

**DESIGN GREEN FOOD PACKAGING
FOR TAKE AWAY HOT DISHES**

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for the award of the degree of
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DECLARATION

“I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged.”

Signature:

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Date:

*This report was done specially for Puan Hasmah binti Sidik
and Puan Norasra binti A Rahman*

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ABSTRACT

Food packaging has been a common issue in society for a long time. One of the issues that always stated was on the quality of food that it contain especially for hot dishes. Besides, food packaging is also related to the environmental impact and the safety of the food. This is due to the several material used had a chemical contact with the food especially the high temperature food. A modification was made from the existing waffle packaging. Some materials were chosen according to their properties that were suitable for the design specification for take away hot waffle. ANSYS Multiphysics software was used to simulate the temperature behavior of a modified food packaging. The simulation was based on a thermal conductivity with the focus to analyses temperature drop of the packaging materials. The comparisons to verify the result of simulation were made between the experiment results. It was found that result from analysis is very close to the corresponding result measured in experiment. It shows the temperature drop between both analyses gave the same pattern. This proves the combination of several materials was capable of producing a revolution for hot waffle packaging.

ABSTRAK

Pembungkus makanan telah menjadi satu isu yang biasa dalam kalangan masyarakat setelah sekian lama. Antara isu yang sering diperkatakan adalah mengenai kualiti makanan yang disimpan terutamanya melibatkan makanan yang panas. Selain itu, pembungkus makanan juga sering dikaitkan dengan kesan terhadap alam sekitar serta keselamatan produk makanan. Hal ini demikian kerana sesetengah bahan yang digunakan bertindakbalas dengan makanan terutamanya pada suhu yang tinggi. Pengubahsuaian telah dibuat berdasarkan pembungkus wafel yang sedia ada. Beberapa bahan telah dipilih mengikut sifat – sifat mereka yang sesuai dengan spesifikasi rekaan bagi wafel panas yang ingin dibawa pulang. Perisian ANSYS Multiphysics telah digunakan untuk membuat simulasi mengenai kelakuan suhu pembungkus makanan yang telah diubahsuai. Simulasi yang dibuat adalah berdasarkan kekonduksian terma dengan menumpukan kepada analisis penurunan suhu bahan pembungkusan tersebut. Perbandingan untuk mengesahkan hasil simulasi telah dibuat diantara hasil eksperimen. Hasil daripada simulasi adalah hampir sama dengan hasil yang diperolehi daripada eksperimen. Ia menunjukkan penurunan suhu diantara kedua – dua analisis memberikan corak penurunan yang sama. Ini membuktikan bahawa gabungan beberapa bahan mampu menghasilkan revolusi kepada pembungkus wafel yang panas.

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LIST OF SYMBOL

T_{in}	=	temperature inside the packaging, °C
T_{out}	=	temperature outside the packaging, °C
t_1	=	time taken at 3 minutes
t_2	=	time taken at 6 minutes
t_3	=	time taken at 9 minutes
t_4	=	time taken at 12 minutes
t_5	=	time taken at 15 minutes

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CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Advances in food processing and the growing consumer demand for healthier products that do not lead to environmental issues and human health has led to change in the approaches used for the manufacture of materials by the food packaging industry. Most of the synthetic products currently used are not degradable and their cost is rising steadily as they are produced from non-renewable resources such as oil (Gutiérrez et al. 2014). The usage of this kind of material will cause natural source reduction.

Packaging design is subjected to complex set of influences to the consumer or user especially the one that contributes to chemical substance. Among the main influences, new technology, materials development, logistic requirements, environmental issues, consumer preferences and marketing aspects (Rundh 2009). All the influences play a key role in designing the food packaging varies with consumers and product safety.

The key to successful packaging is to select the package material and design the best satisfy competing needs with regard the product characteristic, marketing consideration including the distribution needs and consumer needs, environmental and waste management issues and cost.

1.2 PROBLEM STATEMENT

This paper addresses the way packaging design can be used in order to meet customer satisfaction and can lead to less environmental problem. Besides, this paper also describe and analyze the suitable material used as a food packaging for take away hot dishes from previous study. Nowadays, several of food packaging is used in the sale of food product. Some of the design might not suitable for certain food condition especially for hot waffle. Besides, the used of unsafe materials for food packaging will effect human health and environment. Thus, the green food packaging play a primary role in order to satisfy industry requirements, customer desires, maintains food safety and minimizes environmental impact.

1.3 OBJECTIVES

This project is about the study of green food packaging. The objective of this project is to design the green food packaging that ensures the food quality and safety of take away hot dishes.

1.4 SCOPES

The design of this green food packaging is only specified to take away hot waffle. Every types of food need different material and design to content or protect the food from being exposed or damage. There are several scopes in this study which are:

1. To study the evolution and the role of food packaging and its environmental impact.
2. To identify the material that can be used in designing the green food packaging for hot waffle.
3. To simulate the waffle packaging using ANSYS Multiphysics software.

1.5 METHODOLOGY VIEW

This paper therefore addresses the way packaging design can be used in order to meet customer satisfaction and can lead to less environmental problem. Besides, this paper also describe and analyze the suitable material used as a food packaging for take away hot dishes from previous study and the new technology. Nowadays, several of food packaging is used in the sale of food product. Some of the design might not suitable for certain food condition especially for hot dishes. Besides, the used of unsafe materials for food packaging will effect human health and environment. Thus, the green food packaging play a primary role in order to satisfy industry requirements, customer desires, maintains food safety and minimizes environmental impact.

The paper is constructed as follows. The first section describes the role of food packaging and its environmental impact follow with second section about material selection in designing green food packaging for hot waffle. The design specifications are determined based on the previous study from all the journals, thesis, websites, books and articles gain before. As all the design specifications are identified, the next step is design process. In this stage, the design will be made based on the existing product and the comparison will be made based on the advantages and disadvantages of both products. Design stage will also provide a certain material type which has no side effect to the human and the environment. This material is then will be analyze in order to see the ability that specified to a certain design specification.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter consists of all previous studies or literature review related to this project and explains more detail about green food packaging. It includes the role of food packaging, the innovation of green food packaging, suitable material used for hot dishes packaging, packaging design and impact of food packaging to the environment and health.

2.2 ROLE OF FOOD PACKAGING

Packaging is a key component of our modern lifestyle. It is one of the essential elements in the move to convenience foods allowing single or small “serves” to cater for family units of varying sizes, for quick preparation of food and it provides evidence about the food or product that has been tempered with.

Packaging plays an important role in protecting food. It protects the goods we buy from wastage and damage. Without proper packaging, material handling would be messy, inefficient and costly. Besides, it will also affect the modern consumer marketing which can cause the loss of benefit in packaging industries.

The packaging also plays an important role as a medium in spreading the information about the food such as the content of the food, price, cooking instruction and also the information about the nutritional value of the food. Packaging protects the interest of the consumer. The information contained on the package tells the consumer what the product is and how to use it (Blumer 2010). The information provided on packaging allows the consumer to make a good decision in choosing the good product to be purchase and use.

By referring on the previous study, packaging has been defined as “all products made of any materials of any nature to be used for the containment, protection, handling, delivery, and presentation of goods from raw material to processed goods from the producer to the user of the consumer (Blumer 2010).

There are three broad categories of packaging which is primary packaging or often called as sales packaging, secondary packaging also known as group packaging and the third one is tertiary packaging or transport packaging. All the three categories of packaging plays the different role based on its categories and its functional used but all of them are often ore widely used in the world. It is consumed based on its uses, the types of product, the quantity or size of the product and also based on the physical handling of the product.

Every product has different types of packaging in order to give high protection to the product and also to provide the consumer with good appearance. Packaging also has a several function such as containment, protection and preservation, function of environmental aspect, as a medium of communication and also reduction of pilferage.

In today’s competition business world, packaging industry is pressures on the changing trends and influences to ensure it is able to respond quickly and effectively to new challenge. To maintain the competitive edge, the pressure on packaging industry will continue in order to provide cost competitive and innovative solution for packaging based on customers requirement and demand.

2.3 INNOVATION OF GREEN FOOD PACKAGING DESIGN

Packaging and packaging design have become an important factor in marketing diverse “consumer goods”. However, it is subject to a complex set of influences from the business environment. As the consumer required and demand is getting higher in the modern technology, the challenges for packaging industry have been increase.

As we can see, nowadays people are often used plastic to pack their food because it is the easier product that serves the customers. The increase in the presence of plastic in our lives is an unstoppable trend due to the versatility of this material. So innovation in the packaging industry has been focusing on the development of new, more sustainable, economically viable materials with enhanced properties and which also perform the functions required by this sector (Garrido et al. 2014).

Customers always required a good product, the good packaging design that is friendly to user, the packaging that can be reused or recycle, and sometimes they required something that can suite to every type of usage such as a packaging that can stand to high temperature, packaging for oily food and also there are several demand on the packaging that can keep the temperature of the food and also the good product that do not cause harm to the user and do not lead to environmental pollution.

The growing of consumer demand has led to change in the approach used for the manufacturer of materials by the food packaging industry. This is because, most of the synthetic products currently used are not degradable and their cost is rising steadily as they are produced from non-renewable resources such as oil (Gutierrez 2014).

Some people realize the reducing of this source and they try to create something for more better in order to satisfy the demand of the users. For example, in the study of the sustainable packaging design, the researcher has created a new product which is biodegradable container from agro-industrial by-products (Garrido 2014). Other than that, another research is also found a new design for food

packaging by using some native starch derived from cush – cush yam (Gutierrez 2014).



Figure 2.1: Example of biodegradable container for oily product
(Source: Garrido, (2014))

The specification of the packaging design will be discussed more on the design and material selection consideration part.

2.3.1 Basic Material Used For Food Packaging

The packaging industry has been at the forefront of the environmental debate for over a decade. Packaging is not, however, a major waste problem in the world but overall food packaging industry has a sound environmental record. Instead of environmental issues, the food packaging is also been judged due to its safety and the product protection. It is include the types of material used in the designing the food packaging.

As we can see, people nowadays are often to use a plastic bag or polystyrene to packing their take away dishes for customer although there are so many advertisements or campaign about the cause of using those plastic bags has been

done in order to make people realize the effect of using it. But people basically will be noticed once the problem affects their own body or surroundings.

In the innovation of food packaging, there are so many materials that have been used in order to produce a good product which is the product that is not harmful to users and also to the environment. But there are some said that different packaging materials provide different advantages and there will also be a different in the disadvantages (Bayley 2012).

Glass for example, it preserve the taste of the food batter and is chemically inert. But some glass bottle or jars may contain lead. Researcher from the University of Heidelberg in Germany has make an experiment on 125 brands of drinking water from 28 countries and showed that water packed in a glass bottle contain more lead compared to the water bottled in polyethylene terephthalate (PET) plastic (Bayley 2012).

The basic material or the common materials used for packaging are paper, fiberboard, plastic, glass, steel and aluminum. During the past year of food packaging evolution, there are several types of material has been mix together in order to create an innovative and beneficial packaging to user and also to the packaging industries. As for food packaging industry, the innovation is made basically due to the customers demand and also due to the marketing strategies for the company itself.

As we can see, in the pass of decades the evolution of material used for packaging does not have the ending. It can be said that, the food packaging industries has created a lot of food packaging design in order to fulfill the customer's requirement and to fill the demand of the food industries. But most of the basic materials used are the same and the different is how it undergoes the series of action in order to change the characteristic of the material suitable for its uses.

One of the basic materials that are widely used in the food packaging is paper. It is not only used for packaging food but it is also used for transport packaging such as corrugated cupboard due to its characteristic in lightweight. Other than that, the

used of paper has been seen as the most simple material because it can be easily recycle or can simply be disposed without critical equipment needed compared to other materials. The current recycling rate for paper and board packaging waste is 49% (Food Packaging Wastes And Environmental Impact 1990).



Figure 2.2: Example of paperboard used in food packaging
(Source: RockTenn company, (2013))

Glass is the most common form of packaging waste. It can be reused or recycled easily. But same as other materials, it has their own advantages and disadvantages. The disadvantages is due to the lead contain in the glass. On the other hands, studies have found that the chemical contamination of food not coming from the glass itself but mostly it is from the material used to seal the metal lids on glass jar or bottle. A research noticed that the seal bottle that used polyvinyl chloride (PVC) gasket will contain di-ethylhexyl phthalate (DEHP) and sometimes the level of phthalates is unacceptable by the Food Safety Authority (Bayley 2012). From other study, phthalates has been associated and has been determined as endocrine disruption in humans. It means that it can give a side effect to the user.

Material that also has been used instead of paper and glass is aluminum. It has been used in many packaging application. For example used as beverage cans,

foils and laminates and it have a high value as a scrap metal. Based on the previous research from United Kingdom, the price of aluminum can be range from 650 – 750 pounds per ton. From estimation that has been made over 5 billion aluminum cans consumed in U.K in 1993, 31% of them were recycled. It is because, aluminum is known with its characteristic that it can be recycle economically and easily.

Aluminum is also used for bulk items such as steam – table pans, round carryout container with board lid or clear dome and used in many bakery containers such as pastry container. Some aluminum is used to make party platters. It can be appears in silver or may be coated in colors. New innovation has created smooth – wall container for a more upscale look. As the properties of aluminum that can retain heat and cold well, it is often used in many types of food industries.

Besides, aluminum is also a material with high crack – resistance in the freezer and high leak resistance for a high temperature. It is extremely versatile due to its properties. It is because, aluminum can go to oven from freezer and then can straightly use in serving tables. It offers a variety of lidding option such as clear domes, laminated board, aluminum hood and film lid for special case. Aluminum is also comes in variety of gauge. It is also inexpensive material except with specialty coatings.

Another material that is often used in food packaging is plastic. Plastic also offers a lot of advantages based on its characteristic. By comparing to other materials, plastic gives several advantages in its sturdiness and low weight (Food Packaging Wastes And Environmental Impact 1990). Even though plastic can be recycling but it needs a modern technology in which there are only exist in several countries. Although in U.K, there is a lack of facilities needed to make a recycle process and the rate of recycle for plastic is far more below than other materials (Food Packaging Wastes And Environmental Impact 1990). The balance from the recycling process are either disposed by landfill or incinerated.

As for plastic material, there are several types of plastic used as food packaging such as polystyrene, polypropylene, PVC and foamed polypropylene. Different types of plastic have different types of used with different characteristics,

appearance and also different with its properties especially related to the manufacturing process and the way it can be disposed.

In our country, Malaysia, the used of several types of food packaging is not a new thing to be noticed. What is needed to be taking care by the user is the effect of the food packaging to the user itself and also to the impact to the environment. Some materials will provide a lot of benefit to user but it may affect the environment and some of them can have the different spec to the environment and user. But, to choose the best material is always being a question in many researchers mind.

2.3.2 Design and Material Selection Consideration

Design and material selection is an important stage in design process. The selection needs considerations in order to make a right decision for the design. In designing and selecting material for green food packaging especially related to hot waffle, there are several matter need to be considered such as the thermal resistance of the material and material that are friendly to users also to the environment.

2.3.2.1 Thermal Resistance

Waffle is a type of food which is hard to be serving to the customers especially for a take away hot waffle. There are so many specifications that need to be considered in order design the packaging that can keep the quality of the waffle and to make sure the material used have a high thermal resistance suitable for the type of food that need to be packed.

Based on the discussion on basic material used for food packaging, materials that are suitable to use are glass, aluminum and paper. These three materials will give a suitable application as it can stand a high temperature and have no chemical contact with the food it contains. Several papers that is used in food packaging industry for take away hot and oily food product are kraft paper, paperboard and sulfite paper. But by comparing there three types of paper, kraft paper and sulfite paper is more