

## 2) Compression Testing

As a result of Eco - Friendly Food Carrier project, we have obtained data from testing the compression using a compression machine to identify the endurance of the box used. Compression testing is used to identify a materials action or reactivity when subjected to a compressive force by measuring fundamental factors including strain, stress, and deformation. So, the data we collected was based on compressive forced vs. displacement.

The following is a list of Eco-Friendly Food Carrier data that may be collected from compression test results.

Testing specimen Direction	Force (N)				Displacement (m)			
	Trial 1	Trial 2	Trial 3	Average	Trial 1	Trial 2	Trial 3	Average
<b>Top</b>	120	121	120	120	4.003	4.219	3.787	4.003
<b>Side face 1</b>	147	145	149	147	0.741	0.744	0.738	0.741
<b>Bottom</b>	26	25.5	25	26	0.916	0.920	0.913	0.916
<b>Edge</b>	133	133.1	131.5	133	1.150	1.148	1.151	1.150

**Table 4.2.1.2** : Data of Compression Testing

## 4.2.2 Cost of Materials

No.	Materials	Quantity	The Unit Price (RM)	Total (RM)
1.	Carton Box 40 x 25 x 30 cm	2	2.90	5.8
2.	10 pcs Brown Kraft Paper	1	7.20	7.20
3.	Aluminium Foil	3	1.95	5.85
<b>Total Amount</b>				18.85

### **Table 4.2.2 : List of Cost Materials**

**Table 4.2.2** shows that the cost of developing the eco-friendly food carrier project. As it is known that plastic cannot be disposed of easily and has the potential to harm the ozone layer, the material chosen has no directly use of plastic and the materials we used are also safe and suitable for recycling.

### **4.3 RECOMMENDATION**

A suggestion that could have been obtained was to find a more suitable design method, such as providing more space to place cutlery sets such as knives, forks, and spoons, because food and cutlery sets were not suitable if separated. The other suggestion was to design a food carrier with air holes to remove excess water vapour from the inside to prevent the food from becoming stale.

### **4.4 SUMMARY OF CHAPTER**

At the end of this chapter, each experiment performed must have been appropriate for the project to succeed well. In addition, the need for environmentally friendly packaging was increasing as global temperature problems increased. One of its advantages was that it helps the environment. From an economic perspective, making lightweight materials helps the manufacturing industry save money and produced less waste, which could better preserve the environment.

## **CHAPTER 5 DISCUSSION AND CONCLUSION**

### **5.1 INTRODUCTION**

This chapter is represented in three section which the first section contributes to an overall discussion of the study followed by the conclusion and improvement

recommendations would be following. The decisions taken in this chapter are based on all of the data obtained from the tests and the previous chapter's discussion. Besides, the aspects relevant to the study objectives and suggestions will be discussed in this chapter. In addition, conclusions from this test have been drawn.

## **5.2 DISCUSSION**

### **(NURUL IZZAH BINTI AZMI)**

In addition, we also perform a compression test by using a compression machine to determine the behavior or response of a material as it experiences a compressive load by measuring basic variables such as strain, stress, and deformation. By testing the material in compression strength, yield strength, ultimate strength, limit of elasticity and modulus of elasticity among other parameters can all be determined. With an understanding of these different parameters and the values associated with a particular material, it can be determined whether the material is suitable for a particular application or if it will fail under a predetermined stress.

### **(AINA SYAFREEN BINTI RAMLI)**

The discussion that can be gained is that eco -friendly food carriers are very good at sustainability to the world and keeping the environment from being affected. these products use environmentally friendly materials that are suitable for recycling and reusable. tests that have been conducted using load testing and compression testing have also proven the strong hermitage of the materials used in this product. in addition, it also being able to endure heat-resistant while maintaining the aroma of the food.

### **(NUR RABIATUL ADAWIYAH BINTI ROSLI)**

Our discussion was to conduct research by testing the durability and compressibility of our product to see if it could be used and how long it could endure. Compressor testing is used in our products, and they also contain sustainability elements like recycled materials or materials that can't be replenished naturally because we can't save enough waste.

### **5.3 CONCLUSION**

#### **(NURUL IZZAH BINTI AZMI)**

In this study, can affect consumers to use food carriers that provide facilities to families and students among others to carry food safely and easily. In addition, the materials used are harmless to consumers and do not harm the environment because the materials used are environmentally friendly which will not pollute the environment because the materials used are easy to recycle. The use of aluminium on the inside is a good barrier to moisture and is very light. Mainly provides a guarantee of cleanliness, tidiness and can even be insulated to a certain extent.

#### **(AINA SYAFREEN BINTI RAMLI)**

In conclusion, the design of products that contain elements of sustainability, such as renewable or recyclable materials or can replace non-replaceable materials in a natural way, can maintain ecological balance and make customers enjoy the benefits of the product. sustainability capabilities can be used to create processes and structures that not only improve existing needs but also support the ability of future generations to maintain healthy communities. However, identifying the strength of the product and the reactivity of the material using two testing method has determined to be safe to use in order to achieve the stated objectives and problems.

#### **(NUR RABIATUL ADAWIYAH BINTI ROSLI)**

In conclusion, employing this environment can help our country become more sustainable by encouraging more young people and adults to accept the notion of recycling. Furthermore, this factor of sustainability can lower the cost of resources and is widely available. The materials we utilise will be very useful in the future since many people will be interested in the concept. It's also lightweight and portable, making it ideal for many types of organisations.

## **5.4 RECOMMENDATIONS**

Eco-friendly food carriers are packaging products that are safe to use and designed using bio-based materials that are suitable for recycling and give benefits to the environment.

Here are some things that are recommends for improving the study that will be done on eco-friendly food carriers to improving its advantages :-

1. Recommends the use of a waterproof box on the surface of the box so that water is not absorbed into it which will result in the box being damaged or destroyed when exposed to water or when it rains. (NURUL IZZAH BINTI AZMI)
2. I recommend a special design that provides space for cutlery set items, as it is ideal for all of us to carry our own cutlery, as it makes it easier for them to eat food from the food carrier and allows to eat in any situation. (AINA SYAFREEN BINTI RAMLI)
3. I recommend that the product have some design printing on the outside so that people will want to use it. The design must be appropriate for all groups who will be using it. (NUR RABIATUL ADAWIYAH BINTI ROSLI)

## **5.5 SUMMARY**

The results of the testing conducted on eco-friendly food carriers indicate that they have achieved the objectives of the study, which were to design and develop a practical "Eco-Friendly Food Carrier," study the strength of materials and design of an "Eco-Friendly Food Carrier" in packaging engineering, and make sure the food is safe, high quality, preserved, and easy to carry. Furthermore, after working hard with a group member to produce eco-friendly food carriers, they have been proven successful and valuable to consumers who desire to develop an environmental sustainability perspective.



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## **APPENDIX**

<b>APPENDIX A</b>	<b>Questionnaire Question</b>
<b>APPENDIX B</b>	<b>List of Responded</b>
<b>APPENDIX C</b>	<b>Finding of Data Analysis</b>
<b>APPENDIX D</b>	<b>Project Cost</b>
<b>APPENDIX E</b>	<b>Gantt Chart (Project 1)</b>
<b>APPENDIX F</b>	<b>Gantt Chart (Project 2)</b>
<b>APPENDIX G</b>	<b>Plagarism Checker (Project 1)</b>

## APPENDIX A: QUESTIONNAIRE

### QUESTION FOR QUESTIONNAIRE

This research seeks input from all of you on the packaged food environment, which will be analysed and studied, as well as ways to enhance the quality of our goods. Furthermore, it has the potential to improve human comfort

1) Name:

2) Age

- 17 - 27
- 28 - 39
- 39 – 49
- 50 – 60

3) Gender

- Male
- Female

4) Are you interested in ordering food online? If yes, which application food order do you prefer?

- Grab food
- Food panda
- Bungkus IT

5) In your opinion, which do you agree for who is more suited to use of **Carrier boxes**?

- Students
- Workers
- Family

6) In your opinion, is it appropriate if we use paper and aluminium material inside and for outside 2 corrugated boxes?

- Yes
- No

7) Do you agree if the Carrier boxes will remain heat resistant?

- Yes
- No

8) Is it Carrier Boxes worth buying?

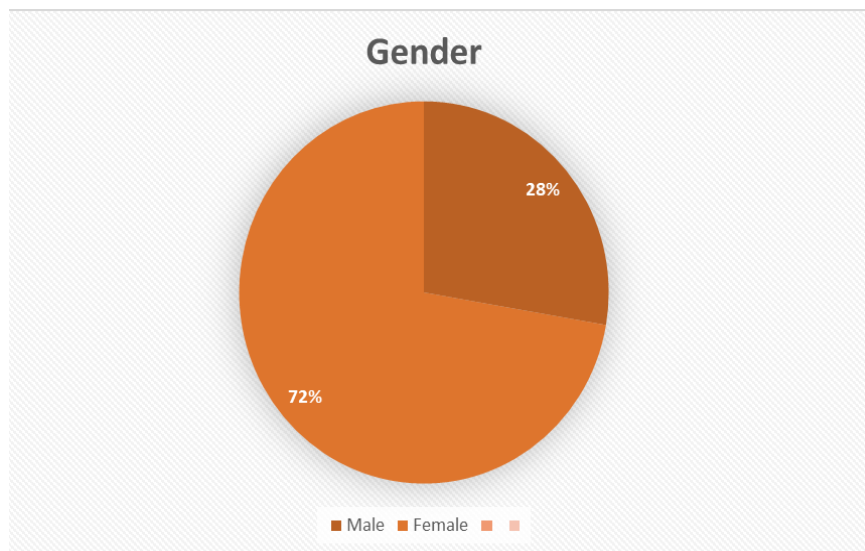
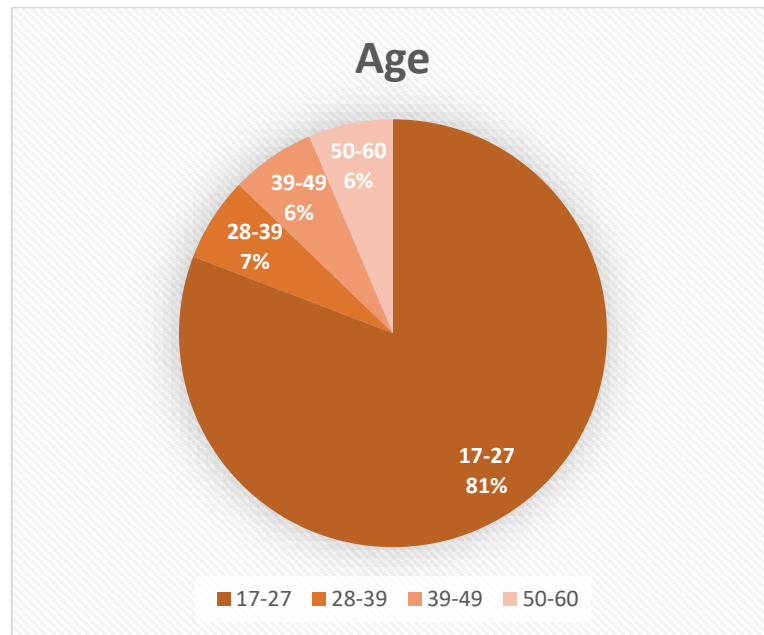
- Yes
- No

## APPENDIX B: LIST OF RESPONDED

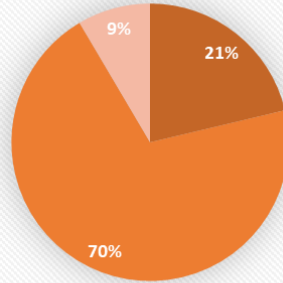
Senarai nama responses

1. Rokiah ismail
2. Nurul izzah
3. Aliea murfiqah binti ahmad puzi
4. None
5. Hamzah
6. Faten farahanim
7. Syuhada Abdul Rahim
8. Rohaida
9. Muhamad luqman hakim
10. Nur fatin fatihah
11. Dini
12. Wan Muhammad azani
13. Aten
14. Mohamad fareez
15. Siti khairunissa
16. Nur athirah
17. Izwan
18. Rosliza binti hasmoni
19. Syafiqah
20. Irfan
21. Aina najuwa binti Mohamad fadli
22. Roslina binti hasmoni
23. Afiq
24. Zety ilyana
25. Ain
26. Farra wahida binti Mohamad zawawi
27. Fatimah
28. Nur akmal batrisya
29. Siti daleela binti badrul anam
30. Dah azmie
31. Rosli bin hasmoni
32. Nur Ilyana binti supaat
33. Mohammad fareez
34. Mohammad rafid zikry bin wan chik
35. Izzatul amsa
36. Zety ilyana
37. Mohammad rafid zikry bin wan chik
38. Bb
39. Fatimah
40. Haikal
41. Syakira
42. Farah izatie binti jeferidin
43. Nur aina sofea binti azali
44. Nur aina sofea binti azali
45. Nurin nazirah binti mohammad ismail fahmi

## APPENDIX C: FINDING OF DATA ANALYSIS

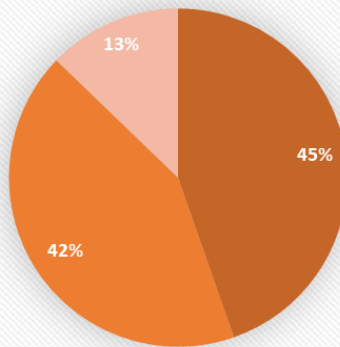


**Are you interested in ordering food online ?  
If yes, which application food order to you prefer ?**



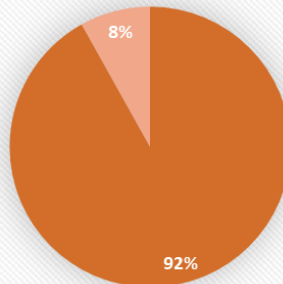
■ Grab Food ■ Food Panda ■ Bungkus IT

**in your opinion, which do you prefer for who is more suited to use of 'lunch box' ?**



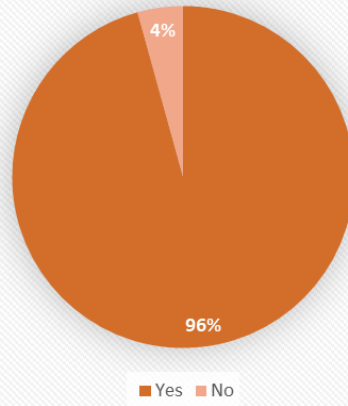
■ students ■ workers ■ family

**In your opinion, is it appropriate if we use paper, aluminium materials inside and outside with 2 corrugated boxes ?**

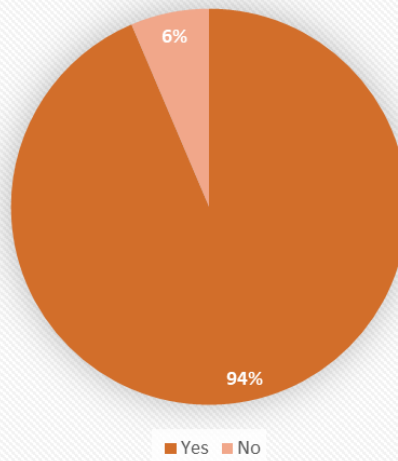


■ Yes ■ No


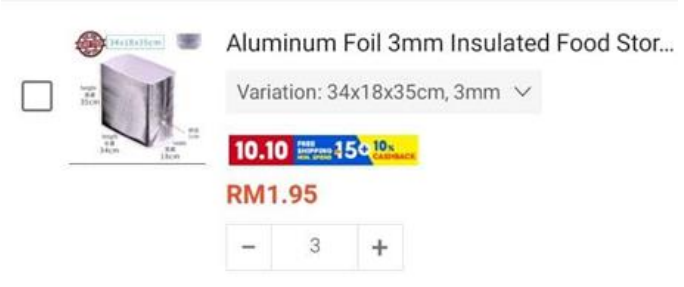
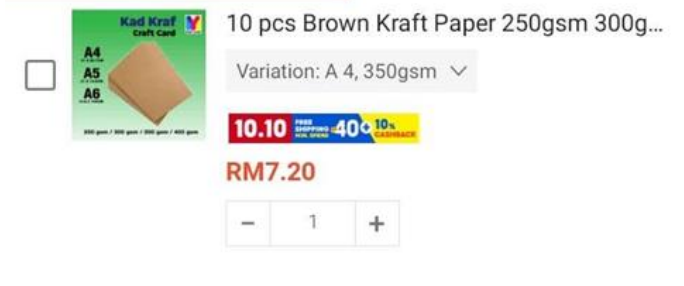
**Do you agree if the lunch box will remain heat resistant ?**



**Is it lunch box worth buying ?**



## APPENDIX D: PROJECT COST

MATERIAL	COST
1. Corrugated paperboard with double wall	 <p>Carton Box Strong Box Courier Box Kota...</p> <p>Variation: M3: 40 x 25 x 30 cm</p> <p><del>RM9.00</del> <b>RM2.90</b></p> <p>10.10 FREE SHIPPING 15% CASHBACK</p> <p>- 2 +</p>
2. Aluminium foil fiberglass insulation	 <p>Aluminum Foil 3mm Insulated Food Stor...</p> <p>Variation: 34x18x35cm, 3mm</p> <p><b>RM1.95</b></p> <p>10.10 FREE SHIPPING 15% CASHBACK</p> <p>- 3 +</p>
3. Unbleached kraft paper with good waterproof	 <p>10 pcs Brown Kraft Paper 250gsm 300g...</p> <p>Variation: A 4, 350gsm</p> <p><b>RM7.20</b></p> <p>10.10 FREE SHIPPING 40% CASHBACK</p> <p>- 1 +</p>
4. Total cost	RM 18.85



**APPENDIX E: GANTT CHART (PROJECT 1)**



**GANTT CHART ECO-FRIENDLY FOOD CARRIER (PROJECT 1)**

SESSION: DIS 2020

DEPARTMENT: MECHANICAL ENGINEERING

CODE/COURSE: DJJ40182 PROJECT 1

WEEK/ PROJECT ACTIVITY	WEEK	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W1 0	W1 1	W1 2	W1 3	W1 4
Project briefing eco-friendly food carrier	P														
	A														
Introduction of the project. Define problem statement. Identify the characteristics of product/innovatio n developed. Identify project title.	P														
	A														
Writing the project proposal	P														
	A														
Literature review	P														
	A														
Project methodology	P														
	A														
Resources indentification and selection	P														
	A														
	P														



**APPENDIX F: GANTT CHART (PROJECT 2 )**



**GANTT CHART ECO-FRIENDLY FOOD CARRIER (PROJECT 2)**

SESSION: 1 2021/2022

DEPARTMENT: MECHANICAL ENGINEERING

CODE/COURSE: DJJ50193 PROJECT 2

WEEKLY / ACTIVITIES	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14
Course registration														
Project design														
Write a final report														
Registration with my IPO														
Assembling project materials components														
Design testing														
Material identification														
Material testing														
Completing the project in its entirety														
Data analysis														
Fabrication														
Plagiarism review														
Presentation of the project progress														
Preparing for a presentation														
Abstract review by supervisor														
Technical paper review by supervisor														



## APPENDIX G: PLAGIARISM CHECKER (PROJECT 1)

### Proposal

#### ORIGINALITY REPORT

<b>19%</b> SIMILARITY INDEX	<b>18%</b> INTERNET SOURCES	<b>3%</b> PUBLICATIONS	<b>12%</b> STUDENT PAPERS
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#### PRIMARY SOURCES

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<b>9</b>	<b>Submitted to Bahrain Polytechnic</b> Student Paper	<b>1%</b>

