

THE DEVELOPMENT OF  
"READY-TO-EAT THAI STYLE MAKI SET"

BY  
MS. PASACHON JITNUEANG

A special project submitted to the Faculty of Biotechnology,  
Assumption University in part of fulfillment of the requirements of the  
degree of Bachelor of Science in Biotechnology

May, 2006

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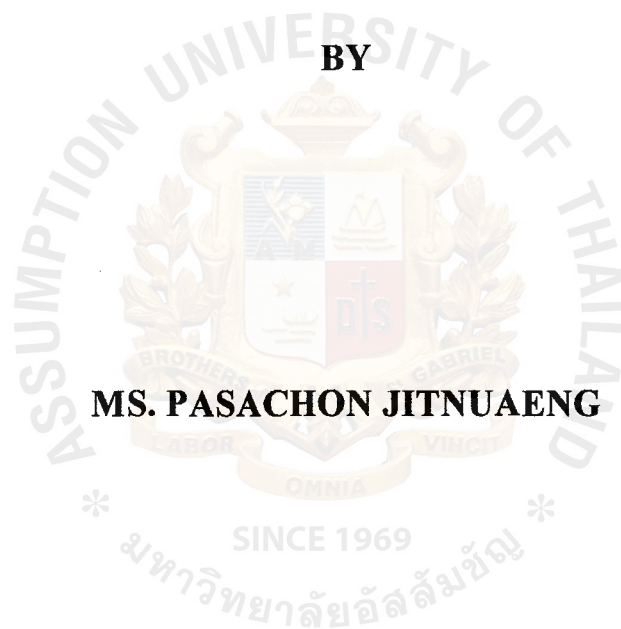
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**2006**

**Title :** The development of "Ready-to-eat Thai style Maki set"

**By :** Ms. Pasachon Jitnueang

**Project Advisor :** A. Tatsawan Tipvarakarnkoon

**Level of study :** Bachelor of Science

**Department :** Food-Technology

**Faculty :** Biotechnology

**Academic year :** 2006



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Title : The development of “Ready-to-eat Thai style Maki set”  
Name : Ms. Pasachon Jitnueang  
Project advisor : A. Tatsawan Tipvarakarnkoon  
Academic year : 2006

### **Abstract**

The aim of this project was to develop the Japanese traditional Maki as Thai style Maki, which shall be convenience for one consumer in a serving size. The mixing of glutinous rice (sticky rice) and Jasmine rice were used instead of Japanese rice. In addition, the product was filled by the Thai style fillings which were chosen from the marketing survey by target consumer. There were three differences filling in one serving size which were Stir fry pork with mushroom, Omelet with carrots and Pork pa-nang curry. The formulation step was conducted to select the appropriate ratio between glutinous rice and jasmine rice by using 9-point hedonic scale. The appropriate ratio selected by the panelists between jasmine rice and glutinous rice was 50:50. The sensory evaluation of the product attributes of each three differences filling and the appropriate ratio between rice and filling were evaluated. The results showed that the appropriate ratio between rice and filling was 25:75. Thus, the process development was conducted, which mentioned on the time for reheating of microwave oven. The appropriate time for reheat “ready-to-eat Thai style Maki set” product was 1.30 minutes, which keeps the qualities of product attributes. After finding out the final formulation and appropriate reheating time, the consumer acceptance test was conducted by Central Location Test and Home Use Tests methods. More than 97% of consumers accepted the product and more than 80% are willing to pay for product if it available in the market. Finally, the storage time was evaluated by means of sensory evaluation. The sensory evaluation was conducted at Day 1, Day 4 and Day 7 during storage of products by using 9- point hedonic scale. The result showed that ready-to-eat Thai style Maki set are accepted during storage more than 7 days without changing the quality of the products.

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**Keywords :** Maki, Jasmine rice , Glutinous rice, Ready-to-eat.

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.....  
(Ms.Pasachon Jitnueang)  
May, 2006

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## **Chapter1**

### **Introduction**

The Japanese believe that food should satisfy all the senses. Food is always prepared with great care and beautifully presented : sometimes very simple, and sometimes is an intricate array. The freshest ingredients are combined in ways that delight the eyes as well as the taste buds. Seasonings are generally quite subtle, in order to enhance the natural flavors. Maki is usually served as a main course or as the penultimate dish in a Japanese dinner, prior to dessert. Maki is a bite-sized rolls of sushi rice and seafood or vegetables may or may not wrapped in nori. The earliest Maki methods probably came to Japan from Southeast Asia or China, at about the time that the Japanese were learning to grow rice. Making Maki both easy enough to be done at home and so complicated that it takes years for the professional chef to master. The original Maki combines seasonal seafood or others and rice, the staple diet of the Japanese people. A wide variety of vegetable can be used in Maki too. There are more Maki restaurants in Japan than any other type of restaurant, although traditional Maki shops are becoming rare. The increasing number of Maki restaurants outside Japan attests to the worldwide popularity of this delightfully appetizing food. Maki is seemed to be popular in nowadays due to Maki (an exquisite food) is such a dietary food and also one of the healthiest and most nutritional foods available. Thus, the addition of herbs would be more trendy and interesting to consumer. Therefore, the development of Japanese traditional Maki to become Thai styles Maki can provide more nutritional value added and mixing of both popular trend from Japan and Thailand. Moreover, as nowadays people lifestyle become changing. People prefer

quick meal and eat out. Ready-to-eat food is become widely and more popular. As the finally product is the development of ready-to-eat Thai styles Maki set, it can provide more convenience to consumer during their lunch or dinner, which take only a few minutes to reheat it. One serving size, which also provide varieties of fillings in one package, as well. Furthermore, even there are some frozen or ready-to-eat Maki available in market, such as Oishi brand or other export frozen Maki in European countries but there is still no ready-to-eat Thai styles Maki set available in market in nowadays.

Therefore, the aims of this project were to develop the original Maki to the Thai styles and convenience for consumers in a serving size.



## Objectives

1. To conduct the marketing survey of Maki product and frozen product consume in the market and the appropriate filling of ready-to-eat Thai styles Maki set product by using questionnaires.
2. To optimize the appropriate formula of product.
3. To optimize the time on microwave heating, to reheat the product.
4. To conduct consumer test.
5. To study the storage time of product.

## Expected Result

1. Consumer behavior for Maki product and frozen product.
2. Appropriate formulation of “ready-to-eat Thai style Maki set”.
3. Appropriate time on microwave heating in order to reheat the product.
4. Innovation idea for distribution of Maki as Thai style filling.
5. The storage time of product is extended.

## Product Concept

The development of “ready-to-eat Thai style Maki set” produced from high quality of Thai style raw materials. Thai rice is used instead of Japanese rice. The product can be kept at frozen temperature or in refrigerator for storage. The shelf life of product is longer than the original Maki, without any preservative, color and flavor added. The product is targeted at general consumer for starvation quenching with easy preparation by microwave oven.

## Chapter2

### Literature review

Maki is also one of the healthiest and most nutritional foods available. Rice, vegetables, fish, seafood, vinegar are basic original Maki ingredients, all readily available and all excellent nutritionally. Therefore, even the original Maki is going to develop to Thai styles, it can increase value added from Thai ingredients are the followings;

- Rice

Rice is the main food for more than half the world's population. It is also a main ingredient of making Maki. Moreover, for rice, as it is a well-known dieting procedure that chewing food well aids in digestion and makes people feel less hungry. Maki rice is fairly firm and therefore requires chewing longer. This allows the appetite nerve center of the brain to receive the signals of satiety, and hence aids in eating less.

***Jasmine rice*** : It is a good source of protein and carbohydrate and because it is digested slowly, it releases energy gradually. It has the additional benefit of being gluten-free, so it can be eaten by people who are wheat-intolerant.

***Glutinous rice*** : apart from provide adherence with jasmine rice to form Maki, glutinous rice has a properties of medicine such as it can treat nausea, dysentery ,and decrease level of urine and sweat ,and maintain stomach and spleen.

- Vinegar

It has antibacterial qualities and has long been used to preserve food. It is used as an aid to digestion, prevents fatigue and lessens the risk of high blood pressure.



- Vegetables

They are an excellent source of vitamins, minerals and fiber. In addition, it has been shown that there is a lower incidence of cancer in populations where a good quantity of fruit and vegetables are consumed. Plants contain compounds known as phytochemicals, which help protect the body from disease.

- Thai herbs

Many herbs and spices used in Thai cuisine have beneficial medicinal properties. Here are some examples.

**Garlic** : Garlic is an annual herbaceous plant with underground bulbs comprising several cloves. Dried mature bulbs are used as a flavouring and condiment in Thai cuisine. The bulbs contain a 0.1-0.36% garlic oil and organic sulfur compounds. Therapeutic uses are as an antimicrobial, diaphoretic, expectorant, anti flatulence and cholesterol lowering agents.

Fig.1 Garlic (www.northernthailand.com, 2006)

**Chilli** : Chilli is an erect, branched, shrub-like herb with fruits used as garnishing and flavouring in Thai dishes. There are many different species. All contain capsaicin, a biologically active ingredient beneficial to the respiratory system, blood pressure and heart. Other therapeutic uses include being a carminative and anti flatulence agent, and digestant.



Fig.2 Chilli (www.northernthailand.com, 2006)

**Cumin** : Cumin is a small shrubby herb, the fruit of which contains a 2-4% volatile oil with a pungent odour, and which is used as a flavouring

and condiment. Cumin's therapeutic properties manifest as a stomachic, bitter tonic, carminative, stimulant and astringent.



Fig.3 Cumin (www.northernthailand.com, 2006)

**Ginger** : Ginger is an erect plant with thickened, fleshy and aromatic rhizomes. Used in different forms as a food, flavouring and spice. Ginger's rhizomes contain a 1-2% volatile oil. Ginger's therapeutic uses are as a carminative, antinauseant and antifatulence agent.

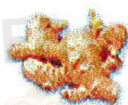


Fig.4 Ginger (www.northernthailand.com, 2006)

**Galanga** : Greater Galanga is an erect annual plant with aromatic, ginger-like rhizomes, and commonly used in Thai cooking as a flavouring. The approximately 0.04 volatile oil content has therapeutic uses as carminative, stomachic, antirheumatic and antimicrobial agents.



Fig.5 Galanga (www.northernthailand.com, 2006)

**Hoary Basil** : Hoary Basil is an annual herbaceous plant with slightly hairy and pale green leaves, eaten either raw or used as a flavouring, and containing approximately 0.7% volatile oil. Therapeutic benefits include the alleviation of cough symptoms, diaphoretic and carminative agents.



Fig.6 Hoary Basil (www.northernthailand.com, 2006)

**Kaffir** : The leaves, peel and juice of the Kaffir Lime are used as a flavouring in Thai cuisine. The leaves and peel contain a volatile oil. The major therapeutic benefit of the juice is as an appetizer.

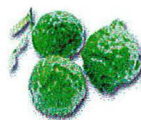


Fig.7 Kaffir (www.northernthailand.com, 2006)

**Krachai** : This erect annual plant with aromatic rhizomes and yellow-brown roots, is used as a flavouring. The rhizomes contain approximately 0.8% volatile oil. The plant has stomach ache relieving and antimicrobial properties and therapeutic benefits as antitussive and antifatulence agent.



Fig.8 Krachai (www.northernthailand.com, 2006)

**Ta-khrai** : This erect annual plant resembles a coarse gray-green grass. Fresh leaves and grass are used as flavouring. Lemon grass contains a 0.2-0.4 volatile oil. Therapeutic properties are as a diuretic, emmanagogue, antifatulence, anti flu and antimicrobial agent.



Fig.9 Ta-khrai (www.northernthailand.com, 2006)

**Lime** : Lime is used principally as a garnish for fish and meat dishes. The fruit contains Hesperidin and Naringin, scientifically proven antiinflammatory flavonoids. Lime juice is used as an appetizer, and has antitussive, anti flu, stomachic and antiscorbutic properties.

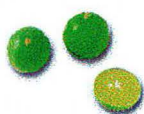


Fig.10 Lime (www.northernthailand.com, 2006)



**Marsh Mint** : The fresh leaves of this herbaceous plant are used as a flavouring and eaten raw in Thai cuisine. Volatile oil contents give the plant several therapeutic uses, including carminative, mild antiseptic, local anesthetic, diaphoretic and digestant properties.



Fig.11 Marsh Mint ([www.northernthailand.com](http://www.northernthailand.com), 2006)

**Pepper** : Pepper is a branching, perennial climbing plant from whose fruiting spikes both white and black pepper are obtained. Used as a spice and condiment, pepper contains a 2-4% volatile oil. Therapeutic uses are as carminative, antipyretic, diaphoretic and diuretic agents.



Fig.12 Pepper ([www.northernthailand.com](http://www.northernthailand.com), 2006)

**Sacred Basil** : Sacred Basil is an annual herbaceous plant that resembles Sweet Basil but has narrower and often times reddish-purple leaves. The fresh leaves, which are used as a flavouring, contain approximately 0.5% volatile oil, which exhibits antimicrobial activity, specifically as a carminative, diaphoretic, expectorant and stomachic.



Fig.13 Sacred Basil ([www.northernthailand.com](http://www.northernthailand.com), 2006)

**Shallots** : Shallots or small red onions, are annual herbaceous plants. Underground bulbs comprise garlic-like cloves. Shallot bulbs contain a volatile oil, and are used as flavouring or seasoning agents. Therapeutic properties include the alleviation of stomach discomfort, and as an



antihelmintic, antidiarrhoeal, expectorant, antitussive, diuretic and anti flu agents.

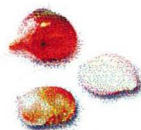


Fig.14 Shallots (www.northernthailand.com, 2006)

**Sweet Basil:** Sweet Basil is an annual herbaceous plant, the fresh leaves of which are either eaten raw or used as a flavouring in Thai cooking. Volatile oil content varies according to different varieties. Therapeutic properties are as carminative, diaphoretic, expectorant, digestant and stomachic agents.



Fig.15 Sweet Basil (www.northernthailand.com, 2006)

**Turmeric :** Turmeric is a member of the ginger family, and provides yellow colouring for Thai food. The rhizomes contain a 3-4% volatile oil with unique aromatic characteristics. Turmeric's therapeutic properties manifest as a carminative, antifatulence and stomachic.



Fig.16 Turmeric (www.northernthailand.com, 2006)

- Meat , pork, chicken

Provide high protein to maintain body.

- Fish and seafood

They are highly nutritious and low in calories. Most fish and seafood are excellent source of vitamin B12, which is essential for building and maintaining cells, and of iodine, which is needed for the thyroid gland to work effectively.

- Egg

They provide some calcium, phosphorous, iron and so on.

From the above, the benefits of developing original Maki to Thai styles have shown out.

As the product is mentioned on development and convenience for consumers to buy and prepare, the followings topics need to be studied.

### 1. Microwave heating

Microwaves were used during World War II as the basis for radars to detect and locate enemy aircrafts at long distances. During this time in 1945, it was accidentally discovered by an American engineer Percy Le Baron Spencer who was working with radar equipment and noticed that some candy he had in his pocket had melted. Spencer realized that it was these microwaves that had heated the candy and his body too. He worked for Raytheon at that time, and they soon realized the potential of this discovery, and produced the first household microwave oven.

The microwave oven consists of a magnetron tube, which converts electricity into high frequency microwaves. Microwaves are a form of electromagnetic energy, like light waves or radio waves, and occupy a part of the electromagnetic spectrum. Microwaves cause food molecules to vibrate rapidly, creating friction that produces heat which then cooks the food. In other words, food cooked in a microwave simply absorbs microwave and turns their energy into thermal energy, which cooks the food. Microwaves are colorless, odorless, tasteless, and these are not radioactive. Microwave oven is one of the most energy efficient appliances money can buy today. For example, it takes 18 times the electricity to bake a potato in a regular oven than in a microwave. Microwaves cook from the outside towards the center of the food. Microwave ovens are faster for most cooking jobs because the energy heats the food and not the oven or the containers. They do not also heat

up the kitchen, especially in the summer time like the other cooking appliances.

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Microwave heating is a heat transfer technology using microwaves electromagnetic waves between 100 centimeters and 1 centimeter in wavelength to heat an object.

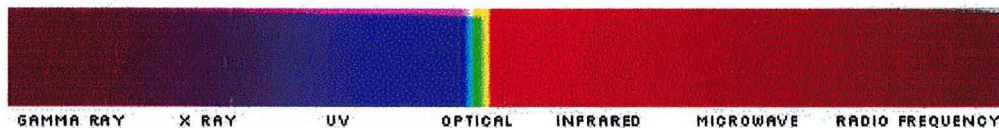


Fig.17 Spectrum (www.advancedenergy.org, 2006)

As the product is ready-to-eat, thus, microwave is needed for reheat the product again. However, microwave heating must concern temperature of microwave and time for reheating the product.

## 2. General formula of making Maki

There are many kinds of Maki but mostly filling are Japanese styles. Moreover, only some kinds are become popular. These are formula (1 serving size) of the popular Maki that available in markets.

- Hana Maki (Salmon Rolls with Mayonnaise and Flying Fish Roe)

Table1: Show the ingredients of making Hana Maki

Ingredients	Amount	Remark
Smoked salmon	50g. or 1¾oz	10 thin slices
Cooked sushi rice	300g. (2cups)	
Mayonnaise	125ml. (1/2cup)	
Wasabi paste	1 tsp.	
Flying fish roe	2 tbsp.	
Chopped chives	2 tbsp.	Finely chop

Source : The Complete Book of Sushi, 2004



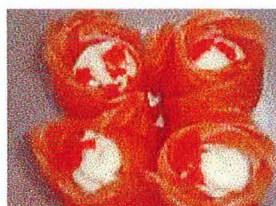


Fig.18 Hana Maki (The Complete Book of Sushi, 2004)

- Gunkan Maki ( Battleship Sushi)

Table2: Show the ingredients of making Gunkan Maki

Ingredients	Amount	Remark
Fresh scallops	6 large items	
Sake	2 tbsp.	
Spring onion	1 item	Finely chop
Tezu	Small bowl	Made from 125ml. (1/2 cup) water and 1 tbsp. rice vinegar
Cooked sushi rice	300g. (2 cups)	
Toasted nori	4 sheets	Cut in 2½cm. (1-in.) strips
Salmon roe	120g. (4oz)	
Seasoned jellyfish (chukka kurage)	120g. (4oz)	
Seasoned seaweed (chukka wakame)	60g. (2oz)	
Sea urchin	80g. (3oz)	

Source : The Complete Book of Sushi, 2004



Fig.19 Gunkan Maki (The Complete Book of Sushi, 2004)

- California Rolls

Table3: Show the ingredients of making California Roll

Ingredients	Amount	Remark
Avocado	1 large item	
Lettuce leaves	8 leaves	Coarsely chop
King tiger prawns	12 items	Poach, peel, vein remove
Mayonnaise mixed with wasabi paste	3 tbsp.	Mix mayonnaise with 1 tsp. wasabi paste
Beni shoga	3 tbsp.	
Salmon roe	3 tbsp.	
Toasted sesame seeds	1 tbsp.	
Cooked sushi rice	450g. (3 cups)	
Toasted nori	4 sheets	

Source : The Complete Book of Sushi, 2004



Fig.20 California Rolls (The Complete Book of Sushi, 2004)

- Genki Maki (Salmon Outside-in Rolls)

Table4: Show the ingredients of making Genki Maki

Ingredients	Amount	Remark
Nori	2 sheets	
Smoked salmon	50g. or 1¾oz	10 thin slices
Cooked sushi rice	300g. (2cups)	
Japanese cucumber	1 item	Shred
Beni shoga	3 tbsp.	
Toasted sesame seeds	2 tbsp.	

Source : The Complete Book of Sushi, 2004





Fig.21 Genki Maki (The Complete Book of Sushi, 2004)

- Maki Sushi (Cucumber Rolls, Crab Rolls and Salmon Rolls)

Table5: Show the ingredients of making Maki Sushi

Ingredients	Amount	Remark
Japanese cucumber	1 item	Peel
Toasted nori	6 sheets	Cut in half
Water	125ml. (1/2cup)	
Rice vinegar	1 tbsp.	
Cooked sushi rice	450g. (3cups)	
Wasabi paste	2 tbsp.	
Toasted white sesame seed	2 tbsp.	
Salmon fillet	225g. (7oz)	1½ x 1½ x 18cm.strips
Cooked crabmeat	225g. (7oz)	
Soy sauce	90ml. (1/3cup)	
Beni shoga	180ml. (3/4cup)	

Source : The Complete Book of Sushi, 2004



Fig.22 Maki Sushi (The Complete Book of Sushi, 2004)

### 3. Effect of ingredients

As the product is required to keep in refrigerator, there are some effects that occur during keep in refrigerators. Due to refrigeration changes the quality of the rice, as it reduces its starchiness and stickiness, and the rice can be come quite hard. Even there are some frozen Maki available in markets but all of them are Japanese filling, which means the filling is uncooked. Thus microorganisms can grow in filling itself and contaminate to the rice which wrap around the filling. In addition, after reheating the Maki, the filling that should be raw can become cooked instead. Moreover, there is no ready-to-eat Thai style Maki available in markets yet, thus microbiological hazard and also some others effect of ingredients must be tested in laboratory, due to its filling is already cooked so it cannot compare with the original ones.

### 4. Shelf life of product

Mostly original Maki is prepared and immediately eating and it is not good idea to keep it at room temperature due to its filling is raw seafood. However, Maki manufacturing will prepare the product at night before selling to markets. In addition, naturally, Maki can be kept only one day. In case of frozen or kept in refrigerator it can provide longer shelf life than the original one. This may occur from low temperature can inhibit the growth of some pathogens. However, the taste of product can be affected by storage time.

### 5. Ready-to-eat food

Ready-to-eat-food is food that is ordinarily consumed in the same state as that in which it is sold or distributed. (Food Standards Australia New Zealand (formerly ANZFA, definition).

As nowadays, consumer lifestyles are changing due to limited time. Thus, the ready-to-eat food is considered as quick meal. The ready-to-eat food simply prepared by reheating in a microwave and consumers can enjoy a tasty meal within minutes. In addition, there are many brands, such as S&P launch the ready-to-eat food in market. Moreover, the ready-to-eat food is not difficult to find out because the ready-to-eat food is available in many places, such as 7-11, Family Mart, Big C, Tops and so on. Events mostly are something like pizza, hotdogs, sausages, sandwiches and so on, but the ready-to-eat food trends to be popular in the future. However, there is still lacking of kind of ready-to-eat food which are composed of rice, curry or any Thai fillings in the market.

#### 6. Frozen product

Frozen food is food preserved by the process of freezing (www.wikipedia.com, definition). Freezing food is a common method of food preservation which slows both food decay and, by turning water to ice, makes it unavailable for bacterial growth and slows down most chemical reactions.

Freezing only slows the deterioration of food and while it may stop the growth of microorganisms. Many enzyme reactions are only slowed by freezing. Therefore freezing commonly stops enzyme activity, either by blanching or by adding chemicals. Foods maybe preserved for several months by freezing. Long term freezing requires a constant temperature of  $-18^{\circ}\text{C}$  (0 Fahrenheit) or less. Some freezers cannot achieve such low temperature. The time food can be kept in the freezer is reduced considerably if the temperature in a freezer fluctuates. Fluctuations could occur by a small gap in the freezer door or adding a large amount of unfrozen food can change the temperature.

Freezing adversely affects the texture of many foods, and the texture of nearly all foods is damaged by thawing and refreezing. Since water expands when food is freeze, cell walls in food are often ruptured, resulting in food that is limp or pulpy when thawed. This is especially true of fruits and vegetables that have high water content. Less damage is done to vegetables that are high in starch. Less damage is also done if the food is frozen quickly, so unfrozen food should be placed in the coldest areas, which are near the bottom of the freezer. Some additives, such as sugar or sorbital, can hinder water's crystallization and preserve the food's cellular structure. Defects in the texture of thawed food can sometimes be occurred by cooking. Some food is frozen specially to get a frozen texture. Ice cream is an example of a food which is intended for consumption while frozen.

American inventor Clarence Birdseye (1886-1956), who developed the quick freezing process of food preservation in the early 20<sup>th</sup> century, is considered the father of the frozen food industry.

The food industry uses a technique called flash freezing, an application of supercooling, to quickly freeze food items. In this case, water contained inside the food is subjected to temperatures well below its melting/freezing point (273K or 0°C). This causes the water inside the foods to freeze very quickly.

Many Arctic communities would preserve food in holes or larders dug into the ice. There is a tradition in Scandinavia of preserving fish and especially herrings in this way. Cold stores provide large volume, long term storage for strategic food stocks held in case of national emergency in many countries.



## Chapter3

### Materials and methods

#### 1. Materials

##### Raw materials

1. Jasmine rice

Mabunkrong brand (100% jasmine rice)

2. Glutinous rice

Ka-set brand

3. Filling

Table6: Show all ingredients that used to make the filling

Filling	Ingredients
Pork pa-nang	Pork, coconut milk, red spur chilli, kaffir lime leave, sugar, salt, fish sauce, sweet basil, pa-nang curry paste.
Omelet with carrots	Eggs, carrots, sugar, oyster sauce, Maggi seasoning, vegetable oil.
Stir fry pork with mushroom	Pork, mushroom, sugar, fish sauce, oyster sauce, pepper, unsweetened condensed milk.

#### 2. Equipment and Utensils

1. Bamboo rolling mat (makisu)

The simple rolling mat used for making Maki rolls is made of thin strips of bamboo woven with cotton string.

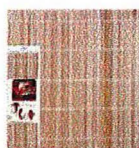


Fig.23 Bamboo rolling mat (www.amazon.com, 2006)



## 2. Plastic sheet

The sheet of plastic covers a rolling mat to prevent adherent rice to the rolling mat.



Fig.24 Plastic sheet ([www.shopping.com](http://www.shopping.com), 2006)

## 3. Rice cooker

The electric or gas rice cooker which can control the temperature and cooking time to give perfect rice every time.



Fig.25 Rice cooker ([www.kitchen.apartmenttherapy.com](http://www.kitchen.apartmenttherapy.com), 2006)

## 4. Rice paddle (shamoji)

This flat paddle is made of wood or plastic. Due to, it is a flat shape, it can slice through rice when mixing it without squashing the grains.



Fig.26 Rice paddle ([www.cuisine-japanaise.com](http://www.cuisine-japanaise.com), 2006)

## 5. Chopping board

Made of wood or resin or plastic.



Fig.27 Chopping board ([www.hk.bizfinder.yahoo.com](http://www.hk.bizfinder.yahoo.com), 2006)

## 6. Knives

Sharper and cut faster.



Fig.28 Knives ([www.organicauthority.com](http://www.organicauthority.com), 2006)

## 7. Mixing bowl

Made of stainless steel is suitable for making Maki.



Fig.29 Mixing bowl ([www.hormel.com](http://www.hormel.com), 2006)

## 8. Balance

Scale or electronic balance to weigh raw materials.



Fig.30 Balance ([www.stou.ac.th](http://www.stou.ac.th), 2006)

## Methods

1. Marketing survey of Maki product and frozen product consume and the appropriate filling of ready-to-eat Thai styles Maki set product

Marketing survey is based on the followings;

- Demographic

As population can determine market and demand of market, demographic is become important as different age, gender, income, education have different demand.

- Consumer behavior

There are factors affecting to consumer behavior that need to be concerned as the followings;

- Cultural Factors which mentions on culture, subculture and social class.

- Social Factors which mention on roles and statuses, family and reference group.
- Personal Factors which mention on age and life cycle stage, occupation, economic circumstances, lifestyle and personality and self concept.
- Psychological Factor which mention on motivation (need), perception, and attitudes.

From the above, the personal factors trend to be the most important factor.

- Consumer satisfaction

The demand of the product is also depend on consumer satisfaction, as it can predict the consumer repeating buying of product in further.

However, the marketing survey of Maki product and frozen product consume and the appropriate filling of ready-to-eat Thai style Maki set product was conducted at universities (ABAC and Chulalongkorn), office and shopping mall. 100 people were randomly selected in order to fill in a questionnaire, which mentioned on demographic information, consumer behavior on frozen product and consumer opinion on “ready-to-eat Thai style Maki set”.

## 2. Optimization of the appropriate formula of product

- Sample preparation

This is the basic formulation of the product in percentage per one piece. Rice and filling ratio were fixed at 60:40 in order to adjust the ratio of Jasmine rice and glutinous rice. RCBD were used. First three treatments of ratio between jasmine rice and glutinous rice were set up as the following table;

Table7: Ratio between jasmine rice and glutinous rice

Jasmine rice	Glutinous rice
25	75
50	50
75	25

The suitable treatment was shown out by based on sensory taste and stability of forming Maki, from 30 panelists. The suitable ratio between jasmine rice and glutinous rice was varied with the three ratios between rice and filling to find out the best formula as final. There were three treatments of ratio between rice and filling were set up as the following table;

Table8: Ratio between rice and filling

Rice (as appropriate Jasmine and Glutinous ratio)	Filling
25	75
50	50
75	25

The suitable ratio between rice and filling was evaluated from consumer satisfaction by 30 panelists.

### Formulation of Thai Fillings

(Pork Pa-nang, Omelet with carrots, Stir fry pork with mushroom)

#### “Pork pa-nang Maki” Recipe

Table9: Show the ingredients of making “Pork pa-nang Maki”

Ingredients	Percentage (%)	Remark
Pork	42.55	Cut into thin strips
Coconut milk	42.55	
Red spur chilli	0.26	Thinly slice
Kaffir lime leave	0.13	Torn into pieces
Sugar	2.39	
Salt	0.09	
Fish sauce	1.13	
Sweet basil	0.26	
Pa-nang curry paste	10.64	

#### Preparation

First of all, Put 20% of coconut milk over medium heat until some of the oil surfaces, then add 10.64% of the curry paste and slowly bring to a boil, stirring constantly. Next, put in 42.55% of pork strips and cook for 5 minutes and add 22.55% remain of coconut milk. Meanwhile, in a bowl, mix the rest of the ingredients, which are 0.26% of red spur chilli, 2.39% of sugar, 0.09% of salt, 1.13% of fish sauce and 0.26% of sweet basil, except for the kaffir lime leaves. Add these to the curried pork, stir well and simmer about 15 minutes. Finally, add 0.13% of kaffir lime leaves and remove from the heat.



### “Omelet with carrots Maki” Recipe

Table10: Show the ingredients of making “Omelet with carrots Maki”

Ingredients	Percentage (%)	Remark
Eggs	56.62	Beat the eggs and mix it well
Carrots	36.61	Cut into tiny dices
Sugar	0.9	
Oyster sauce	0.73	
Maggi seasoning	2.59	
Vegetable oil	2.55	

#### Preparation

Begin with beaten mixture of 56.62% of egg, 36.61% of carrots, 0.73% of oyster sauce, 2.59% of Maggi and 0.9% of sugar in a bowl, by a fork until combined. After that, heat 2.55% of vegetable oil in the frying pan over medium heat until foaming. Then, pour the egg mixture into the center of the pan and allow the egg mixture to set. As the egg mixture set, use a spatula to push the edges of the egg mixture. Then, turn down the other side, which is still uncooked, to make direct contact with the pan. Let the egg mixture to set.

Next, make sure that both side of omelet is cooked and remove the omelet from the heat.

### “Stir fry pork with mushroom Maki” Recipe

Table11: Show the ingredients of making “Stir fry pork with mushroom Maki”

Ingredients	Percentage (%)	Remark
Pork	65.90	Minced pork
Mushroom	16.47	Cut into tiny pieces
Sugar	2.47	
Fish sauce	1.55	
Oyster sauce	5.73	
Pepper	0.21	
Vegetable oil	1.07	
Unsweetened condensed milk	6.60	

#### Preparation

Firstly, mix 65.90% of minced pork with 6.60% of unsweetened condensed milk and 5.73% of oyster sauce in a bowl. Then, Place the bowl in the refrigerator for 5 minutes. Next step is soaking 16.47% of mushrooms about 20 minutes, when the mushrooms are soft, drain, and cut into thin strips. After that, heat a frying pan over medium heat. When very hot, add 1.07% of vegetable oil and heat until foaming. Then, add the minced pork mixture and stir-fry just until the minced pork shows no more pink. Next, add the whole thin strips mushrooms and stir-fry with the minced pork mixture. Finally, add 2.47% of sugar, 1.55% of fish sauce, 5.73% of oyster sauce and 0.21% of pepper. Then, stir-fry together. When all ingredients are well cooked, remove from the heat.

- Sensory evaluation

The sensory evaluation took place in faculty of Biotechnology (Assumption University). First of all, giving 3 different samples of ratio between jasmine rice and glutinous rice to 30 panelists (Biotech students) and also prepared a pencil, drinking water, tissue, and chopsticks to each panelist. Then let all panelists evaluated the samples by using 9-point hedonic scale test, as shown in appendix B.1. For ratio between rice : filling and formulation of all different Thai fillings (Pork pa-nang, omelet with carrot and stir fry pork with mushroom) were exactly evaluated as same as the sensory evaluation of the ratio between jasmine rice and glutinous rice. All output was analyzed by SPSS program.

- Process of making “ready-to-eat Thai Style Maki Set”

Glutinous rice and Jasmine rice were mixed and cooked.



Place long side of one plastic sheet lengthwise on bamboo mat about 3 slats from the edge closest to the Maker.



Dip both hands in finger bowl, shaking off excess.



Working from one side to the other, spread one-quarter of rice evenly over plastic sheet leaving a 1-inch (2.5 cm.) strip uncovered on the long side farthest from the Maker.



Gently rake fingers across grains to spread rice evenly.



Put the filling on 1/3 of spread rice. Spread filling evenly.



Using index finger and thumb, pick up edge of bamboo mat nearest the Maker.



Place remaining finger over fillings to hold them as you roll mat forward tightly, wrapping rice and plastic sheet around filling. The strip of plastic sheet without rice should still be visible.



Press gently and continue rolling forward to complete roll.



Gently press mat to shape and seal roll. Unroll mat and roll on cutting board.



Using a sharp knife to cut roll in pieces.



Remove out the plastic sheet.



Pack in box and keep in refrigerator or freezer

Fig.31 Process of making “ready-to-eat Thai Style Maki Set”

### 3. Optimization the time on microwave heating for reheating the product

As the product is required to reheat by using microwave, temperature and time are the important factors in this method.

Mostly microwaves that available in any households, convenience stores and offices quite have the same temperature setting, automatically. Thus, the medium heating levels of microwave (for the microwave that have 850 watt) were varied with three different times, which were 1, 1.30 and 2 minutes, by using RCBD. The suitable time (minute) evaluated by sensory of 30 panelists by 9-point hedonic scale.



#### 4. Consumer acceptance test of Thai style Maki set product.

The product was tested by two groups are as followings;

- Center location test (CLT)

100 target people at universities, office and shopping mall were randomly chosen, as the target group in general. The product samples, which were kept in refrigerator and already reheated, and questionnaires were given to the target people (as shown in appendix C.1)

- Home use test (HUT)

30 target people were given the product samples, instruction and questionnaires (as shown in appendix C.2) to test by themselves at their home.

All data from both Center location test and Home use test were analyzed by SPSS program.

#### 5. Storage test of product.

The attributes can be affected by storage time, so the sensory evaluation was conducted to find that the consumers are able to detect the changing of attributes during storage. Thus, the sensory evaluation was done on Day 1, Day 4 and Day 7.

#### 6. Product profiling of final product

The product profiling was conducted by 10 panelists. There were three different samples (Pork pa-nang filling, Stir fry pork with mushroom, and Omelet with carrots filling). At table, there were drinking water, soy sauce, chopsticks, tissue, paper and pen for each panelist. The detail of the product was described at the beginning. Then everybody was given sample of Pork pa-nang filling. After that, the test of product attribute began by mentioned on appearance(mean:shape and color of the product), aroma(mean:smell of the product), flavor(mean:smell and taste of the

product that can be detected during the product is in a mouth), texture(mean:texture of the product such as texture of rice, filling and overall that can be detected during chewing) and after taste(mean:smell of the product that can be detected after swallowing).

Gave time to all 10 panelists to list what could be observed according to the mentions, around 15 minutes. Then let all 10 panelists tell what could be detected from the sample of Pork pa-nang filling. Began with appearance, aroma, flavor, texture, and after taste. Listed all ideas on a board that everybody can see clearly. After that, each attribute was concluded in a short word. Next, sample of Stir fry pork with mushroom filling and sample of omelet with carrots filling were given to all 10 panelists, respectively. Then, did exactly the same as testing of the sample of Pork pa-nang filling. Finally, the 10 panelists were asked for any new idea of new apperance of the product, individually.



Fig.32 Product profiling by some panelists

## Chapter4

### Results and Discussion

#### 1. Marketing survey of Maki product and frozen product consume and the appropriate filling of ready-to-eat Thai styles Maki set product

##### Part1 : Demographic Information

Marketing survey was conducted from 100 subjects. The locations were divided into 4 areas of Universities, supermarket and office. The overall results are shown in table12. For demographic characteristics, 50% male and 50% female were random. As the target group is general, so every age was also random and the highest percentage of age was between the ages of 19-24 years old. Also most of them are student (High school, College, Bachelor degree and Master degree), which up to 42 percents. The second most is employee. For the educational level of the subjects was found that the highest level, which is 61 percent, is Bachelor degree, according to the most of subjects are student. In addition, most of subjects had income lower than 15,001 baht as can be seen from the result, there is 33 percents of the total subjects who had income less than 5,000 baht and 29 percents had income around 5,000-15,000 baht.

Table12: The percentage for demographic information on marketing survey

Title	Percentage(%)
1. Sex	
- Male	50
- Female	50
	Total 100

Title	Percentage(%)
<b>2. Age</b>	
- <18	14
- 18-24	42
- 25-30	13
- 31-36	6
- 37-42	7
- 43-48	9
- >48	9
Total 100	
<b>3. Occupation</b>	
- government officer	17
- business owner	1
- housewife	1
- employee	23
- student	42
- government enterprise	1
- others	15
Total 100	
<b>4. Education</b>	
- Lower than High school	17
- High school	2
- bachelor degree	61
- master degree	19
- doctor degree	1
Total 100	



Title	Percentage(%)
5. Income (baht/month)	
- <5,000	33
- 5,000-15,000	29
- 15,001-25,000	16
- 25,001-35,000	4
- >35,000	18
	Total 100

## Part2 : Consumer Behavior, Opinion and Need to frozen food

For the investigation on consumer behavior, opinion and need that shown in table13, were found that 99 subjects out of 100 used to consume frozen product. Most of them trended to consume frozen/ready to eat rice and/or Dim sum product, which is more than 30 percents. From the result showed that most of subjects used to consume S&P, which up to 34 percents and Ezy-go, Pran-talay, Surapon food, respectively. Moreover, up to 43.14 percents prefer S&P product and the second most prefer is Pran-talay, which is around 22.55 percents. The reason that most subjects prefer to S&P is because of delicious and having more varieties. However the quantity and price seem not too be very important since the result showed that there are only 5.26 and 7.89 percents, respectively. More than 50 percents of the subjects trend to consume frozen/ready to eat product occasionally. The reason for subjects in choosing to consume frozen food is expressed as easy to buy (31.05%), easy to prepare (28.42%) and ready to eat (22.63%), consecutively. In addition, most of subjects spent around 30-50 baht for purchasing frozen product. Furthermore, 59.08 percents consume the product within the date of purchasing and more than 25 percents kept the product few days before eat. However, there is 6.86 percents of subjects who kept the product

more than three days. There are up to 43.44 percents of subjects who spent around 2-3 minutes to cook the food by using microwave at normal temperature. The problems that subjects found during consuming the product after reheating are the hardness of rice and its difficulty for chewing. Convenient store (44.54%) such as 7-11 and Family Mart seem to be the place where the subjects usually buy the frozen product. However, 31.09 percents of subjects buy the product at Super-store such as Big C, Tesco Lotus, Carrefour. More than 50% of the subjects purchased the frozen product for consuming at home (62.04%) and around 18.52 percent consume in office and also about 12.04 percents consume in dormitory.

Table13: The percentage for consumer behavior, opinion and need on marketing survey of frozen food

Title	Percentage(%)
6. Have you ever eaten the frozen product?	
- used to	90
- never	10
	Total 100
7. Which kinds of frozen food that you have eaten? ( more than 1 choice)	
- rice	33.67
- Dim sum	31.63
- noodles	5.61
- dessert	19.31
- others	9.69
	Total 100

Title	Percentage(%)
8. Which brands of frozen food that you have eaten? (more than 1 choice)	
- Pran-talay	19.91
- Surapon food	17.59
- S&P	34.72
- Ezy-go	24.08
- others	3.70
	Total 100
9. What is your most favorite brand?	
- Pran-talay	22.55
- Surapon food	14.70
- S&P	43.14
- Ezy-go	12.75
- others	6.86
	Total 100
10. What is the most importance reason that you prefer to your favorite brand?	
- delicious	45.62
- suitable quantity between rice and food	5.26
- not too expensive	7.89
- variety	25.44
- others	15.79
	Total 100

Title	Percentage(%)
11. How often do you consume frozen product?	
- everyday	1.01
- 1-2 times/week	11.11
- 3-4 times/week	4.04
- once a month	16.16
- occasionally	67.68
Total 100	
12. What are the reasons that you choose to consume frozen food?	
- good taste	12.63
- easy to buy	31.05
- ready to eat	22.63
- easy to prepare	28.42
- not too expensive	3.16
- others	2.11
Total 100	
13. What is your budget for purchasing the frozen food per time?	
- <30 baht	10.10
- 30-50 baht	47.48
- 51-70 baht	11.11
- 71-90 baht	10.10
- >90 baht	21.21
Total 100	



Title	Percentage(%)
14. Normally, how do you consume the frozen food?	
- within one day	59.80
- next day	15.69
- next two days	10.79
- next three days	0
- more than three days	6.86
- others	6.86
Total	100
15. What are the problems that you experienced during consume the frozen food? (more than 1 choice)	
- the quantity of rice is too much	21.52
- rice is hard and difficult to chewing	22.15
- the color of product is pale	6.33
- taste is not good	20.25
- quantity is too few	17.09
- not variety	6.96
- others	5.70
Total	100
16. Normally, how many minutes do you spend on cooking/reheating the frozen food ? (by using microwave at normal temperature)	
- < 1 minute	0
- around 1-2 minutes	15.15
- around 2-3 minutes	43.44
- around 3-4 minutes	25.25
- > 4 minutes	16.16
Total	100

Title	Percentage(%)
17. From where have you purchased the frozen product?	
- convenient store (7-11, Family Mart, etc...)	44.54
- superstore (Big C, Tesco Lotus, Carrefour, etc...)	31.09
- supermarket (Tops, etc...)	17.65
- others (Mini Mart, etc...)	6.72
	Total 100
18. Where do you normally consume the frozen food?	
- home/house	62.04
- school/university	3.70
- car	3.70
- office	18.52
- Dormitory	12.04
- others	0
	Total 100

Part3 : Consumer Behavior, Opinion and Need to “Ready-to-eat Thai style Maki set”

From the result that showed in the table14, there were 94 percents of the overall subjects interested in the product. Most of subjects trended to interested in set number four, which consists of Stir fry pork/chicken with mushroom, Dry prawn Tum Yum, Omelet and the second most prefer set is number two, which consists of Pork/chicken Pa-nang, Fry pork/chicken, Omelet and the third most prefer set is number three, which consists of Stir fry Garlic with pork/chicken, Chicken/pork green curry, Stir fry spicy pork/chicken. In addition, the most important reason that the subjects are going to buy the product is palatable, which up to 41.26 %.

Table14: The Consumer Behavior, Opinion and Need to “Ready-to-eat Thai style Maki set”

Title	Percentage(%)
19. If there is a Thai style Maki (similar to Japanese Maki), that can be kept for longer and reheated by microwave and also variety in one set/box, available in the market. Are you interested to the product or not?	
- Yes	94
- No	6
	Total 100
20. Which kinds of the Thai style filling that do you think it should be contained in the set?	
- Set1 : Pork/chicken Ka-plow, Omelet, Stir fry vegetables	10.68
- Set2 : Pork/chicken Pa-nang curry, Fry pork/chicken , Omelet	20.39
- Set3 : Stir fry Garlic with pork/chicken, Chicken/pork green curry, Spicy pork/chicken	19.42
- Set4 : Stir fry pork/chicken with mushroom, Dry prawn Tum Yum, Omelet	39.80
- Set5 : Stir fry Ka-ree pork/chicken, Spicy pork/chicken, Fry pork/chicken	9.71
- others :	0
	Total 100
21. What is the reason that you are going to buy the product?	
- easy to buy	17.48
- easy to prepare	9.09
- save time	17.48
- palatable	41.26
- variety	13.29
- others	1.40
	Total 100

## 2. Optimization of the appropriate formulation of product

After the marketing survey was done, raw materials and apparatus were prepared to find out the appropriate formulation. Glutinous rice and jasmine rice were used instead of Japanese rice. There were three different ratios between glutinous rice and jasmine rice. From the result can be seen that the ratio of 50% glutinous rice : 50% jasmine rice had the highest score. Thus, it means that panelists prefer at most. As the glutinous rice is quite hard, the adding of 100% of glutinous rice was absolutely too hard but good for cohesion and stickiness, however. Thus, the panelists did not like very much. For mixing of 75% glutinous rice: 25% Jasmine rice, the panelists liked moderately the appearance looked soft and hardness of rice slightly decrease than used of 100% glutinous rice while the cohesion and stickiness of rice were not better than 100% glutinous. For the best ratio, which was 50% glutinous rice : 50%jasmine rice, was the most difficult making as less of stickiness and cohesion than the other two ratio. However, the appearance looked the best and the rice was softest. Therefore, most panelists chose this ratio. (Table15)

Table15: The average score of each attribute of 3 different ratios between glutinous and jasmine rice

Attributes	Sensory score (9-point hedonic scale)		
	50%G : 50%J	75%G : 25%J	100%G : 0%J
appearance	6.97±0.67 <sup>b</sup>	5.93±0.63 <sup>a</sup>	5.73±0.59 <sup>a</sup>
cohesion	6.00±0.77 <sup>a</sup>	5.76±0.78 <sup>a</sup>	5.90±0.84 <sup>a</sup>
hardness of rice	6.63±0.69 <sup>b</sup>	6.10±0.64 <sup>b</sup>	4.63±0.80 <sup>a</sup>
stickiness of rice	6.30±0.65 <sup>b</sup>	5.97±0.68 <sup>ab</sup>	5.37±0.64 <sup>a</sup>
overall	6.83±0.38 <sup>c</sup>	5.90±0.44 <sup>b</sup>	5.20±0.47 <sup>a</sup>

Remark : G = Glutinous rice , J = Jasmine rice

Note: <sup>a,b,c</sup> means the mean of each attribute that has different alphabet was significantly different (p<0.05)



After the appropriate ratio of rice was selected, the filling was the next step to conduct sensory evaluation on attributes, compatibility and ratio between rice and filling. According to the marketing survey, the highest score was shown in Stir fry pork/chicken with mushroom, Dry prawn Tum yum, Omelet. Nevertheless, in the fact that Dry prawn Tum yum is difficult to cohesive with rice in Maki product and its cost quite expensive as well, therefore Dry prawn Tum yum was selected out and changed to be dried Pa-nang, which was the second most prefer. However, most of filling was composed with pork instead of chicken due to chicken trends to be not safe for consumers as some of them believe in the flu bird. In this part, there was varied only 2 samples, which were 25% rice : 75% filling and 50% rice : 50% filling ratios. For Pork pa-nang curry, most panelists prefer the ratio of 25%rice : 75%filling to 50%rice : 50%filling. Average score of all attributes in ratio of 25%rice : 75%filling, accept for the appearance were highest than 7.00 so most panelist do accept the product quite well. However, the appearance of this filling must be improved as it had got very low average score. (Table16)

Table16: The average score of each attribute of 2 difference sample of Pork pa-nang curry

Attributes	Sensory score (9-point hedonic scale)	
	25%R : 75%F	50%R : 50%F
Appearance <sup>ns</sup>	5.00±1.44	4.83±1.60
smell <sup>ns</sup>	7.37±0.85	7.10±0.80
Sweetness**	7.10±0.66	6.73±0.69
saltiness**	7.23±0.77	6.77±0.73
compatibility*	7.33±0.66	7.03±0.72
Ratio of rice:filling**	7.30±0.70	6.60±0.77
overall**	7.57±0.77	7.17±0.46

Remark : R = Rice , F = Filling

Note: <sup>ns</sup> means the mean of each attribute of two formulations was not significantly different ( $p < 0.05$ )

\* means the mean of each attribute of two formulations was significantly different ( $p < 0.05$ )

\*\* means the mean of each attribute of two formulations was highly significant different ( $p < 0.01$ )

For Stir fry pork with mushroom, the appearance was still not good, even changed from making by manual to cartoon mold. Thus, it was still needed to further study. However, other attributes were scored around 7.00, which no need hardly improve. As same as the other two fillings, ratio of 25%rice : 75%filling still was chosen. (Table17)

Table17: The average score of each attribute of 2 difference sample of Stir fry pork with mushroom

Attributes	Sensory score (9-point hedonic scale)	
	25%R : 75%F	50%R: 50%F
appearance <sup>ns</sup>	5.80±1.61	5.83±1.68
smell <sup>ns</sup>	7.00±0.79	6.67±0.84
sweetness <sup>ns</sup>	7.00±1.05	7.10±1.09
saltiness**	7.33±0.99	6.70±0.99
compatibility <sup>ns</sup>	7.07±0.98	7.17±0.83
Ratio of rice:filling**	7.47±0.82	6.67±0.92
overall <sup>ns</sup>	7.33±0.99	7.00±0.83

Remark : R = Rice , F = Filling

Note: <sup>ns</sup> means the mean of each attribute of two formulations was not significantly different ( $p < 0.05$ )

\*\* means the mean of each attribute of two formulations was highly significant different ( $p < 0.01$ )

For Omelet filling, the result showed that the product needed to improve on sweetness, saltiness, compatibility. These may affected the overall liking of the product. However, the most panelists still liked the

ratio of 25%rice:75%filling as same as the Pork pa-nang filling. This time, appearance was highly improved and the panelists more satisfied. The appearance was improved by using the rice mold. (Table18)

Table18: The average score of each attribute of 2 difference sample of Omelet

Attributes	Sensory score (9-point hedonic scale)	
	25%R : 75%F	50%R : 50%F
appearance <sup>ns</sup>	7.46±1.24	7.04±1.40
smell <sup>ns</sup>	7.07±0.58	6.87±0.63
sweetness <sup>ns</sup>	6.47±1.25	6.33±1.35
saltiness <sup>ns</sup>	6.07±0.91	5.87±1.07
compatibility*	5.80±0.89	5.43±1.04
Ratio of rice:filling**	7.73±1.01	6.57±1.30
overall <sup>ns</sup>	6.90±0.80	6.57±1.17

Remark : R = Rice , F = Filling

Note: <sup>ns</sup> means the mean of each attribute of two formulations was not significantly different ( $p < 0.05$ )

\* means the mean of each attribute of two formulations was significantly different ( $p < 0.05$ )

\*\* means the mean of each attribute of two formulations was highly significant different ( $p < 0.01$ )

From the above table, compatibility, sweetness and saltiness were improved. In order to increase sweetness and compatibility, carrots were added. For improvement of saltiness, Mackie was used. Apart from increase the average score of compatibility, sweetness and saltiness, the overall liking was also increased too. (Table19)

Table19: The average score of each attribute of sample of Omelet with carrots

Attributes	Sensory score (9-point hedonic scale)
	25%R: 75%F
compatibility	7.53±0.78
sweetness	7.30±0.70
saltiness	7.80±0.81
overall	7.47±0.68

Remark : R = Rice , F = Filling

### 3. Optimization of the time on microwave heating for reheating the product

The process development of the product was mentioned on the time for reheating. In order to reheat the product, the microwave oven is used. As temperature of microwave is automatically set, thus the temperature was not mentioned in this part. The time of reheating was varied 3 levels, which were 1 minute, 1.30 minutes and 2 minutes. The 9 points hedonic scale was used as the sensory evaluation. From 30 panelists, the result showed that 1.30 minutes was the best time for reheat the product with still keeping quality of attributes. At 1 minute, the product was still cold while at 2 minutes, the product was too cooked. Even changing the time for heating, the sweetness and saltiness of product still were similar. Appearance and smell of cooked well product is actually better than both overcooked and medium cooked, as same as the hardness of rice. Therefore the average score of overall liking at 1.30 was the highest. (Table20)



Table20: The average score of each attribute of 3 difference reheating times

Attributes	Sensory score (9-point hedonic scale)		
	1 minute	1.30 minutes	2 minutes
appearance	6.33±0.77 <sup>a</sup>	7.33±0.69 <sup>b</sup>	6.53±0.72 <sup>a</sup>
smell	6.80±0.85 <sup>a</sup>	7.03±0.82 <sup>a</sup>	6.93±0.71 <sup>a</sup>
sweetness	7.20±1.34 <sup>a</sup>	7.17±1.25 <sup>a</sup>	7.13±1.39 <sup>a</sup>
saltiness	7.43±0.96 <sup>a</sup>	7.47±0.86 <sup>a</sup>	7.47±0.88 <sup>a</sup>
hardness of rice	6.07±0.67 <sup>a</sup>	7.27±0.60 <sup>b</sup>	6.80±0.59 <sup>b</sup>
overall	6.63±0.73 <sup>a</sup>	7.47±0.70 <sup>b</sup>	7.17±0.69 <sup>b</sup>

Note: <sup>a,b</sup> means the mean of each attribute that has different alphabet was significantly different ( $p < 0.05$ )

#### 4. Consumer test

##### 4.1 Central Location Test

##### Part I : Demographic Information

Central Location Test was conducted by 100 people at University, Office and Shopping Mall. The ratio of gender between male and female was 1:1 in order to avoid bias error. The highest percentage of age was between the age of 19-24 years old and second range of age went to 25-30 years old. 37% and 36% were students and employee, respectively. Most of the consumer graduated in bachelor degree, which up to 73%. More than 60% of the total consumers had income more than 15,001 baht. (Table21)

Table21: Percentage for demographic information on consumer test

Title	Percentage(%)
1. Sex	
- Male	50
- Female	50
	Total 100

<b>Title</b>	<b>Percentage(%)</b>
<b>2. Age</b>	
- <18	2
- 18-24	38
- 25-30	32
- 31-36	21
- 37-42	1
- 43-48	3
- >48	3
	Total 100
<b>3. Occupation</b>	
- Government officer	5
- Student	36
- Business owner	8
- Government enterprise	9
- Housewife	2
- Employee	37
- Other	3
	Total 100
<b>4. Education</b>	
- Lower than High school	2
- High school	1
- Bachelor degree	73
- Master degree	22
- Higher than Master	2
	Total 100
<b>5. Income (Bt/Month)</b>	
- <5,000	0
- 5,000-15,000	38
- 15,001-25,000	23
- 25,001-35,000	29
- >35,000	10
	Total 100

## Part II : Consumer behavior

For this part, consumers were asked about the frequency of consuming for original Maki and frozen product. In addition, the consumers were asked about the factors that affect the consumer's decision on perchance of frozen product. The results showed that the consumers often buy the frozen product two times per week (up to 32%). The first importance attribute of the frozen product was "Taste" and the second was "Clean" and the third were "Price" and "Variety". 45% of the consumers said that 9 pieces is the amount of original Maki (compared with Fuji brand) that enough for consume in one time or another word is serving size was about 9 pieces of original Maki. (Table22)

Table22: Percentage for consumer behavior on consumer test

Title	Percentage(%)
6. How often do you eat frozen product per week?	
- >4	0
- 4	6
- 3	15
- 2	23
- 1	32
- <1	24
	Total 100
7. How many pieces of Maki you normally purchase per serving size? (compared with Fuji's Maki )	
- >9	1
- 9	45
- 8	24
- 7	12
- 6	15
- <6	3
	Total 100

Title	Percentage(%)
8. Rank the important quality attribute that you want in the frozen product (Rank only 1-3) (1=most important 2=second most important 3= least important)	
<u>First</u> - Appearance	2
- Taste	74
- Flavor	0
- Odor	0
- Color	0
- Price	3
- Fresh	1
- Clean	15
- Variety	5
Total 100	
<u>Second</u> - Appearance	8
- Taste	26
- Flavor	2
- Odor	1
- Color	0
- Price	11
- Fresh	3
- Clean	36
- Variety	13
Total 100	
<u>Third</u>	
- Appearance	3
- Taste	0
- Flavor	3
- Odor	2
- Color	4
- Price	33
- Fresh	3
- Clean	19
- Variety	33
Total 100	



### Part III : Product Acceptance

For the last part of the questionnaire, all of the questions were about “the ready-to-eat Thai style Maki set” in order to know how much of the successful on this product. From 100 people, up to 98% accepted the product. However, 2% rejected the product by the reason of the fresh food is better than the frozen one. Furthermore, 91% of the consumers like the product, which can divide the liking into 4 levels; 1% like slightly, 10% like moderately, 67% like very much and 13% like extremely. Moreover, up to 81% wanted to buy the product for sure because this is a new product which never available in the market, having variety in one box, the taste was so delicious, the appearance was good (bite size), more filling than rice and the product is also palatable. 14% of total consumer said maybe buys the product because they not normally purchase frozen product and also decision is depend on the price and occasion. For the rest of 5%, who was sure for not buy the product because they personally prefer to consume fresh product and still prefer to consume original Maki. However, most of consumer thought that 10-12 pieces should be contained in 1 box, as the size of the product is not too big. As nowadays, the economic is not good so most people try to save money for everything. Thus, more than 90% of consumer was willing to pay 30-40 baht, which is the lowest price in the question, for the product per 1 box. (Table23)

Table23: Percentage for product acceptance on consumer test

<b>Title</b>	<b>Percentage(%)</b>
9. Overall, how would you rate this product?	
- Dislike extremely	0
- Dislike very much	0
- Dislike moderately	0
- Dislike slightly	2
- Neither like nor dislike	7
- Like slightly	1
- Like moderately	10
- Like very much	67
- Like extremely	13
Total	100
10. Is this product acceptable?	
- Yes	98
- No	2
Total	100
11. Would you buy this product if it were commercially available?	
- Sure	81
- Maybe	14
- Sure for not	5
Total	100
12. How many pieces of the product should be contained in 1 box?	
- <12	5
- 12-10	87
- 9-7	8
- 6-4	0
- >4	0
Total	100
13. How much would you be willing to pay for this product per 1 box?	
- 30-40	91
- 41-50	9
- >50	0
Total	100

## 4.2 Home Use Tests

### Part I : Demographic Information

Home Use Tests were conducted by 30 houses, which located on Sukhumvit road, Ramkhumhang road, Ladplod road and Ja-rean kung road. The ratio of gender between male and female was 1:1 in order to avoid bias error. Most of consumers were in the range of 31-36 years old. More than 80% graduated bachelor degree. Most of them were employee (36.68%), government officer(33.33%) and student who live in dormitory and their own house(23.33%). All of them had income more than 5,000 baht which means they have ability to buy the product. (Table24)

Table24: Percentage for demographic information on consumer test

Title	Percentage(%)
1. Sex	
- Male	50
- Female	50
	Total 100
2. Age	
- <18	0
- 18-24	23.33
- 25-30	23.33
- 31-36	26.67
- 37-42	16.67
- 43-48	3.33
- >48	6.67
	Total 100
3. Occupation	
- Government officer	33.33
- Student	23.33
- Business owner	3.33
- Government enterprise	3.33
- Housewife	0
- Employee	36.68
- Other	0
	Total 100

Title	Percentage(%)
4. Education	
- Lower than High school	0
- High school	0
- Bachelor degree	83.33
- Master degree	16.67
- Higher than Master	0
	Total 100
5. Income (Bt/Month)	
- <5,000	0
- 5,000-15,000	23.33
- 15,001-25,000	33.33
- 25,001-35,000	36.67
- >35,000	6.67
	Total 100

## Part II : Consumer behavior

For this part, consumers were asked about the frequency of consuming for original Maki and frozen product. In addition, the consumers were asked about the factors that affect the consumer's decision on purchasing of frozen product. The question was exactly the same as the question that asked in Central Location Test. The results showed that the consumers often buy the frozen product two times per week (up to 36.67%). The first importance attribute of the frozen product was "Taste" and the second was "Variety" and the third were "Price". This may difference from the result of central location test, which mentioned on "clean" as the second importance. Moreover, 50% of the consumers said that 9 pieces is the amount of original Maki (compared with Fuji brand) that enough for consume in one time or another word is serving size was about 9 pieces of original Maki. This result was similar to the result of central location test method. (Table25)



Table25: Percentage for consumer behavior on consumer test

Title	Percentage(%)
6. How often do you eat frozen product per week?	
- >4	0
- 4	3.33
- 3	10.00
- 2	36.67
- 1	20.00
- <1	30.00
	Total 100
7. How many pieces of Maki you normally purchase per serving size? (compared with Fuji's Maki )	
- >9	6.67
- 9	50.00
- 8	33.33
- 7	0
- 6	10.00
- <6	0
	Total 100
8. Rank the important quality attribute that you want in the frozen product (Rank only 1-3) (1=most important 2=second most important 3= least important)	
<u>First</u>	
- Appearance	3.33
- Taste	76.67
- Flavor	0
- Odor	0
- Color	0
- Price	3.33
- Fresh	0
- Clean	6.67
- Variety	10.00
	Total 100

Title	Percentage(%)
<b>Second</b>	
- Appearance	6.67
- Taste	23.33
- Flavor	0
- Odor	0
- Color	0
- Price	10.00
- Fresh	0
- Clean	10.00
- Variety	50.00
Total 100	
<b>Third</b>	
- Appearance	23.33
- Taste	0
- Flavor	10.00
- Odor	3.33
- Color	0
- Price	46.67
- Fresh	3.33
- Clean	6.67
- Variety	6.67
Total 100	

### Part III : Product Acceptance

For the last part of the questionnaire, all of the questions were about “the ready-to-eat Thai style Maki set” in order to know how much of the successful on this product. From 30 houses, up to 100% accepted the product. Furthermore, 83.34% of the consumers like the product, which can divide the liking into 4 levels; 10% like slightly, 10% like moderately, 53.34% like very much and 10% like extremely. Moreover, up to 83.33% wanted to buy the product for sure because the taste was so delicious, the appearance was good (bite size), easy for preparing, more filling than rice and the product is also palatable. 6.67% of total consumer said maybe buys the product because they not normally purchase frozen product and

prefer to cook fresh food. For the rest of 10%, who was sure for not buy the product because they personally prefer to consume fresh product and prefer to cook fresh food. However, most of consumer thought that 10-12 pieces should be contained in 1 box, as the size of the product is not too big. As nowadays, the economic is not good so most people try to save money for everything. Thus, more than 93% of consumer was willing to pay 30-40 baht, which is the lowest price in the question, for the product per 1 box. (Table26)

Table26: Percentage for product acceptance on consumer test

Title	Percentage(%)
9. Overall, how would you rate this product?	
- Dislike extremely	0
- Dislike very much	0
- Dislike moderately	3.33
- Dislike slightly	0
- Neither like nor dislike	13.33
- Like slightly	10.00
- Like moderately	10.00
- Like very much	53.34
- Like extremely	10.00
	Total 100
10. Is this product acceptable?	
- Yes	100
- No	0
	Total 100
11. Would you buy this product if it were commercially available?	
- Sure	83.33
- Maybe	6.67
- Sure for not	10.00
	Total 100

Title	Percentage(%)
12. How many pieces of the product should be contained in 1 box?	
- <12	6.67
- 12-10	70.00
- 9-7	20.00
- 6-4	3.33
- >4	0
Total 100	
13. How much would you be willing to pay for this product per 1 box? (Check only one)	
- 30-40	93.34
- 41-50	3.33
- >50	3.33
Total 100	

### 5. Storage study of product

For study the effect of storage time on the product attributes at Day1, Day4 and Day7 by using 9 points hedonic scale as the sensory evaluation. The results showed that when the storage time was increasing, the product attributes were decreasing in quality. However, from the below tables, showed that there is no difference on the average score of product attributes at Day1 and Day4. Most average score at Day1 and Day4 were above 7.00 so it means that the panelists still accept it. At Day7 most of panelists could detect the changing of attributes so most of the average score were below 7.00 due to the product was kept too long.



Table27: The average score of product attributes of three difference samples at Day1

Attribute	Sensory score (9-point hedonic scale)		
	Pork Pa-nang curry	Omelet with carrots	Stir fry pork with mushroom
appearance	7.67±0.69 <sup>b</sup>	7.80±0.65 <sup>b</sup>	7.33±0.69 <sup>a</sup>
smell	7.33±0.61 <sup>a</sup>	7.40±0.63 <sup>a</sup>	7.50±0.58 <sup>a</sup>
taste	7.97±0.69 <sup>a</sup>	7.67±0.72 <sup>a</sup>	7.63±0.70 <sup>a</sup>
overall	7.77±0.70 <sup>a</sup>	7.67±0.68 <sup>a</sup>	7.67±0.68 <sup>a</sup>

Note: <sup>a,b</sup> means the mean of each attribute that has different alphabet was significantly different (p<0.05)

Table28: The average score of product attributes of three difference samples at Day4

Attribute	Sensory score (9-point hedonic scale)		
	Pork Pa-nang curry	Omelet with carrots	Stir fry pork with mushroom
appearance	7.27±0.59 <sup>a</sup>	7.17±0.55 <sup>a</sup>	7.23±0.63 <sup>a</sup>
smell	7.10±0.99 <sup>a</sup>	7.10±0.86 <sup>a</sup>	6.97±0.78 <sup>a</sup>
taste	7.20±0.77 <sup>a</sup>	7.47±0.69 <sup>a</sup>	7.27±0.76 <sup>a</sup>
overall	7.27±0.84 <sup>a</sup>	7.33±0.68 <sup>a</sup>	7.30±0.77 <sup>a</sup>

Note: <sup>a</sup> means the mean of each attribute that has different alphabet was significantly different (p<0.05)

Table29: The average score of product attributes of three difference samples at Day7

Attribute	Sensory score (9-point hedonic scale)		
	Pork Pa-nang curry	Omelet with carrots	Stir fry pork with mushroom
appearance	6.93±0.65 <sup>a</sup>	7.10±0.69 <sup>a</sup>	6.97±0.63 <sup>a</sup>
smell	6.67±0.80 <sup>a</sup>	6.70±0.83 <sup>a</sup>	6.60±0.84 <sup>a</sup>
taste	6.53±0.59 <sup>a</sup>	6.57±0.60 <sup>a</sup>	6.30±0.61 <sup>a</sup>
overall	6.50±0.83 <sup>a</sup>	6.57±0.75 <sup>a</sup>	6.53±0.70 <sup>a</sup>

Note: <sup>a</sup> means the mean of each attribute that has different alphabet was significantly different (p<0.05)

## 6. Product Profiling

Product profiling comes from the focus group discussion with 10 panelists, in order to define product attribute which are appearance (included; shape, color, etc.), aroma, flavor, texture and after taste. The results are separated into each following group;

### Appearance

- Omelet with carrots
  - Short cylinder shape
  - Bite size
  - Colorful (yellow from eggs orange from carrots and white from rice)
  - Gloss on rice
  - Grease oil
  - Cohesion
- Pork Pa-Nang
  - Short cylinder shape
  - Bite size
  - Orange-red color (from curry and chili)
  - Green color (from leave of Kaffir lime)
  - White color (from rice)
  - Gloss on rice
  - Grease oil
  - Cohesion
- Stir fry pork with mushroom
  - Short cylinder shape
  - Bite size
  - Roasted brown color (from pork mixed with mushroom and garlic)
  - Green color (from parsley)
  - White color (from rice)
  - Gloss on rice
  - Grease oil
  - Cohesion

### Aroma

- Omelet with carrots
  - Egg
  - Sauce
  - Rice
  - Carrots

- Pork Pa-Nang
  - Coconut milk
  - Kaffir lime
  - Curry
  - Rice
  - Pork
- Stir fry pork with mushroom
  - Sauce
  - Mushroom
  - Garlic
  - pork
  - Pepper
  - Parsley

#### Flavor

- Omelet with carrots
  - Egg
  - Carrots
  - Rice
  - Saltiness
  - Sweetness
- Pork Pa-Nang
  - Rice
  - Curry
  - Coconut milk
  - Spicy
  - Sweetness
  - Saltiness
- Stir fry pork with mushroom
  - Rice
  - Garlic
  - Mushroom
  - Pork
  - Pepper
  - Parsley
  - Sweetness
  - Saltiness

#### Texture

- Omelet with carrots
  - Softness of rice and egg
  - Stickiness of rice

- Crispy of carrots
- Pork Pa-Nang
  - Softness of rice and pork
  - Stickiness of rice
- Stir fry pork with mushroom
  - Softness of rice, pork and mushroom
  - Stickiness of rice

#### After taste

- Omelet with carrots
  - Egg
  - Sweetness of rice
  - Carrots
- Pork Pa-Nang
  - Coconut milk
  - Kaffir lime
  - Curry
  - Spicy
  - Saltiness
  - Sweetness of rice
- Stir fry pork with mushroom
  - Pepper
  - Garlic
  - Mushroom
  - Saltiness
  - Sweetness of rice

After all attributes were concluded, the panelists were asked for giving new ideas of appearance, which means the shape of the product. There were many ideas such as round shape, heart shape, star shape, triangle shape, square shape and so on. However, the panelists concluded that the best appearance of this product is should be “Short cylinder shape”.



Fig.33 The final product (all 3 different fillings)



## Chapter5

### Conclusion

The development of “ready-to-eat Thai style Maki set” was initiated with study of marketing survey from 100 subjects. As the target group of the product is general, thus the marketing survey was done in many places such as Universities, office and shopping mall. The “ready-to-eat Thai style Maki set” is concerned as the kind of frozen product. Therefore, the most questions were according to the consumer behavior on frozen product. In fact, consumers do not trend to consume the frozen product as many due to the rice was too hard for chewing, rice was too much and taste was not good (>20%).

Moreover, to become aware that consumers want in the product, some question was about the consumer opinion on “ready-to-eat Thai style Maki set”. Most of subjects are interesting in the product due to it seem to be palatable for them.

Followed by the optimization of the appropriate formula and development of the process, using glutinous rice and jasmine rice as the raw materials in order to formulate the appropriate ratio of rice, which finally found that ratio of 50glutinous rice : 50Jasmine rice is the best, followed by result of 9 points hedonic scale. In addition, from sensory evaluation (9 points hedonic scale), most panelists prefer the ratio of 25rice : 75filling to 50rice : 50filling in all three difference filling, which are Pork pa-nang curry, Omelet with carrots and Stir fry pork with mushroom. Even, the appearance of the product was the main problem in this objective, but finally it was solved. Moreover, the omelet filling was

one of the problems in sensory evaluation but later improved to omelet with carrots, which satisfied the panelists. For the development of process, which mention on the time for reheating the product by microwave oven, the appropriate time for reheating is 1.30 minutes. At this time the product will be cooked well and not split out the filling from the rice.

Consumer test was conducted by 100 consumers from Central Location Test (CLT) and other 30 houses from Home Use Tests (HUT), in order to find out consumer acceptance. Consumer test was done at many places such as university, office, shopping mall, houses and so on, as the target group is general. More than 97% of both consumer from CLT and HUT are accept the product, and also more than 80% of them are willing to pay for the product if it available in the market. The consumer prefers 10-12 pieces in one box and the price of the product should be in the range of 30-40 baht per one box.

Storage life of the product is mentioned on the effect of product attributes by storage time. Thus, the sensory evaluation, which used of 9 points hedonic scale, was created at Day1, Day4 and Day7 for panelists to detect if there any change of the attributes of the product. However, finally found that the product attributes can be affected by storage time.

From the overall, the development of “ready-to-eat Thai style Maki set” is quite successful due to more than 97% of consumer do accept the product and up to 80% is willing to pay for the product if it available in the market. Moreover, the product is cheaper than the cost of making original Maki (Japanese Maki), which highly cost raw materials. Also easy to preparing and provide more variety to the consumer in our country style.

## **Chapter6**

### **Further Study**

- Study and prolong the shelf life of “the ready-to-eat Thai style Maki set” without the changing of the taste of the product.
- The study of the appropriate package for the distribution and storage of “the ready-to-eat Thai style Maki set” which will be able to used with microwave oven and also suitable for carrying.
- Improve the taste of the filling and create more idea of filling which concern the compatibility of product.
- Study on the stabilizer to improve the cohesion of rice, in order to prevent the splitting out of filling from rice when reheating in longer time by microwave oven.

**Time Table for The development of “ready-to-eat Thai style Maki set”**

Job Description	Time (month/week)											
	March				April				May			
	1	2	3	4	1	2	3	4	1	2	3	4
1. Marketing Survey			↔									
2. Preliminary trial					↔							
3. Formulation and process development of prototype product						↔						
4. Time on microwave heating									↔			
5. Shelf life of product									↔			
6. Consumer test										↔		
7. Project report and presentation of the project					↔							

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## Appendix A

### 1. Marketing survey for frozen food consumption

#### Marketing Survey Questionnaire for “Ready-to-eat Thai style Maki set”

Dear participant,

I, Ms.Pasachon Jitnueang, the forth year student of faculty of Biotechnology has created this questionnaire according to the product development of “ready-to-eat Thai style Maki set” which will be carried out as a senior project. This is to become aware of the important attributes that consumers want in the product. I would like to ask for your cooperation in answering this questionnaire subjected to you real opinion. All of your information provided to us will be beneficial to the development process and kept confidentially.

Product description: The ready-to-eat Thai style Maki set is a kind of ready-to-eat product. The product is similar to Japanese Maki but the mix of glutinous rice and jasmine rice are used instead of Japanese rice and also filled by Thai style filling. This product can be kept for longer in refrigerator and ready to eat by reheat in microwave oven.

#### Part I : Demographic Information

##### 1. Gender

☐ Male ☐ Female

##### 2. Age

☐ < 18 ☐ 18-24  
☐ 25-30 ☐ 31-36  
☐ 37-42 ☐ 43-48  
☐ > 48

##### 3. Occupation

☐ Government officer ☐ Student  
☐ Business owner ☐ Government enterprise  
☐ Housewife ☐ Employee  
☐ Other.....

##### 4. Education

☐ < High school ☐ High school  
☐ Bachelor degree ☐ Master degree  
☐ > Master degree

## 5. Income (Bt/month)

- |  |  |
|--|--|
| <input type="checkbox"/> < 5,000       | <input type="checkbox"/> 5,000-15,000  |
| <input type="checkbox"/> 15,001-25,000 | <input type="checkbox"/> 25,001-35,000 |
| <input type="checkbox"/> > 35,000      |  |

## Part II : Consumer behavior on frozen product

## 6. Have you ever eaten the frozen product?

- |                                  |                                |
|----------------------------------|--------------------------------|
| <input type="checkbox"/> used to | <input type="checkbox"/> never |
|----------------------------------|--------------------------------|

## 7. What kind of frozen food that you have eaten? ( more than 1 choice)

- |                                     |                                   |
|-------------------------------------|-----------------------------------|
| <input type="checkbox"/> rice       | <input type="checkbox"/> noodles  |
| <input type="checkbox"/> tim sum    | <input type="checkbox"/> desserts |
| <input type="checkbox"/> other..... |                                   |

## 8. What brand of frozen food that you have eaten? (more than 1 choice)

- |                                       |                                 |
|---------------------------------------|---------------------------------|
| <input type="checkbox"/> Pran-talay   | <input type="checkbox"/> S & P  |
| <input type="checkbox"/> Surapon food | <input type="checkbox"/> Ezy-go |
| <input type="checkbox"/> other.....   |                                 |

## 9. What is your most favorite brand ?

- |                                       |                                 |
|---------------------------------------|---------------------------------|
| <input type="checkbox"/> Pran-talay   | <input type="checkbox"/> S & P  |
| <input type="checkbox"/> Surapon food | <input type="checkbox"/> Ezy-go |
| <input type="checkbox"/> other.....   |                                 |

## 10. What is the most importance reason that you prefer to your favorite brand? (from number 9)

- |  |  |
|--|--|
| <input type="checkbox"/> delicious                               | <input type="checkbox"/> not too expensive |
| <input type="checkbox"/> suitable quantity between rice and food | <input type="checkbox"/> variety           |
| <input type="checkbox"/> other .....                             |  |

## 11. How often do you consume frozen product?

- |   |   |
|---|---|
| <input type="checkbox"/> everyday       | <input type="checkbox"/> 1-2 times/week |
| <input type="checkbox"/> 3-4 times/week | <input type="checkbox"/> once a month   |
| <input type="checkbox"/> occasionally   |   |

## 12. What are the reasons that you choose to consume frozen food?

- |  |  |
|--|--|
| <input type="checkbox"/> good taste      | <input type="checkbox"/> easy to buy       |
| <input type="checkbox"/> ready to eat    | <input type="checkbox"/> not too expensive |
| <input type="checkbox"/> easy to prepare | <input type="checkbox"/> other .....       |

13. What is your budget for purchasing the frozen food in one time?

- |                                |                                |
|--------------------------------|--------------------------------|
| <input type="checkbox"/> < 30  | <input type="checkbox"/> 30-50 |
| <input type="checkbox"/> 51-70 | <input type="checkbox"/> 71-90 |
| <input type="checkbox"/> > 90  |                                |

14. Normally, how do you consume the frozen food?

- |   |                                      |
|---|--------------------------------------|
| <input type="checkbox"/> within one day | <input type="checkbox"/> next day    |
| <input type="checkbox"/> next 2 days    | <input type="checkbox"/> next 3 days |
| <input type="checkbox"/> > 3 days       | <input type="checkbox"/> other.....  |

15. What are the problems that you find during consume the frozen food?

(more than 1 choice)

- ☐ the quantity of rice is too much
- ☐ rice is hard and difficult to chewing
- ☐ the color of product is pale
- ☐ taste is not good
- ☐ quantity is too few
- ☐ not variety
- ☐ others

16. Normally, how many minutes do you spend on cooking/reheating the frozen food ? (by using microwave at normal temperature)

- ☐ < 1 minute
- ☐ around 1-2 minutes
- ☐ around 2-3 minutes
- ☐ around 3-4 minutes
- ☐ > 4 minutes

17. From where have you purchased the frozen product?

- ☐ convenient store (7-11, Family Mart, etc...)
- ☐ superstore (Big C, Tesco Lotus, Carrefour, etc...)
- ☐ supermarket (Tops, etc...)
- ☐ others (Mini Mart, etc...)

18. Where do you normally consume the frozen food?

- ☐ home/house
- ☐ school/university
- ☐ car
- ☐ office
- ☐ dormitory
- ☐ others

Part III : Consumer opinion on “ready-to-eat Thai style Maki set”

19. If there is a Thai style Maki (similar to Japanese Maki), that can be kept for longer and reheated by microwave and also variety in one set/box, available in the market. Are you interested to the product or not?

- ☐ Yes
- ☐ No

20. What kind of the Thai style filling that do you think it should be contained in the set?

- ☐ Set1 : Pork/chicken Ka-plow, Omelet, Stir fry vegetables
- ☐ Set2 : Pork/chicken Pa-nang curry, Fry pork/chicken , Omelet
- ☐ Set3 : Stir fry Garlic with pork/chicken, Chicken/pork green curry, Spicy pork/chicken
- ☐ Set4 : Stir fry pork/chicken with mushroom, Dry prawn Tum Yum, Omelet
- ☐ Set5 : Stir fry Ka-ree pork/chicken, Spicy pork/chicken, Fry pork/chicken
- ☐ others : .....

21. What is the reason that you are going to buy the product?

- ☐ easy to buy
- ☐ easy to prepare
- ☐ save time
- ☐ palatable
- ☐ variety
- ☐ others

Thank You for your corporation



## Appendix B

B.1) To find out the appropriate formulation of rice

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

Sample code	.....	.....	.....
Appearance	.....	.....	.....
Cohesion	.....	.....	.....
Hardness of rice	.....	.....	.....
Stickiness of rice	.....	.....	.....
Overall	.....	.....	.....

Thank You for Your Cooperation

B.2) To find out the appropriate formulation of Pork Pa-nang

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

**Sample code**

.....

**Appearance**

.....

**Smell**

.....

**Sweetness**

.....

**Saltiness**

.....

**Compatibility**

.....

**Ratio of rice:filling**

.....

**Overall**

.....

Thank You for Your Cooperation

B.3) To find out the appropriate formulation of Omelet

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

<b>Sample code</b>	.....	.....
Appearance	.....	.....
Smell	.....	.....
Sweetness	.....	.....
Saltiness	.....	.....
Compatibility	.....	.....
Ratio of rice:filling	.....	.....
Overall	.....	.....

Thank You for Your Cooperation

B.4) To find out the appropriate formulation of Omelet with carrots

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_  
Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

<b>Sample code</b>	.....	.....
<b>Appearance</b>	.....	.....
<b>Sweetness</b>	.....	.....
<b>Saltiness</b>	.....	.....
<b>Overall</b>	.....	.....

Thank You for Your Cooperation

B.5) To find out the appropriate formulation of Stir fry pork with mushroom

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

Sample code	.....	.....
Appearance	.....	.....
Smell	.....	.....
Sweetness	.....	.....
Saltiness	.....	.....
Compatibility	.....	.....
Ratio of rice:filling	.....	.....
Overall	.....	.....

Thank You for Your Cooperation



B.6) To find out the appropriate reheating time for Pork Pa-nang

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

Sample code	.....	.....
Appearance	.....	.....
Smell	.....	.....
Sweetness	.....	.....
Saltiness	.....	.....
Overall	.....	.....

Thank You for Your Cooperation

B.7) To find out the appropriate reheating time for Omelet with carrots

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

<b>Sample code</b>	.....	.....
<b>Appearance</b>	.....	.....
<b>Smell</b>	.....	.....
<b>Sweetness</b>	.....	.....
<b>Saltiness</b>	.....	.....
<b>Overall</b>	.....	.....

Thank You for Your Cooperation

B.8) To find out the appropriate reheating time for Stir fry pork with mushroom

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

Sample code	.....	.....
Appearance	.....	.....
Smell	.....	.....
Sweetness	.....	.....
Saltiness	.....	.....
Overall	.....	.....

Thank You for Your Cooperation

## Appendix C

### C.1) Central Location Test

#### Consumer Acceptance Test

“The development of ready-to-eat Thai styles Maki Set”

Dear participant

According to the development of “The development of ready-to eat Thai styles Maki Set” which has been carried out by Ms.Pasachon Jitnueang, Biotechnology student of Assumption University (Thailand), the product aims to develop the original Maki to the Thai styles and convenience for consumers in 1 serving size.

I would like to ask for your cooperation in answering this questionnaire subjected to your real opinion and behavior. All of your information provided to me will be beneficial to such research and be kept confidentially.

Your cooperation will be high appreciated.

#### Part I: Demographic Data

1. Gender

☐ Male

☐ Female

2. Age

☐ <18

☐ 19-24

☐ 25-30

☐ 31-36

☐ 37-42

☐ >42

3. Education

☐ Lower than High school

☐ High school

☐ Bachelor

☐ Master

☐ Higher than Master

4. Occupation

☐ Student

☐ Government enterprise

☐ Government officer

☐ Employee

☐ Business owner

☐ Housewife

☐ other

5. Income (Bath/month)

☐ lower than 5,000

☐ 5,000-15,000

☐ 15,001-25,000

☐ 25,001-35,000

☐ more than 35,000

#### Part II: Consumer's Behavior

6. How often do you eat frozen product per week?

☐ more than 4 times

☐ 4 times

☐ 3 times

☐ 2 times

☐ 1 time

☐ less than 1 time

7. How many pieces of Maki you normally purchase per serving size?(compared with Fuji's Maki )
- ☐ more than 9 pieces      ☐ 9 pieces  
☐ 8 pieces      ☐ 7 pieces  
☐ 6 pieces      ☐ less than 6 pieces
8. Rank the important quality attribute that you want in the frozen product (Rank only 1-3)  
 (1=most important 2=second most important 3=least important)
- ☐ appearance      ☐ odor      ☐ fresh  
☐ taste      ☐ color      ☐ clean  
☐ flavor      ☐ price      ☐ variety

### Part III: Product Evaluation

Instruction: 1. Please rinse your mouth before starting  
 2. Evaluate this product and check the space that best reflects feelings about the product

9. Overall, how would you rate this product?
- |           |           |            |          |          |          |            |           |           |
|-----------|-----------|------------|----------|----------|----------|------------|-----------|-----------|
| Dislike   | Dislike   | Dislike    | Dislike  | Neither  | Like     | Like       | Like      | Like      |
| Extremely | Very much | Moderately | Slightly | like nor | slightly | Moderately | Very much | Extremely |
|           |           |            |          | Dislike  |          |            |           |           |
| <u>1</u>  | <u>2</u>  | <u>3</u>   | <u>4</u> | <u>5</u> | <u>6</u> | <u>7</u>   | <u>8</u>  | <u>9</u>  |

10. Is this product acceptable?

Yes        No       

11. Would you buy this product if it were commercially available?

☐ Sure because \_\_\_\_\_  
☐ Maybe because \_\_\_\_\_  
☐ Sure for not buy because \_\_\_\_\_

12. How many pieces of this product should be contained in 1 box?

☐ more than 12 pieces      ☐ 12-10 pieces      ☐ 9-7pieces  
☐ 6-4 pieces      ☐ less than 4 pieces

13. How much would you be willing to pay for this product?(check one only)

☐ 30-40 baht      ☐ 41-50 baht      ☐ more than 50 baht

Thank you for your participation



## C.2) Home Use Tests

**Consumer Acceptance Test**

“The development of ready-to-eat Thai styles Maki Set”

Dear participant

According to the development of “The development of ready-to-eat Thai styles Maki Set” which has been carried out by Ms.Pasachon Jitnueang, Biotechnology student of Assumption University (Thailand), the product aims to develop the original Maki to the Thai styles and convenience for consumers in 1 serving size.

I would like to ask for your cooperation in answering this questionnaire subjected to your real opinion and behavior. All of your information provided to me will be beneficial to such research and be kept confidentially.

Your cooperation will be high appreciated.

**Instruction :** Please remove the product out of the box and then reheat the product for 1.30 minutes.

## Part I: Demographic Data

## 1. Gender

☐ Male ☐ Female

## 2. Age

☐ <18 ☐ 19-24 ☐ 25-30  
☐ 31-36 ☐ 37-42 ☐ >42

## 3. Education

☐ Lower than High school ☐ High school  
☐ Bachelor ☐ Master  
☐ Higher than Master

## 4. Occupation

☐ Student ☐ Government enterprise ☐ Government officer  
☐ Employee ☐ Business owner ☐ Housewife  
☐ other

## 5. Income (Bath/month)

☐ lower than 5,000 ☐ 5,000-15,000 ☐ 15,001-25,000  
☐ 25,001-35,000 ☐ more than 35,000

## Part II: Consumer's Behavior

## 6. How often do you eat frozen product per week?

☐ more than 4 times ☐ 4 times ☐ 3 times  
☐ 2 times ☐ 1 time ☐ less than 1 time

7. How many pieces of Maki would you like to purchase per serving size? (compared with Fuji's Maki)

☐ more than 9 pieces      ☐ 9 pieces  
☐ 8 pieces      ☐ 7 pieces  
☐ 6 pieces      ☐ less than 6 pieces

8. Rank the important quality attribute that you want in the frozen product (Rank only 1-3)

(1=most important 2=second most important 3=least important)

☐ appearance      ☐ odor      ☐ fresh  
☐ taste      ☐ color      ☐ clean  
☐ flavor      ☐ price      ☐ variety

### Part III: Product Evaluation

Instruction: 1. Please rinse your mouth before starting

2. Evaluate this product and check the space that best reflects feelings about the product

9. Overall, how would you rate this product?

Dislike    Dislike    Dislike    Dislike    Neither    Like    Like    Like    Like  
 Extremely   Very much   Moderately   Slightly   like nor   slightly   Moderately   Very much   Extremely  
    Dislike

☐ 1      ☐ 2      ☐ 3      ☐ 4      ☐ 5      ☐ 6      ☐ 7      ☐ 8      ☐ 9

10. Is this product acceptable?

Yes ☐ No ☐

11. Would you buy this product if it were commercially available?

☐ Sure because \_\_\_\_\_  
☐ Maybe because \_\_\_\_\_  
☐ Sure for not buy because \_\_\_\_\_

12. How many pieces of this product should be contained in 1 box?

☐ more than 12 pieces      ☐ 12-10 pieces      ☐ 9-7 pieces  
☐ 6-4 pieces      ☐ less than 4 pieces

13. How much would you be willing to pay for this product? (check one only)

☐ 30-40 baht      ☐ 41-50 baht      ☐ more than 50 baht

Comments : .....  
 .....  
 .....

Thank you for your participation

## Appendix D

D.1) To find out the effect of attributes by storage time (Day1)

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

<b>Sample code</b>	.....	.....	.....
<b>Appearance</b>	.....	.....	.....
<b>Smell</b>	.....	.....	.....
<b>Taste</b>	.....	.....	.....
<b>Overall</b>	.....	.....	.....

Thank You for Your Cooperation

D.2) To find out the effect of attributes by storage time (Day4)

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

<b>Sample code</b>	.....	.....	.....
Appearance	.....	.....	.....
Smell	.....	.....	.....
Taste	.....	.....	.....
Overall	.....	.....	.....

Thank You for Your Cooperation

D.3) To find out the effect of attributes by storage time (Day7)

### 9 points Hedonic Scale Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Product: \_\_\_\_\_

#### Instruction

1. Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need too.
2. Please taste the samples in the order presented, from left to right.
3. Please evaluate the liking score by using the following scores:

- 1 = Dislike extremely
- 2 = Dislike very much
- 3 = Dislike moderately
- 4 = Dislike slightly
- 5 = Neither like nor dislike
- 6 = Like slightly
- 7 = Like moderately
- 8 = Like very much
- 9 = Like extremely

Sample code	.....	.....	.....
Appearance	.....	.....	.....
Smell	.....	.....	.....
Taste	.....	.....	.....
Overall	.....	.....	.....

Thank You for Your Cooperation



## Appendix E

## SPSS OUTPUT

## 2. Optimize the appropriate formulation for product

Table30: The output of analysis for appearance of three difference ratio of rice

## appearance

sample code	N	Subset	
		1	2
Duncan <sup>a,b</sup> 678	30	5.7333	
921	30	5.9333	
324	30		6.9667
Sig.		.617	1.000

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 2.374.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table31: The output of analysis for cohesion of three difference ratio of rice

## cohesion

sample code	N	Subset
		1
Duncan <sup>a,b</sup> 921	30	5.7667
678	30	5.9000
324	30	6.0000
Sig.		.520

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 1.710.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table32: The output of analysis for hardness of rice of three difference ratio of rice

## hardness of rice

sample code	N	Subset	
		1	2
Duncan <sup>a,b</sup> 678	30	4.6333	
921	30		6.1000
324	30		6.6333
Sig.		1.000	.170

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 2.212.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table33: The output of analysis for stickiness of rice of three difference ratio of rice

stickiness				
sample code	N	Subset		
		1	2	
Duncan <sup>a,b</sup> 678	30	5.3667		
921	30	5.9667	5.9667	
324	30		6.3000	
Sig.		.140	.409	

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 2.412.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table34: The output of analysis for overall of three difference ratio of rice

overall					
sample code	N	Subset			
		1	2	3	
Duncan <sup>a,b</sup> 678	30	5.2000			
921	30		5.9000		
324	30			6.8333	
Sig.		1.000	1.000	1.000	

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 1.570.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table35: The output of analysis for appearance of two difference Pork Pa-nang samples

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	sample1 - sample2	-.16667	1.51050	.27578	-.73070	.39736	-.604	29	.550

Table36: The output of analysis for smell of two difference Pork Pa-nang samples

Paired Samples Test									
		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Interval of the Difference				
					Lower				Upper
Pair 1	SAMPLE1 - SAMPLE2	-.2667	1.01483	.18528	-.6456	.1123	-1.439	29	.161

Table37: The output of analysis for sweetness of two difference Pork Pa-nang samples

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 SAMPLE1 - SAMPLE	-.3667	.61495	.11227	-.5963	-.1370	-3.266	29	.003

Table38: The output of analysis for saltiness of two difference Pork Pa-nang samples

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 SAMPLE1 - SAMPLE2	-.4667	.86037	.15708	-.7879	-.1454	-2.971	29	.006

Table39: The output of analysis for compatibility of two difference Pork Pa-nang samples

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 SAMPLE1 - SAMPLE2	-.3000	.65126	.11890	-.5432	-.0568	-2.523	29	.017

Table40: The output of analysis for ratio of rice:filling of two difference Pork Pa-nang samples

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 SAMPLE1 - SAMPLE2	-.7000	.74971	.13688	-.9799	-.4201	-5.114	29	.000

Table41: The output of analysis for overall of two difference Pork Pa-nang samples

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
				Std. Error Mean	95% Confidence Interval of the Difference				
					Mean	Std. Deviation			
Pair 1	SAMPLE1 - SAMPLE2	-.4000	.67466	.12318	-.6519	-.1481	-3.247	29	.003

Table42: The output of analysis for appearance of two difference Omelet samples

Paired Samples Test									
		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	sample1 - sample2	-.42308	1.83680	.36023	-1.16498	.31882	-1.174	25	.251

Table43: The output of analysis for smell of two difference Omelet samples

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	sample1 - sample2	-.20000	.66436	.12130	-.44808	.04808	-1.649	29	.110

Table44: The output of analysis for sweetness of two difference Omelet samples

Paired Samples Test									
		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	sample1 - sample2	-.13333	1.07425	.19613	-.53447	.26780	-.680	29	.502

Table45: The output of analysis for saltiness of two difference Omelet samples

Paired Samples Test									
		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	sample1 - sample2	-.20000	1.06350	.19417	-.59712	.19712	-1.030	29	.312

Table46: The output of analysis for compatibility of two difference Omelet samples

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	sample1 - sample2	-.36667	.76489	.13965	-.65228	-.08105	-2.626	29	.014

Table47: The output of analysis for ratio of rice:filling of two difference Omelet samples

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	sample1 - sample2	-1.16667	1.68325	.30732	-1.79520	-.53813	-3.796	29	.001

Table48: The output of analysis for overall of two difference Omelet samples

Paired Samples Test									
		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	sample1 - sample2	-.33333	.99424	.18152	-.70459	.03792	-1.836	29	.077

Table49: The output of analysis for compatibility of two difference Omelet with carrots samples

One-Sample Test						
	Test Value = 200					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
SAMPLE1	-1358.345	29	.000	-192.4667	-192.7565	-192.1769

Table50: The output of analysis for sweetness of two difference Omelet with carrots samples

One-Sample Test						
	Test Value = 200					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
SAMPLE1	-1503.050	29	.000	-192.7000	-192.9622	-192.4378

Table51: The output of analysis for saltiness of two difference Omelet with carrots samples

One-Sample Test						
	Test Value = 200					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
SAMPLE1	-1307.477	29	.000	-192.2000	-192.5007	-191.8993



Table52: The output of analysis for overall of two difference Omelet with carrots samples

**One-Sample Test**

	Test Value = 200					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
SAMPLE1	-1547.517	29	.000	-192.5333	-192.7878	-192.2789

Table53: The output of analysis for appearance of two difference Stir fry pork with mushroom samples

**Paired Samples Test**

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	sample1 - sample2	-.03333	1.99107	.36352	-.77681	.71015	-.082	29	.928

Table54: The output of analysis for smell of two difference Stir fry pork with mushroom samples

**Paired Samples Test**

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 sample1 - sample2	.33333	.99424	.18152	-.03792	.70459	1.836	29	.077

Table55: The output of analysis for sweetness of two difference Stir fry pork with mushroom samples

**Paired Samples Test**

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	sample1 - sample2	-.10000	1.06188	.19387	-.49651	.29651	-.516	29	.610

Table56: The output of analysis for saltiness of two difference Stir fry pork with mushroom samples

**Paired Samples Test**

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 sample1 - sample2	.63333	.85029	.15524	.31583	.95084	4.080	29	.000

Table57: The output of analysis for compatibility of two difference Stir fry pork with mushroom samples

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	sample1 - sample2	-.10000	.80301	.14661	-.39985	.19985	-.682	29	.501

Table58: The output of analysis for ratio of rice:filling of two difference Stir fry pork with mushroom samples

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	sample1 - sample2	.80000	1.03057	.18815	.41518	1.18482	4.252	29	.000

Table59: The output of analysis for overall of two difference Stir fry pork with mushroom samples

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	sample1 - sample2	.33333	.99424	.18152	-.03792	.70459	1.836	29	.077

### 3. Optimize the time on microwave heating, to reheat the product.

Table60: The output of analysis for appearance of three difference reheating time appearance

sample code	N	Subset	
		1	2
Duncan <sup>a,b</sup> 527	30	6.3333	
884	30	6.5333	
716	30		7.3333
Sig.		.404	1.000

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .848.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table61: The output of analysis for smell of three difference reheating time

smell		
sample code	N	Subset
		1
Duncan <sup>a,b</sup> 527	30	6.8000
884	30	6.9333
716	30	7.0333
Sig.		.271

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .584.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table62: The output of analysis for sweetness of three difference reheating time

sweetness		
sample code	N	Subset
		1
Duncan <sup>a,b</sup> 884	30	7.1333
716	30	7.1667
527	30	7.2000
Sig.		.768

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .666.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table63: The output of analysis for saltiness of three difference reheating time

saltiness		
sample code	N	Subset
		1
Duncan <sup>a,b</sup> 527	30	7.4333
884	30	7.4667
716	30	7.4667
Sig.		.848

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .390.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table64: The output of analysis for hardness of rice of three difference reheating time

hardness of rice			
sample code	N	Subset	
		1	2
Duncan <sup>a,b</sup> 527	30	6.0667	
884	30		6.8000
716	30		7.2667
Sig.		1.000	.053

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .840.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table65: The output of analysis for overall of three difference reheating time

overall			
sample code	N	Subset	
		1	2
Duncan <sup>a,b</sup> 527	30	6.6333	
884	30		7.1667
716	30		7.4667
Sig.		1.000	.111

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .517.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

## 5. Study the shelf life of product

### Day1

Table66: The output of analysis for appearance of three samples

appearance			
sample	N	Subset	
		1	2
Duncan <sup>a,t</sup> stirfry	30	7.3333	
panang	30		7.6667
omelet	30		7.8000
Sig.		1.000	.347

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .297.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table67: The output of analysis for smell of three samples

smell		
sample	N	Subset
		1
Duncan <sup>a,k</sup> panang	30	7.3333
omelet	30	7.4000
stirfry	30	7.5000
Sig.		.372

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .452.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table68: The output of analysis for taste of three samples

taste			
sample	N	Subset	
		1	2
Duncan <sup>a,k</sup> stirfry	30	7.6333	
omelet	30	7.6667	
panang	30		7.9667
Sig.		.824	1.000

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .333.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table69: The output of analysis for overall of three samples

overall		
sample	N	Subset
		1
Duncan <sup>a,k</sup> omelet	30	7.6667
panang	30	7.7667
stirfry	30	7.7667
Sig.		.661

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .675.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.



Day4

Table70: The output of analysis for appearance of three samples

appearance		
sample	N	Subset
		1
Duncan <sup>a,t</sup> omelet	30	7.1667
stirfry	30	7.2333
panang	30	7.2667
Sig.		.449

Means for groups in homogeneous subsets are displayed.  
Based on Type III Sum of Squares  
The error term is Mean Square(Error) = .227.  
a. Uses Harmonic Mean Sample Size = 30.000.  
b. Alpha = .05.

Table71: The output of analysis for smell of three samples

smell		
sample	N	Subset
		1
Duncan <sup>a,t</sup> stirfry	30	6.9667
panang	30	7.1000
omelet	30	7.1000
Sig.		.383

Means for groups in homogeneous subsets are displayed.  
Based on Type III Sum of Squares  
The error term is Mean Square(Error) = .304.  
a. Uses Harmonic Mean Sample Size = 30.000.  
b. Alpha = .05.

Table72: The output of analysis for taste of three samples

taste		
sample	N	Subset
		1
Duncan <sup>a,t</sup> panang	30	7.2000
stirfry	30	7.2667
omelet	30	7.4667
Sig.		.086

Means for groups in homogeneous subsets are displayed.  
Based on Type III Sum of Squares  
The error term is Mean Square(Error) = .313.  
a. Uses Harmonic Mean Sample Size = 30.000.  
b. Alpha = .05.

Table73: The output of analysis for overall of three samples

overall			
sample		N	Subset
			1
Duncan <sup>a,t</sup>	panang	30	7.2667
	stirfry	30	7.3000
	omelet	30	7.3333
	Sig.		.188

Means for groups in homogeneous subsets are displayed.  
Based on Type III Sum of Squares  
The error term is Mean Square(Error) = .033.

- a. Uses Harmonic Mean Sample Size = 30.000.
- b. Alpha = .05.

Day7

Table74: The output of analysis for appearance of three samples

appearance			
		N	Subset
sample			1
Duncan <sup>a,t</sup>	panang	30	6.9333
	stirfry	30	6.9667
	omelet	30	7.1000
	Sig.		.138

Means for groups in homogeneous subsets are displayed.  
Based on Type III Sum of Squares  
The error term is Mean Square(Error) = .164.

- a. Uses Harmonic Mean Sample Size = 30.000.
- b. Alpha = .05.

Table75: The output of analysis for smell of three samples

smell			
sample		N	Subset
			1
Duncan <sup>a,t</sup>	stirfry	30	6.6000
	panang	30	6.6667
	omelet	30	6.7000
	Sig.		.256

Means for groups in homogeneous subsets are displayed.  
Based on Type III Sum of Squares  
The error term is Mean Square(Error) = .101.

- a. Uses Harmonic Mean Sample Size = 30.000.
- b. Alpha = .05.

Table76: The output of analysis for taste of three samples

taste		
sample	N	Subset
		1
Duncan <sup>a,t</sup> stirfry	30	6.3000
panang	30	6.5333
omelet	30	6.5667
Sig.		.068

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .277.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.

Table77: The output of analysis for overall of three samples

overall		
sample	N	Subset
		1
Duncan <sup>a,t</sup> panang	30	6.5000
stirfry	30	6.5333
omelet	30	6.5667
Sig.		.188

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = .033.

a. Uses Harmonic Mean Sample Size = 30.000.

b. Alpha = .05.



