AN APPLICATION OF
CHRYSANTHEMUM
(Chrysanthemum morifolium)
DRINK AS PIE FILLING

BY

PUVIS JIRATAKHUN

A special project submitted to
School of Biotechnology, Assumption University
In part fulfillment of the requirements of the Degree of Bachelor of
Science in Biotechnology
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Academic year: 2012

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(A. Nootrudee   Siriboon)

Advisor

Acknowledgement

Abstract

The study was aimed to find a possibility of applying Chrysanthemum (*Chrysanthemum morifolium*) drink as a pie filling. Consumer survey revealed that Nata de Coco, Ginkgo seeds and Lotus seeds were the most likely possible ingredient to apply in the Chrysanthemum drink sweet pie. A preliminary test was done using pineapple pie to develop the dough and filling to evaluate the pie formula. Upon confirming that the dough and the formula were feasible, they were applied with the three ingredients obtained from consumer survey. The pie had low intensity of Chrysanthemum flavor which was solved by, first, using only 70% of the Chrysanthemum drink initially in preparation of the pie filling and adding the remaining amount, 30%, back after boiling the filling which helped to retain the Chrysanthemum flavor, and, second, soaking the ingredients in the Chrysanthemum drink overnight. The study revealed that the Nata de Coco achieved the highest average preference score in Chrysanthemum aroma, 6.4±1.7. Just-about-right test indicated that sweetness and the amount of Natta de Coco required adjustment. Sugar was reduced by 5% and the amount of Natta de Coco was varied from 19.9, 19.1, and 18.2%. It was found that it was unnecessary to adjust the sweetness since the sweetness was needed to mask bitterness of the Chrysanthemum drink. The amount of the Nata de Coco was also remained the same. Hedonic scale test was carried out to ensure that the formula of the pie filling was feasible. After the confirmation, consumer test was carried out. Nata de Coco-Chrysanthemum pie product received a score of 7.2±0.8 on preference test and was found to be satisfactory with 91% of consumers from Siam Square areas and there were 88% of the consumers willing to purchase the product with the price of 16 - 30 Baht per piece.

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Introduction

Nowadays with the advancement in the medical technology and technique, the traditional herbs and medicines have become of less importance. Most people believe in the modern medicine and supplements which give the results that are more apparent and faster than the traditional herbs and medicines. To make the matter worse, the traditional herbs usually require complex methods of preparing and brewing before consumption that make them non-compatible with the modern medical supplements. The modern medical supplements come in tablets or injections which are much more convenient to be administered into body. Therefore, most of the herbs now become only part of refreshing drink sold in many stalls and their health benefit has decreased. Thus, this project aims to not only increase the popularity of a traditional herb but also developing a new product, using an ingredient that is available in the market, with possible potential to offer health benefit to the consumers.

The choice of the traditional herb in this research is dried Chrysanthemum flower or Kek-huai, which will be applied in a pie filling. The reason why the dried Chrysanthemum flower is chosen is because it is well-known to many people as a common Chinese drink and is likely to be popularized more easily than other less well-known herbs. Another reason why Chrysanthemum drink is the potential candidate is that it has a pleasant yellowish gold color which is likely to be attractive as a pie stuffing. This exceptional herb has pleasing color unlike many herbs which have dark color. As a drink, the aroma of the Chrysanthemum flower is pleasant and well-liked by most people. Chrysanthemum taste, which is either tasteless or bitter depending on the concentration of the dried flower used and can be enhanced by addition of sugar. The bitterness is masked by the sweetness from sugar. In addition, the Chrysanthemum drink as a pie filling will add a new variety of pie stuffing into the food market.

Besides the general benefits such as helping in recovery from influenza, prevention of sore throat and as a cooling herb that can cool one down or relieve fever (Fig, 2009), Chrysanthemum also has many health benefits unknown to many people. It is an antioxidant agent (Duh, 1999) due to the present of phenolic compound (James M. Harnly, Long-Ze Lin, 2009). It can also prevent migraine (Awang, 2006) and Parkinson's disease (In-Su Kim, Hyun-Myung Ko, Sushruta Koppula, Byung-Wook Kim, Dong-Kug Choi, 2011). As a pie filling, Chrysanthemum may not show these

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properties explicitly, but it is very much possible that these properties will not be destroyed and still present even in the tiniest amount even when the Chrysanthemum has been heated in the process of pie production. This is because when the Chrysanthemum is used as medication or extraction, it is usually brewed by using heat before applied used as medicine or disease-preventing agent. Its property of anti-oxidant can even be advantage of the pie production since it may help delay or prevent rancidity of the fried pie that has been stored over some period.

With this research making a new use of the Chrysanthemum drink as pie stuffing, the value of the Chrysanthemum itself can be increased as well. Also, there is no report of previous studies which use Chrysanthemum drink as pie filling. Therefore, this research aims to generate the new knowledge of applying Chrysanthemum drink as pie filling. At the same time, this project helps adding the value of Chrysanthemum as well as promoting the consumption of traditional herbs to the consumers.

Objectives

1. To develop the variety of pie filling by using Chrysanthemum drink as ingredient
2. To study the acceptability of Chrysanthemum Pie by general consumers

Literature Review

Pie

Traditionally, a pie is a baked dish which is usually made of a pastry dough casing that covers or completely contains a filling of various sweet or savory ingredients. Non-baked type of pie or fried pie is also available. The filling of the pie can be meat or fruits. Pies are defined by their crusts (Yummy Pie Recipes, 2012). There are filled pies, top-crust pies and two-crust pies. A filled pie (also single-crust or bottom-crust), has pastry lining the baking dish, and the filling is placed on top of the pastry, but left open. A top-crust pie, which may also be called a cobbler, has the filling in the bottom of the dish and the filling covered with a pastry or other covering before baking. A two-crust pie has the filling completely enclosed in the pastry shell. Flaky pastry is a typical kind of pastry used for pie crusts, but many things can be used, including baking powder biscuits, mashed potatoes, and crumbs.

Chrysanthemum

Chrysanthemum is one of the most popular herbs in the East. Its scientific name is *Chrysanthemum morifolium*. They grow best and produce the most flowers if they are planted in full sunshine. They thrive well when there are plenty of foods and water. There are hundreds of varieties of Chrysanthemums, each having different heights, colors, flower sizes and times of bloom. The pant is propagated as seeds or from cuttings and dividing. As a garden plant, Chrysanthemum is sold in a pod for bedding plants, to gallon size, and larger plants. They should be planted into well prepared, fertile, sandy soil (How to Grow and Care for your Chrysanthemum Plants, 21).

Chrysanthemum drink is a flower-based tisane made from Chrysanthemum flowers of the species. This beverage had been drunk since the Song Dynasty (960–1279.) To prepare the drink, the dried Chrysanthemum flowers are steeped in a teapot, cup or glass containing hot water, around 90° to 95°C. Many times, sugar is added to sweeten the drink, and occasionally with goji berries, the Chinese dried fruits from *Lycium barbarum*. Then, the drink is poured from the container and serve hot or with ice for cold serve. Chrysanthemum drink is transparent, light yellow to bright yellow with pleasant floral aroma.

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In China, Chrysanthemum is known as cooling herb to treat influenza and acne. As a medicine, the dosage of Chrysanthemums for most treatments is 10g per day (Carson, 2011). Chrysanthemum beverage is also an effective treatment for heat rash and cold symptoms. It helps for treating "hot" colds, which are generally accompanied by fever and swollen glands. Chrysanthemum beverage is effective against acute infections of the eyes, such as acute conjunctivitis to treat blurred vision, dry eyes and tired eyes.

Nata de Coco

Nata de coco has originated in the Philippines. In Spanish, the word 'Natta de coco' means 'cream of coconut'. It is made from fermentation coconut juice with bacteria, *Acetobacter xylnium* that produces a chewy, translucent, jelly-like gel. The main component of the gel is cellulose. People are familiar with Nata de coco as sweetened jelly or a candy or dessert that can be consumed with other ingredients such as pickles, drinks, ice cream, puddings and fruit mixes (Tutorgig, 2013)

Since Nata de coco is made up of cellulose fiber and water, it has been highly recommended for high dietary fiber, low fat and no cholesterol content product. Strips of Nata de Coco are used in mass-produced bubble tea drinks as a healthier alternative to tapioca.

The production of Nata de Coco includes the fermentation of the coconut juice by bacterium starter. The starting culture of *Acetobater xylinum* is prepared first by inoculating the bacteria in pineapple juice for 2-3 weeks. Fresh coconut juice is filtered to remove insoluble particles or debris before adding C source and N source and boiled to pasteurize the juice. Before adding the starting culture, the vinegar or acetic acid is added to decrease its pH to 3 – 4 to favor bacterium growth. During fermentation *Acetobacter xylinum* uses fructose and sucrose and converts them to pelikel cellulose. The process is allowed to take place until obtaining 1.5 cm thick of cellulose gel. The gel is, then, harvested, and washed repeatedly to remove acid until there is no acid left in the gel (http://formulation.vinensia.com/2011/10/ manufacturing-process-of-nata-de-coco.html, 28/03/2013). Lastly, cutting and packaging is done to prepare the Nata de Coco for the consumers (Nata de Coco, 2013).

Puffin Margarine

Puffing margarine is manufactured for making puff pastry or pie. It is different from regular margarine in its melting point is higher. The high melting point allows this margarine to be worked at room temperature without melting. Since preparation of pastry dough is taken place at room temperature, melting is not referred. If the margarine melts during preparing the dough, it will run off the dough, leaving the dough slip and difficult to roll out. The puffing margarine contains high amount of saturated fatty acid that causes them to remain semi-solid and stable during working the dough.

The word 'margarine' comes from a Greek word 'margarites' which meane pearl. The origin of margarine started with a French scientist, Michel Eugene Chevreu, who, isolated margaric acid from animal fats in 1813. This fatty acid is a main component of margarine that made margarine pearl-like appearance. (Trex, 2010)

Today's margarines contain only traces of maligned trans-fats, are fortified with essential fatty acids - particularly omega-3 - and vitamins, and are sometimes even infused with olive oil. Most brands are also relatively low in saturated fats or calories and contain no cholesterol. Numerous types of margarine carry the Heart and Stroke Foundation's Health Check seal, a designation that tells consumers the product has met its nutrition criteria. Product labels are also designed to boast about the healthy changes (Weeks, 2012). The trend of healthier margarine is definitely beneficial to the application of margarine in the bakery and other products.

Salt

The multiple chemical and physical properties of salt make possible 14,000 known uses. From the days of the cave men, humans have discovered ingenious means to use salt to enhance the quality of our lives. So valuable is this common mineral that wars have been waged and revolutions fought for access to salt. Its largest use is largely invisible to the public: about 40% of salt worldwide is used as the raw material that chemical companies transform into chlorine and soda ash, the foundations of inorganic chemistry. Salt is a processing aid in innumerable industries and the means by which animal nutrition experts ensure the health and productivity of livestock and poultry. We are all familiar with the salt shaker on the table in most of our homes. We less often think of the salt we use to regenerate our water softeners to protect the pipes and appliances in

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our homes. And seasonally, many of us give thanks for the salt that road maintenance crews apply to keep our cars, trucks and school buses safely on snowy winter roads (Uses and Benefits of Salt, 2011).

Man's inherent salt appetite isn't the only reason salt is used in food. It also helps make foods safe and appealing. Salt is an essential nutrient as well. Humans possess an inherent appetite for salt. It is highly possible that salt is the world's oldest food additive. Salt brings to food far more than one of the five basic taste sensations (sweet, salty, sour, bitter and umami); it enhances other tastes as well. Sweets taste sweeter with salt. Salt masks bitter tastes, making naturally bitter foods like chocolate and broccoli become delicious. Before recorded history, men learned salt's key role in food safety and preservation by retarding the growth of spoilage microorganisms. Today, food technologists rely on salt to satisfy consumer preferences in color, texture, appearance and aroma. And, all evidence suggests that consumers do have preferences, and they prefer the attributes that only salt can deliver (Salt in Food, 2011)

Butter

Butter is a dairy product made by churning fresh or fermented cream or milk. It is generally used as a spread and a condiment, as well as in cooking, such as baking, sauce making, and pan frying. Butter consists of butterfat, milk proteins and water.

Most frequently made from cows' milk, butter can also be manufactured from the milk of other mammals, including sheep, goats, buffalo, and yaks. Salt, flavorings and preservatives are sometimes added to butter. Rendering butter produces clarified butter or ghee, which is almost entirely butterfat.

Butter is a water-in-oil emulsion resulting from an inversion of the cream, an oil-in-water emulsion; the milk proteins are the emulsifiers. Butter remains a solid when refrigerated, but softens to a spreadable consistency at room temperature, and melts to a thin liquid consistency at 32–35 °C (90–95 °F). The density of butter is 911 g/L (56.9 lb/ft3). It generally has a pale yellow color, but varies from deep yellow to nearly white. Its unmodified color is dependent on the animals' feed and is commonly manipulated with food colorings in the commercial manufacturing process, most commonly annatto or carotene (Butter, 2013).

Sucrose

Sucrose or table sugar is obtained from sugar cane or sugar beets. It is made from glucose and fructose units. The glucose and fructose units are joined by an acetal oxygen bridge in the alpha orientation. The structure is easy to recognize because it contains the six member ring of glucose and the five member ring of fructose. To recognize glucose, horizontal projection of the -OH on carbon # 4must be looked for. The alpha acetal is really part of a double acetal, since the two monosaccharides are joined at the hemiacetal of glucose and the hemiketal of the fructose. There are no hemiacetals remaining in the sucrose and therefore sucrose is a non-reducing sugar (Sucrose, 2003).

Flour and Pastry Dough

Pastry Dough is made of flour which is a powder which is made by grinding cereal grains, other seeds or roots (like Cassava). Flour is also the main ingredient of bread. Wheat flour is one of the most important foods in European, North American, Middle Eastern and North African cultures, and is the defining ingredient in most of their styles of breads and pastries. Maize flour has been important in Mesoamerican cuisine since ancient times, and remains a staple in much of Latin American cuisine. Rye flour is an important constituent of bread in much of central/northern Europe. The word "flour" is originally a variant of the word "flower". Both derive from the Old French fleur or flour, which had the literal meaning "blossom," and a figurative meaning "the finest." The phrase "fleur de farine" meant "the finest part of the meal," since flour resulted from the elimination of coarse and unwanted matter from the grain during milling. It was discovered around 6000 BC that wheat seeds could be crushed between simple millstones to make flour (FLOUR VIDEO | USE IN COOKING RECIPES, 2012).

There are many different recipes for pie dough. The ideal recipe must be excellent for making fried pie crusts. It must absorb very little grease. If small turnovers or turnovers with pre-cooked filling are being made, they may be fried at a slightly higher temperature (375°F) but reduce heat if they brown too quickly. If uncooked filling is used or larger turnovers are being made, lower temperature to 360°F (CM, 2012).

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Materials and Methods

Materials

- All-purpose flour, UFM Brand
- Dried Chrysanthemum Flower, Tiger Brand
- Sugar, Mitrphol Brand
- Salt, Prungthip Brand
- Salted butter, Allowrie Brand
- Puffin margarine, Puff Top Brand

Equipment and apparatus

- Digital balance (ES-3000H, Zepper)
- Oven
- Bakery utensil

Methodology

1. **Formulation of Chrysanthemum drink pie filling**

   1.1 Consumer survey

   The survey of consumers' opinion on Chrysanthemum drink pie was done by using questionnaire (Appendix A: A-1). The consumers included 100 consumers at Siam Square and Central World. The questionnaire aimed to survey consumer behavior on Chrysanthemum beverage consumption, pie consumption, and consumers' opinion on Chrysanthemum drink pie.

1.2 Preliminary experiment

a. Preparation of pie dough

Pie dough was prepared as a stock according to the formula in Table 1:

Table 1: Pie dough formula

Ingredients	Amount	Percentage, fwb
All-purpose flour	500 grams	100
Salted butter	75 grams	15
Puffin margarine	300 grams	60
Salt	5 grams	1
Cold water	250 Milliliters	50

Stock dough preparation

- Rup salted butter with sifted flour so that butter is distributed as pea-size and coated with flour, thoroughly.

- Add water to the flour-butter mix and combine them to rough dough. Put in a plastic bag and store in a refrigerator for 20-30 minutes to allow flour to absorb moisture completely.

- Put the dough on a flour dusted working table and roll out into a rectangular sheet.

- Place cut puffin margarine on two-thirds of the area, leaving at least 1 inch along the edge of the sheet. Fold the remaining sheet over the puffin margarine and seal the edge. Fold the folded sheet over the remaining portion of the sheet and seal the edge. Put the dough in the plastic bag and store in the refrigerator for 20-30 minutes to firm the dough and the puffing margarine.

- Put the dough on the flour dusted table, roll and fold with 3-fold and put it back in the refrigerator. Repeat cooling and folding another two times.

- Store the pastry dough in the refrigerator for further use.

b. Preparation of pineapple pie filling

Pineapple pie was used as a reference formula to determine a possibility to modify the pie filling formula for Chrysanthemum drink with the selected ingredients from 1.3.1. The formula was shown in Table 2.

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The Chrysanthemum drink pie filling preparation is divided into three steps, including

    i.   Chrysanthemum drink preparation

    ii.   Chrysanthemum filling preparation

    iii.   Preparation of ingredient

Table 2: Chrysanthemum pie filling with pineapple filling formula

Ingredients	Amount/ Volume	Percentage
Pineapple flesh	85 grams	23.4
Sugar	50 grams	13.7
Butter	20 grams	5.5
Chrysanthemum drink	196 grams	53.8
Salt	1.5 grams	0.4
All-purpose flour	11.8 grams	3.2

i. Chrysanthemum drink preparation

1. Boil 10% dried Chrysanthemum flower with water.

2. Filter through sheet cloth.

3. Cool down to room temperature.

ii. Chrysanthemum filling preparation

1. Boil one-third of Chrysanthemum drink with sugar until all sugar is dissolved.

2. Add all-purpose flour to the sweetened Chrysanthemum drink and bring to boil to gelatinize the flour, stirred all the time. Cool the paste down to room temperature.

3. Mix the remaining ingredient to the Chrysanthemum paste.

iii. Preparation of ingredient

1. Add the ingredient in the remaining Chrysanthemum drink and bring to boil.

2. Cool down to room temperature and keep in the refrigerator overnight.

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1.3 Development of Chrysanthemum drink pie filling

a. Determination of the ingredients for Chrysanthemum drink pie filling

The ingredients for Chrysanthemum pie filling were the top three most-selected ingredients resulted from the consumer survey opinion on Chrysanthemum drink pie (1.1).

1.4 Development of Chrysanthemum drink pie

1.4.1 Determination of the most preferable formula for each pie filling ingredient

Chrysanthemum drink pie was prepared using pie stock from 1.2.a. The pie filling was prepared using the formula in Table 2 but replacing fresh pineapple with the selected ingredient from 1.3.a.

1.4.2 Screening for the most preferable ingredient

The pie samples were tested using 9-point hedonic scale preference test on 7 attributes including color, appearance, Chrysanthemum flavor, saltiness, sweetness, texture and overall liking by 20 untrained test panelists. All test panelists were students from School of Biotechnology, Assumption University, Hua mak campus.

1.4.3 Just-About-Right Test

The most preferable ingredient from (1.4.2) was tested in the Just About Right (JAR) test. Five attributes pertaining to the characteristics of the Chrysanthemum drink pie were studied.

1.4.4 Adjusting the formula

Chrysanthemum drink pie was adjusted according to the result from 1.4.3. The ingredient or the preparation method was changed based on the trend result from 1.4.3. The pie samples were tested in a 9-point hedonic scale preference test on 5 attributes by 20 untrained test panelists.

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1.4.5 Confirmation of prototype formula

The prototype formula of the Chrysanthemum drink pie obtained from 1.4.4 was tested in the 9-point hedonic scale preference test (Appendix D: D-1) on 7 attributes including color, appearance, Chrysanthemum flavor, saltiness, sweetness, texture and overall liking to confirm the prototype formula. The same group of 20 untrained test panelists was used in the sensory evaluation.

All formulations and sensory evaluation were conducted twice to duplicate the result.

1.5 Consumer acceptance test of the prototype product

The consumer test was conducted using questionnaire (Appendix E: E-1) with the prototype product from (1.4.4) from 200 consumers.

2. Sensory Evaluation

2.1 The preference test 9-point hedonic scale (Appendix B: B-1) was used in selecting and screening the most preferable ingredient and Chrysanthemum drink flavor for developing the Chrysanthemum drink pie.

2.2 The Just About Right (JAR) scale test (Appendix C: C-1) was used to determine the attribute that needed to be adjusted. Also, 9-point hedonic scale preference test (Appendix C: C-3) was used to determine the acceptability of the adjusted Chrysanthemum drink pie.

2.3 The consumer acceptance test was used on a large group of consumers to study the consumer's behaviors, opinion, attitudes and needs toward the application of Chrysanthemum drink as pie filling.

3. Statistical Analysis

3.1 The Randomized Complete Block Design (RCBD) was used as the experimental design where the treatment was ingredient and test panelists were block.

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3.2 The Microsoft Excel Program was used to perform the statistical analysis for analysis of variance or ANOVA at $p < 0.05$.

4. Experimental Location

4.1 E1 room, E building Assumption University (Hua Mak Campus)

4.2 Assumption University (Hua Mak Campus)

5. Experimental Plan

The experimental plan covered the 7 tasks of working a period of 7 months for developing the Chrysanthemum drink pie with the most preferred ingredient as following;

5.1 Searching for the information and methodology

The information regarding Chrysanthemum drink was searched during late June 2012 while the consumer behavior on Chrysanthemum drink consumption and pie consumption, as well as consumers' opinion on Chrysanthemum drink pie was surveyed by using the questionnaire and analyzed in early July. Both information and idea were used as the reference for the Chrysanthemum drink pie.

5.2 Preliminary Test

In July, a preliminary test was done by preparing the stock pie dough in order to learn about the pie making process. Moreover, the Chrysanthemum drink pie filling based on pineapple was made as a basic pie filling to determine the possibility to adapt the formula from the selected ingredients obtained in the consumer's survey.

5.3 Formulation of Chrysanthemum drink pie filling

From August to December The Chrysanthemum pie fillings with the selected ingredients were developed to determine the compatibility. The preference test 9-point hedonic scale was used in selecting and screening the most preferable ingredient and Chrysanthemum flavor

5.4 Formulation of Chrysanthemum drink pie prototype formula

The most preferred formula from the development of Chrysanthemum pie filling during August and December was used to develop a prototype formula by the preference test 9-point hedonic scale during late January to early February.

5.5 Consumer acceptance survey

The consumer test was done on 200 consumers from different places during February and early March in order to observe consumer's behavior and feedback toward pie in the market, Chrysanthemum pie product and also the demographic information.

5.6 Collect data and analyze results

The preference test 9-point hedonic scale and the Just About Right (JAR) scale test were done during development of Chrysanthemum pie filling and development of Chrysanthemum pie formula since August to January. Lastly, the result of consumer acceptance test was analyzed in February and March.

5.7 Preparation of report and project presentation

All the information, data and result collected since the beginning to the end of the project were compiled into a report and the presentation was prepared in March.

Table 3: Time schedule for the development of Chrysanthemum pie

Activity	Year									
	2012							2013		
	June	July	August	September	October	November	December	January	February	March
1. Searching for the information and methodology	■									
2. Preliminary Test		■								
3. Formulation of Chrysanthemum drink pie filling			■	■	■	■	■			
4. Formulation of Chrysanthemum drink pie prototype formula								■	■	
5. Consumer acceptance survey									■	■
6. Collect data and analyze results			■	■	■	■	■		■	■
7. Preparation of report and project presentation										■

Results and Discussions

1. Formulation of Chrysanthemum Drink Pie Filling

1.1 Consumer survey

Consumer survey with 100 consumers in Siam Square and Central World was conducted to determine consumer's behavior on consumption of pie, Chrysanthemum drink, and the opinion of a potential of making Chrysanthemum drink pie filling.

Have you ever eaten pie?

10.00%

90.00%

- Yes
- No
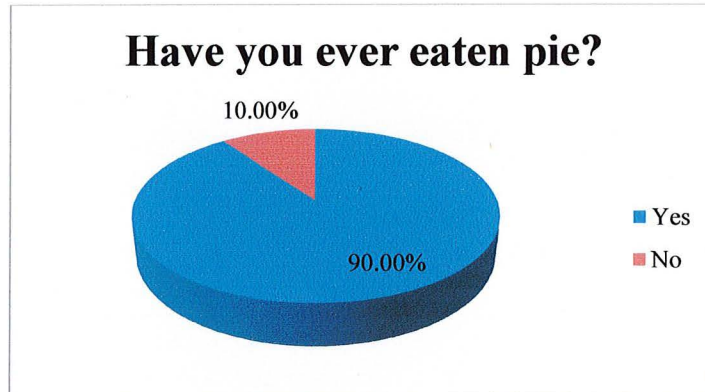
Figure 1: The percentage of participants who have/never consumed pie

Frequency

8.89%

17.78%

15.56%

22.22%

35.56%

- Less than once a month
- Once a month
- Less than once a week
- 1 – 3 times per week
- More than 4 times per week
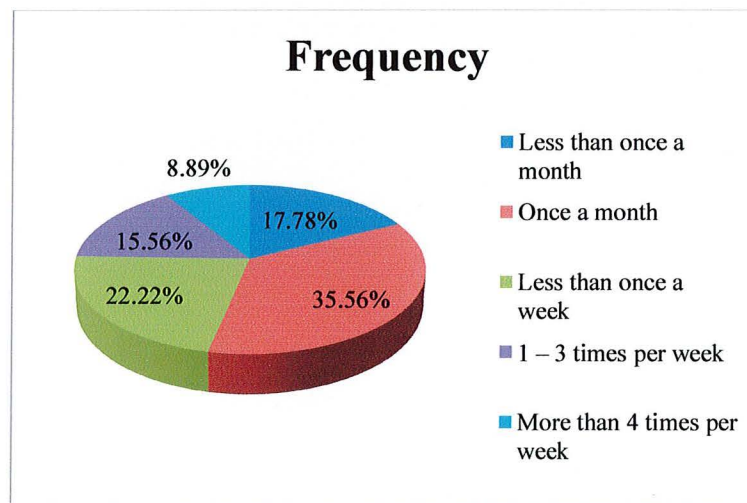
Figure 2: The frequency of pie consumption

From the questionnaire, it could be seen in Figure 1 that the majority of people participated (90%) had consumed pie before. Among these participants, most of them consume pie at the rate of one time per month (35.6%), followed by the rate of less than once a week (22.2%) in Figure 2.

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Reasons

- Tasty 29.79%
- Crispy 24.47%
- Benefit 2.13%
- Convenience 19.15%
- Aroma 12.77%
- Cheap 7.45%
- Quantity 3.19%
- 1.06%
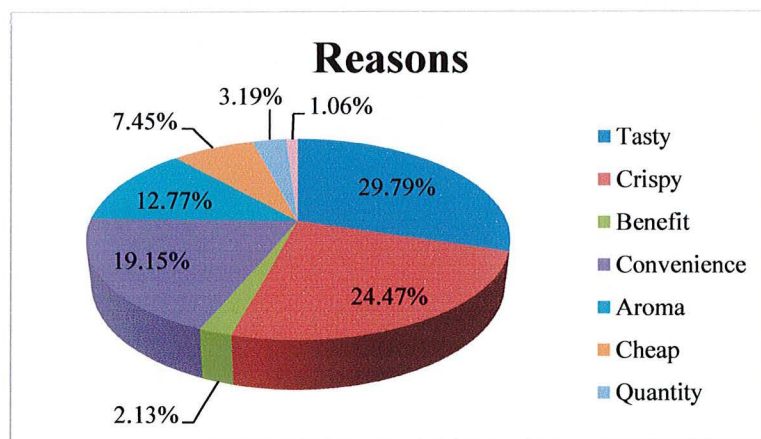
Figure 3: The reason of pie consumption

Figure 3 demonstrated that the main reason why they consumed pie was its tastiness with 30% of the respondents and closely followed by crispness of the product, 24.5%. This indicates that most of the participants consumed pie because of the pleasant feeling such as good taste or crispiness of it. Furthermore, the next popular reason for pie consumption was convenience, 19.2%. Pie is a product that can be consumed on-the-go. It can also be a quick breakfast for many people since it is easy to consume and provided high energy. Significantly, very few participants consumed pie for the reason of nutritional benefit, 2.1%. Pie is usually seen as an unhealthy product since it contains butter, margarine and sugar. Nevertheless, applying Chrysanthemum drink as a pie filling could help improve the nutritional value as well as consumers' perception.

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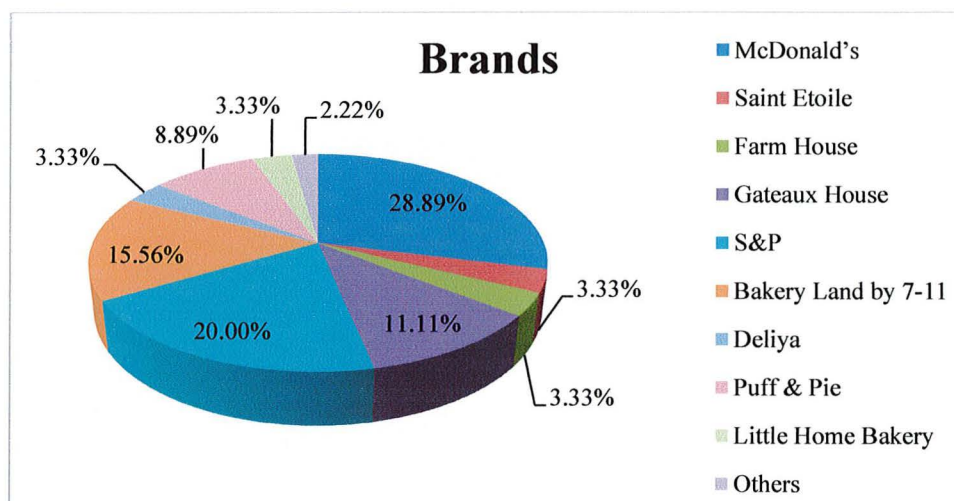
Figure 4: The brands of the pie consumed

Brand in which participants most often consumed was McDonald's, 28.9%, as shown in Figure 4. McDonald's pie was perceived as a trendy dessert by most people. It was also always served hot which enhanced the crispiness and, therefore, tastiness of the pie. Thus, it was not surprising that McDonald's pie as at the top of the ranking.

S&P pie held the next position, 20%. S&P is known as one of the best professional bakery in Thailand. However, their pies are not always served hot. Therefore, it came in second, following McDonald's. Pie from other bakery had significantly lower ranking than the two brands aforementioned. This was because McDonald's and S&P were the most popular destination of people for pie.
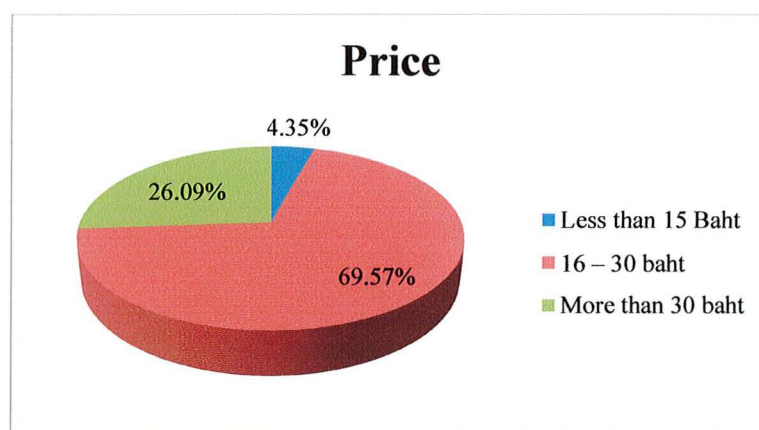
Price

Figure 5: The price of pie consumed

Most of the participants paid 16-30 Baht for a piece of pie, 69.6%, and 26.1% paid more than 30 Baht per time, 4.4% paid less than 15 baht per time as shown in Figure 5.

Types
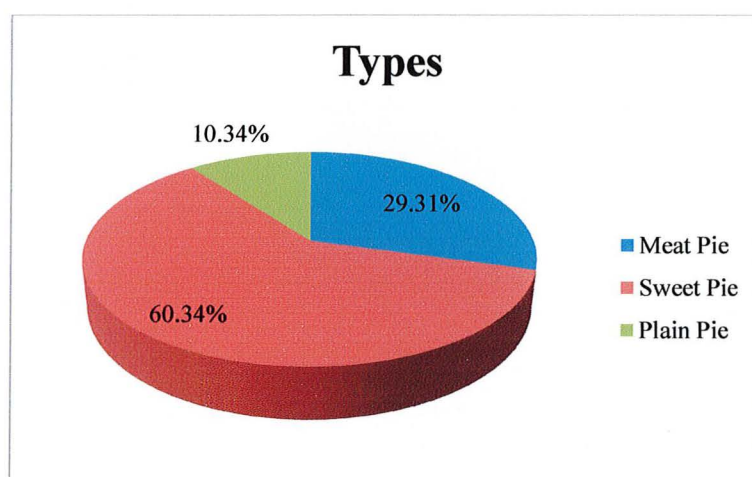
Figure 6: Type of pie consumed

On type of pie filling in Figure 6, it was found that the majority of the participants consumed sweet pie rather than meat pie, 60.3% to 29.3%. It was expected because most of Thai people consumed pie as a dessert rather than a main dish. Even the meat pie was also consumed as snack rather than main dish. Unlike the Westerners that have a culture of consuming pie as a main dish.

Favorite

Legend:
- Chicken Pie
- Tuna Pie
- Shredded pork with crab stick pie
- Mushroom Pie
- Spinach Pie
- Roasted red pork with salted egg
- Beef Pie
- Chicken Curry Pie
- Ham Cheese Pie
- Ham Egg Pie
- Corn Pie
- Pineapple Pie
- Taro Pie
- Apple Pie
- Coconut Pie
- Palmyra Palm Pie
- Mixed Fruit Pie
- Others

Percentages on chart: 2.08%, 2.08%, 0.00%, 6.25%, 3.13%, 12.50%, 10.42%, 3.13%, 8.33%, 9.38%, 14.58%, 13.54%, 2.08%, 2.08%, 3.13%, 0.00%, 6.25%, 1.04%

Figure 7: Type of pie favored by participants

The favorite pie the consumers had (Figure 7) were pineapple pie, corn pie, chicken pie and tuna pie with the percentages of 14.6%, 13.5%, 12.5 and 10.4%, respectively. The percentages related to the pie products available in McDonald's and S&P in Thailand. Pineapple pie and corn pie were the two main types of pie provided by McDonald' while the chicken pie and tuna pie were sold in S&P. Chicken pie could also be found in most bakery venders for its most popular type of meat pie in Thailand.

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Which type of food do you think has a potential to be applied as pie filling?

Legend:
- Tom-Yum
- Canned Fish
- Fried Rice
- Fish Maw
- Steamed Curry
- Curried Cake
- Oyster omelet
- Pad Thai
- Stir-Fried Meat and Basil
- Pa-lo
- Thai rice noodle roll
- Fried Vegetable
- Spicy salad
- Spicy Curry
- Stir-Fried Meat and Chili
- Salad
- Stew
- Chinese Spaghetti
- Papaya Salad
- Spicy pork salad
- Sukiyaki
- Others

Figure 8: Food with potential to be pie filling

When asked for type of food or dish suitable to be made into pie filling (Figure 8), the majority of participants chose the Thai spicy pork salad or Larb for the most potential candidate (15.3%). In fact, Thai spicy pork salad or Larb was one of the most popular dishes in country and was reflected in most people choice. It was also relatively dry as compared to the other types of food that were more soup type. Nevertheless, the next most popular choice was the Tom Yum, which achieved the equal score as steam curry of 12.9%. Tom Yum was an extremely popular dish in Thailand. The steam curry also received the same percentage as Tom Yum because of its uniqueness that caught the consumers' attention.

Which type of dessert do you think has a potential to be applied as pie filling?

Legend:
- Taro Balls
- Sweet Boiled Bean
- Sweet Soy Bean
- Sweet Sticky Rice
- Banana in Coconut Milk
- Job's Tear
- Thai Custard
- Tapioca Balls
- Tapioca in Syrup
- Filled Wheat Flour Dumpling
- O-Nee-Pae Guay
- Thai Sweetmeat
- Sweet Condense Milk
- Jam
- Nata de Coco
- Fruit
- Others
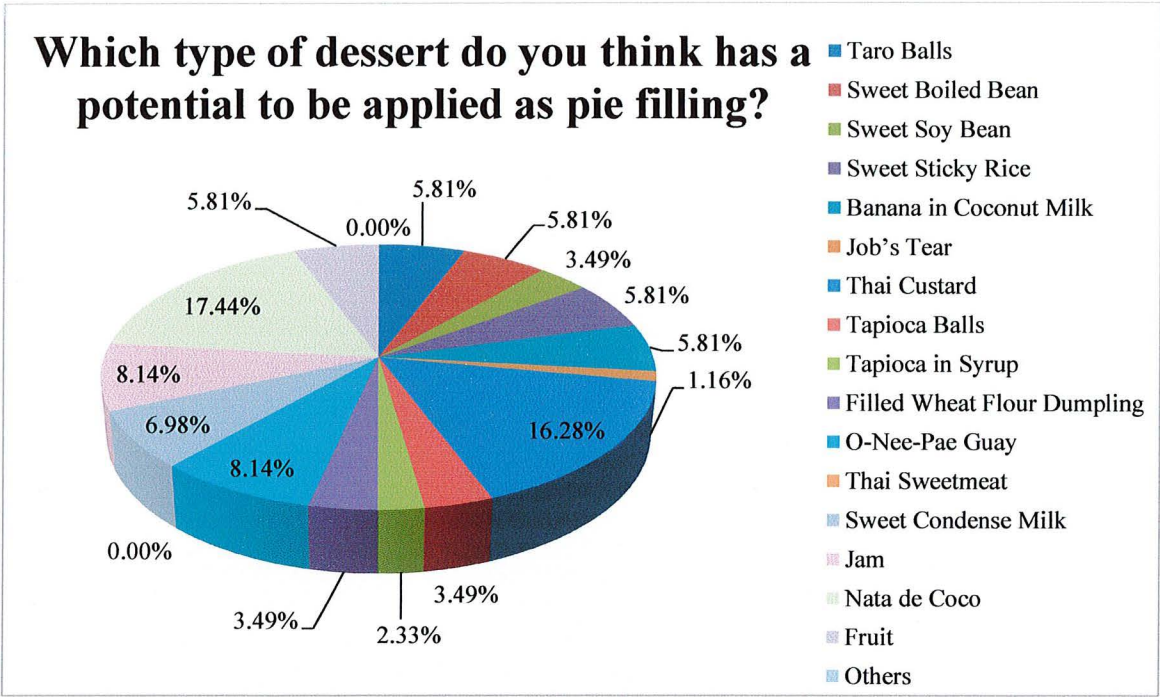
Figure 9: Dessert with potential to be pie filling

Furthermore, when asked for a type of dessert suitable to be made into a pie filling in Figure 9, the dessert that achieved the highest percentage was Nata de Coco (17.4%). This could be because of the chewy texture of the Nata de Coco. The second-most popular choice for the participants was Kaya or Sang-kaya or coconut custard (16.3%). Another popular dessert in Thailand, Kaya was widely consumed with bread. Thus it was interesting choice for pie filling. O-Nee-Pae Guay, a type of Chinese dessert, and Jam were ranked as the third sweet pie filling choice (8.1%). However, the number of participants who chose the O-Nee-Pae Guay and Jam were not as high as those achieved in the Nata de Coco and Kaya.

Do you like Chrysanthemum drink?

18.00%

82.00%

- ■ Yes
- ■ No
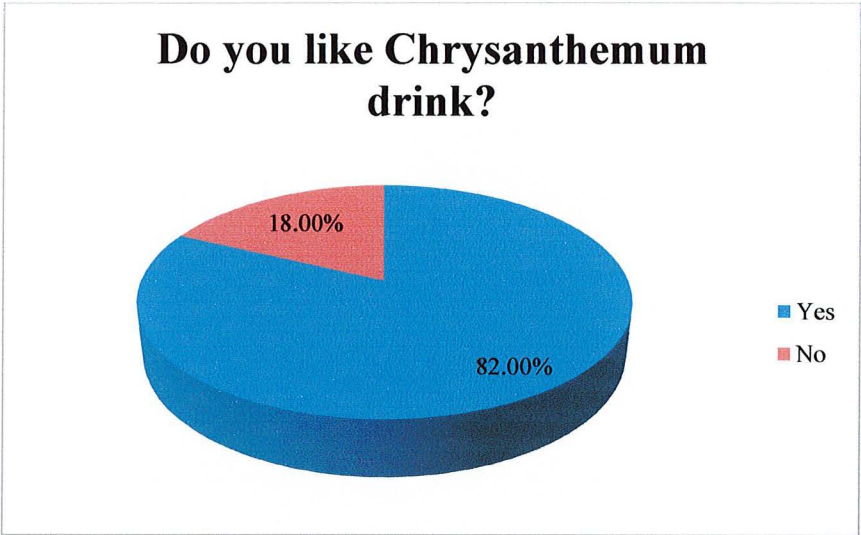
Figure 10: Percentage of participants who like/dislike Chrysanthemum drink

From figure 10, it could be seen that the majority of participants liked to consume Chrysanthemum (82%). This was expected since Chrysanthemum drink was one of the most common herbal drinks in Thailand.

What category of food do you think can go along with Chrysanthemum?

12.00%

88.00%
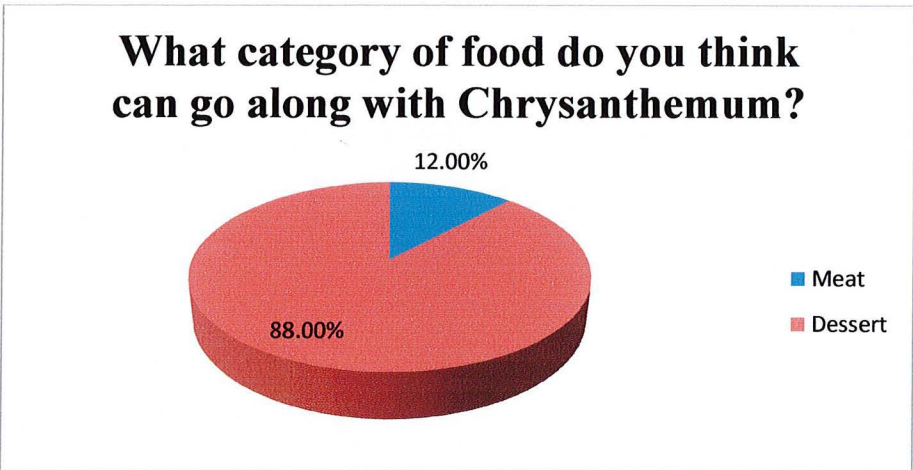
- ■ Meat
- ■ Dessert

Figure 11: Categories of food that can go along with Chrysanthemum

Figure 11, most of the participants also believed that Chrysanthemum drink was better consumed with a sweet type of pie filling rather than the meat pie type, 88%. Again, this was expected since most people in Thailand were familiar with Chrysanthemum drink as a sweet drink or sweet beverage.

What food do you think can go along with Chrysanthemum and be made into pie filling?

Legend:
- Crispy Fish
- Shredded Pork
- Boiled Egg
- Tom-Yum
- Canned Fish
- Fried Rice
- Fish Maw
- Steamed Curry
- Curried Cake
- Oyster omelet
- Pad Thai
- Stir-Fried Meat and Basil
- Pa-lo
- Thai rice noodle roll
- Fried Vegetable
- Spicy salad
- Spicy Curry
- Stir-Fried Meat and Chili
- Salad
- Stew
- Chinese Spaghetti
- Papaya Salad
- Spicy pork salad
- Sukiyaki
- Others

Figure 12: Food that participants believe can get along with Chrysanthemum as a pie filling

In Figure 12, the meat filling that the participants thought that could be incorporated into pie with Chrysanthemum was shredded pork (17.2%), which was actually the sweetened shredded pork. Thus, it could be considered as the sweet pie filling. The second choice was Tom Yum, 15.6% which, as mentioned earlier, was the most popular dish in the country. However, Tom yum was a contradicted choice for sweet pie filling unlike sweetened shredded pork.

What dessert do you think can go along with Chrysanthemum and be made into pie filling?

Legend:
- Lotus Seed
- Sweet Kidney Bean
- Sweet Mung Bean
- Taro Balls
- Gingko Seed
- Sweet Soy Bean
- Sweet Sticky Rice
- Banana in Coconut Milk
- Job's Tear
- Thai Custard
- Tapioca Balls
- Tapioca in Syrup
- Mung Bean Rice Crepe
- O-Nee-Pae Guay
- Thai Sweetmeat
- Sweet Condense Milk
- Jam
- Nata de Coco
- Fruit
- Others

Pie chart values: 1.05%, 0.00%, 10.53%, 7.37%, 4.21%, 2.11%, 12.63%, 5.26%, 2.11%, 3.16%, 8.42%, 5.26%, 6.32%, 0.00%, 3.16%, 6.32%, 2.11%, 2.11%, 1.05%, 16.84%

<u>Figure 13</u>: Dessert that participants believe can get along with Chrysanthemum as a pie filling

Figure 13, type of dessert could go along with Chrysanthemum drink and be made into pie filling should be Nata de Coco (16.8%), which was also the choice that had been chosen as the most suitable candidate for the sweet pie filling in Figure 9. Nata de Coco was also popular in many desserts in Thailand. It was usually a topping of snow ice, ice-cream and yoghurt. The next most popular choices were ginkgo seed and lotus seed, 12.6% and 10.5%, respectively. Both seeds were used in Chinese cruising and dessert. While Ginko seed was claimed to have health benefit, the lotus seed was more common to wider consumers.

All in all, the category of food that Chrysanthemum drink pie was chosen to go along was the dessert because it was much more popular as a choice to go along with Chrysanthemum drink. Thus, Nata de Coco, Ginko seed and locust seed were selected for Chrysanthemum drink pie filling.

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1.2 Preliminary experiment

a. Preparation of pie dough

Firstly, pie dough was prepared following the formula in Table 1. The pie dough had good quality. The margarine was incorporated into the dough and distributed uniformly through layers of pie dough. As a result the pie formed many crisp layers after baking. This gave rise to the puffiness and crispiness of the pie. Thus, this pie dough formula was deemed suitable to be used in the project.

b. Preparation of pineapple pie filling

Next, the preparation of pineapple pie as the reference formula for Chrysanthemum drink pie formulation was carried out. Pineapple pie was selected as a model to determine the possibility to adapt the formula for the selected ingredients from 1.3.1. The used formula is shown in Table 2. Overall, the pineapple pie achieved was acceptable. It had crispy texture and an appropriate sweetness. However, the pineapple aroma from the pineapple flesh had masked the Chrysanthemum aroma. Therefore, it still needed to some adjustment to suit with the Chrysanthemum drink.

1.3 Development of Chrysanthemum drink pie filling

a. Determination of the ingredients for Chrysanthemum drink pie filling

After the preliminary test, the three most popular ingredients chosen from 1.1 which were Nata de Coco, lotus seed, and ginkgo seed were used to make fillings with Chrysanthemum drink. The formulas were adjusted by replacing the pineapple flesh with the selected ingredients as shown in the following Tables 3 to Table 5.

Table 4: Chrysanthemum drink pie filling with nata de coco formula

Ingredients	Amount/ Volume	Percentage
Nata de coco	40 grams	19.9
Sugar	50 grams	24.8
Chrysanthemum drink	98 grams	48.7
Salt	1.5 grams	0.7 (0.74)
All-purpose flour	11.8 grams	5.9

Table 5: Chrysanthemum drink pie filling with lotus seed formula

Ingredients	Amount/ Volume	Percentage
Lotus seed	12 grams	6.9
Sugar	50 grams	28.8
Chrysanthemum drink	98 grams	56.6
Salt	1.5 grams	0.8 (0.87)
All-purpose flour	11.8 grams	6.8

Table 6: Chrysanthemum drink pie filling with ginkgo seed formula

Ingredients	Amount/ Volume	Percentage
Ginkgo seed	15 grams	8.5
Sugar	50 grams	28.4
Chrysanthemum drink	98 grams	55.6
Salt	1.5 grams	0.8 (0.85)
All-purpose flour	11.8 grams	6.7

1.4 Development of Chrysanthemum pie

1.4.1 Determination of the most preferable formula for each pie filling ingredient

Nine-point hedonic scale preference test (Appendix B: B-1) was use in the sensory analysis. Twenty untrained test panelists were the students, teachers and staffs from School of Biotechnology, Assumption University were asked to determine their likeness on 7 attributes including color, appearance, Chrysanthemum flavor, saltiness, sweetness, texture and overall liking. Each sample was different in the selected ingredients - Nata de Coco filling, lotus seed filling, and ginkgo seed filling. The results were analyzed and summarized in Table 6.

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Table 7: The average score of 9-point hedonic scale preference test for Chrysanthemum drink pie with different selected ingredients.

Attributes	Average scores ± SD of Chrysanthemum drink pie*		
	Ginkgo	Lotus Seed	Nata de Coco
Color	7.4±0.8	7.3±0.8	7.4±0.7
Appearance	7.0±0.9	6.8±1.1	6.8±1.0
Chrysanthemum Flavor	5.5±1.1	5.5±0.9	5.6±0.8
Saltiness	7.0±0.8	7.1±0.7	7.2±0.8
Sweetness	6.8±1.1	6.6±1.0	6.8±0.9
Texture	7.1±0.8	7.0±0.7	7.2±0.8
Overall Liking	7.0±0.8	7.1±0.7	7.2±0.6

Note: * There were no significant different at $p < 0.05$.

Table 6 shows that there was no significant different in all treatments in all studied attributes ($p<0.05$). When added to Chrysanthemum drink pie Ginkgo seed, Lotus seed and Nata de Coco as pie filling, they produced the pies that were rated closely in all attributes.

For color, Nata de Coco got the same average score as Ginkgo seed, followed by ginkgo seed and lotus seed, 7.4±0.7, 7.4±0.8, and 7.3±0.8, respectively. Score 7 was rated as moderately like. Since the color of pies was observed from the crust of the pie. the color was varied depending on the baking time and the baking temperature as well as blushing of egg washing. Since the pies were baked as a same time, they had almost similar baking environment that could produce no difference in color.

For appearance, Ginkgo seed got the highest average score, 7.0±0.9, followed by Lotus seed and Nata de Coco, 6.8±1.1, and 6.8±1.0, respectively. The appearance was rated as moderately like, the same as color. There was no significant difference in appearance average scores. The same as color, the appearance was also observed from the crust. Thus different pie fillings did not affect the appearance.

For Chrysanthemum flavor, Nata de Coco got the highest average score, 5.6±0.9, followed by Ginkgo seed and Lotus seed, 5.5±0.9, and 5.5±1.1, respectively. However, the average scores were rated as neither like nor dislike or neutral and might consider as not acceptable. The Chrysanthemum flavor was low and was difficult to detect upon consumption because of strong butter flavor of the pie. Moreover, the Chrysanthemum flavor

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might have been lost during baking in the oven, all of which had caused the low Chrysanthemum flavor in the product.

For saltiness, Nata de Coco got the highest average score, 7.2±0.8, followed by Lotus seed and Ginkgo seed, 7.1±0.7, and 7.0±0.8, respectively. The average scores were in the acceptable range of moderately like of the attribute. Thus, it could indicate that the amount of salt used in the formula was appropriate.

Unlike saltiness, sweetness from Nata de Coco got the same average score as Ginkgo seed, followed by Lotus seed 6.8±0.9, 6.8±1.1, and 6.6±1.1, respectively. They were rated as slightly like as some test panelists suggested that the pie fillings were too sweet. This might indicate that the amount of sugar used in the formulas were too high.

For texture, Nata de Coco got the highest average score, 7.2±0.8, followed by Ginkgo seed and Lotus seed, 7.1±0.9 and 7.0±0.7, respectively. The average scores were in the acceptable range of moderately like. Texture in this case had combined the texture of the crust and the pie filling, it could not clearly say that the texture was affected by the selected ingredient applied in the pie filling.

For overall liking Nata de Coco got the highest average score, 7.2±0.6, followed by Lotus seed and Ginkgo seed, 7.1±0.7, and 7.0±0.8, respectively. The score was in moderately like and could reflect that the choices of the ingredients might be suitable for the Chrysanthemum drink pie filling.

As a conclusion, the sweetness and Chrysanthemum flavor should be improved in order to achieve the consumer likeness.

Figure 14: Chrysanthemum pie after baking (from left to right: pie with Nata de Coco, pie with Lotus seeds, and pie with Ginkgo seeds)

Therefore, the experiment was repeated with the aim to improve Chrysanthemum flavor. Since leakage was high in the first experiment, the amount of filling in pies was decreased to prevent leakage and loss of volatile compounds from Chrysanthemum drink during baking. The pie samples were tested in a 9-point hedonic scale preference test with the same group of test panelists. The average liking scores from 7 attributes were analyzed and concluded in Table 7.

Table 8: The average score of 9-point hedonic scale preference test for Chrysanthemum drink pie containing different selected ingredients from the second sensory test

Attributes	Average scores ± SD of Chrysanthemum drink pie*		
	Ginkgo	Lotus Seed	Nata de Coco
Color	7.0±1.3	7.1±1.0	7.0±1.1
Appearance	6.8±1.2	6.3±1.4	6.8±1.1
Chrysanthemum Flavor	5.7±1.2	5.7±1.0	5.5±1.0
Saltiness	7.0±1.0	6.6±1.3	7.2±0.8
Sweetness	7.2±0.8	6.9±1.1	6.7±1.3
Texture	7.4±0.9	7.1±1.0	7.1±1.4
Overall Liking	7.0±0.8	7.0±0.7	7.1±0.8

Note: * There were no significant different at $p < 0.05$.

Table 7 showed that there was no significant different in all treatments in all studied attributes (p<0.05) after adjusting the amount of pie filling.

For color, Lotus seed got the highest average score of, 7.1±1.1, followed by Ginkgo seed and Nata de Coco with the same average score of 7.0±1.1 and 7.1±1.3. The same as the first sensory test, color of pie crust was on the outside and hardly related to the Chrysanthemum drink pie filling. With factors of baking time, baking temperature and egg washing, there should not be any difference in color that the test panelist could detect as the result from different pie filling.

For appearance, Ginkgo seed and Nata de Coco received the highest average score, 6.8±1.2 and Lotus seed, 6.3±1.4, the least. There was no significant difference in appearance average scores (p > 0.05). The appearance was depended on how well the pie dough was prepared and not related to the pie filling.

For Chrysanthemum flavor, Ginkgo seed and Lotus seed got the average score, 5.7±1.2 and 5.7±1.0, followed by Nata de Coco, 5.5±1.0. The same as the first sensory evaluation, the test panelists rated the pie samples in a range of neither like nor dislike, not even reaching slightly like level (6). Chrysanthemum flavor was very low and hardly detected during testing. Loss occurred during baking as well as reducing the pie filling content. In addition, strong buttery flavor from the pie crust and other ingredients in the pie filling must have masked the very low Chrysanthemum flavor.

For saltiness, Nata de Coco got the highest average score, 7.2±0.8, followed by Ginkgo seed and Lotus seed, 7.0±1.0 and 6.6±1.3, respectively. The average scores were in the acceptable range.

For sweetness, Ginkgo seed got the highest average score, 7.2±0.8, followed by Lotus seed and Nata de Coco, 6.9±1.1 and 6.7±1.3, respectively. Still, there were the suggestions from the participants that the pie fillings were too sweet. This confirmed that the amount of sugar used in the formulas were too high.

For texture, Ginkgo seed got the highest average score, 7.4±0.9 while Nata de Coco and Lotus seed got the same score of 7.1±1.4 and 7.1±1.0. The average scores were in the acceptable range. This ensured that the selected ingredients used were suitable for pie fillings.

For overall liking, Nata de Coco got the highest average score, 7.1±0.8, while Lotus seed and Ginkgo seed got the same score, 7.0±0.7 and 7.0±0.8. It indicated that panelists preferred the Chrysanthemum drink pie with these additional ingredients almost at the same level.

In conclusion, the reduction of amount of filling in pies did not help increase the Chrysanthemum flavor in pie filling. Nevertheless, it helped preventing a leakage of filling at the seam of the pie.

An attempt to increase the Chrysanthemum flavor by using an extract from the dried Chrysanthemum flower was conducted. It was found that the equipment used for essential oil extraction was unable to extract the Chrysanthemum essential oil. The extract was aqueous liquor with Chrysanthemum odor. It could be that there was very small amount of the essential oil in the Chrysanthemum drink or the essential oil, somehow, had dissolved in the aqueous solution and could not be separated. The attempt was not successful.

To improve the Chrysanthemum flavor, Chrysanthemum drink was separated into two portions. The first portion, 70% Chrysanthemum drink were used in the preparation of the pie filling while the remaining, 30%, were added back at the end of the preparation to provide the flavor after heating the pie filling. Moreover, Nata de Coco, Lotus seed and Ginkgo seed were soaked in the Chrysanthemum drink overnight to allow them to absorb the Chrysanthemum flavor. During preparation, pie size was also increased so that more pie filling could be added.

1.4.2 Screening for the most preferable ingredient

Three pie samples were prepared following the same solution from the latest part of 1.4.1. They were rated in the 9-point hedonic scale preference test and the summary was presented in Table 8.

Table 9: The average score of 9-point hedonic scale preference test for Chrysanthemum pie with different selected ingredient from the third sensory test

Attributes	Average scores ± SD of Chrysanthemum drink pie*		
	Ginkgo	Lotus Seed	Nata de Coco
Color	7.3±0.8	6.7±1.3	6.8±1.4
Appearance	7.0±0.9	6.4±1.2	6.8±1.2
Chrysanthemum Flavor	6.0±1.1	5.8±1.7	6.4±1.7
Saltiness	6.6±1.2	6.6±1.0	7.0±1.4
Sweetness	6.7±1.4	6.1±1.3	6.4±1.7
Texture	6.8±0.9	6.7±0.7	7.2±1.0
Overall Liking	6.9±0.8	6.7±0.7	7.2 ±1.0

Note: * There were no significant different at $p < 0.05$.

Table 8 showed that there was no significant different in all treatments in all studied attributes ($p<0.05$) in the third sensory test.

Like the first and second experiments, color and appearance were, observed from the outside crust, not related to the pie filling. All treatments received no significant different scores on these two attributes. However, all treatments were rated from slightly like (6) to moderately like (7).

For the Chrysanthemum flavor, Nata de Coco got the highest average score, 6.4±1.7, followed Ginkgo seed and Lotus seed, 6.0±1.1, and 5.8±1.7, respectively. These scores were higher than the scores of Chrysanthemum flavor in the previous experiments. As the test panelists could detect more the Chrysanthemum flavor in the pie than the pie for the previous experiment. The reason could line on that there was no leakage of filling during baking, and, thus, least loss the volatile compounds of Chrysanthemum. In addition, soaking the selected ingredients in the Chrysanthemum drink solution allowed the ingredients to absorb the

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Chrysanthemum drink inside the pieces, therefore, the Chrysanthemum flavor could remain in the pie sample.

Though, saltiness and sweetness of the pie samples were in the acceptable range of 6.6 to 7.0, and 6.1 to 6.7, respectively, it was observed that the scores were declined from the previous tests. A suggestion obtained from the sensory test indicated that the pie was too sweet which could result in lesser score.

For texture Nata de Coco got the highest average score, 7.2±1.0, followed Ginkgo seed, and Lotus seed, 6.8±0.9, and 6.7±0.7, respectively. It could be the gel-like texture of Natta de Coco that was different from Gingko seed and Lotus seed, which were more nut-like texture.

For overall liking Nata de Coco got the highest average score, 7.2 ±1.0, followed Ginkgo seed, and Lotus seed, 6.9±0.8, and 6.7±0.7, respectively. This attribute was chosen as a main selecting criterion of the ingredient since the result showed no significant difference of all treatments.

In conclusion, Chrysanthemum drink pie with Nata de Coco got the highest average scores in 4 attributes out of 7 attributes. Apart from color and appearance, Nata de Coco obtained the highest average scores in Chrysanthemum flavor, saltiness, texture, and overall liking. Hence, Nata de Coco was chosen as the ingredient for the Chrysanthemum drink pie.

1.4.3 Just-About-Right Test

Just-About-Right test was conducted with the Chrysanthemum pie filling containing Natta de Coco, the result obtained from 1.4.2. The results of JAR test were used as a trend for adjustment of the pie filling. Five attributes were selected for the JAR test. The attributes were related to taste and texture of the Chrysanthemum drink pie filling. They were flower aroma which was related to the Chrysanthemum flavor, sweetness, saltiness, size of Nata de Coco piece in the pie filling and the amount of the Nata de Coco in each pie. Twenty untrained test panelists who were students and staff in School of Biotechnology, Assumption University were used as a tool in the JAR test. The results as percentage of the just right level were presented in Table 9.

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Table 10: The percentage of Just-About-Right Test for each attribute

Attribute	Too little	Somewhat too little	Just Right	Somewhat too much	Too much
Flower Aroma		15%	75%	10%	
Sweetness			45%	55%	
Saltiness		10%	75%	15%	
Size of Nata de Coco			60%	40%	
Amount of Nata de Coco			45%	55%	

From Table 9, the flower aroma in the pie sample was rated as just-right by 75% of the test panelists, whereas 10% thought that it was somewhat too much and 15% stated that it was somewhat too low. Thus with three-quarters of the test panelists rated it as just-right, the flower aroma of the Chrysanthemum drink pie was considered at the right level.

Sweetness of the Chrysanthemum drink pie obtained 45% just-right level while 55% stated that it was somewhat too sweet. The result indicated that the sugar should be adjusted since more than 50% of the test panelists thought that the Chrysanthemum drink pie was too sweet.

Saltiness of the Chrysanthemum drink pie had been rated at the just-right level for 75%. 10% thought that it was somewhat too less salty while 15% as somewhat too sweet. Thus, as majority of the test panelists rated as it was just-right and needed no adjusting.

The size of Nata de Coco was considered to be just right by 60% of the test panelists, while the rest of the test panelists, 40%, stated that it was somewhat too big. As more than 50% of the test panelists said that it was just-right, there was no need to adjust this attribute.

The amount of the Nata de Coco was considered to be just right by 45% of the test panelists and 55% of them stated that it was somewhat too much. There might need some adjustment in the amount of the Nata de Coco in the pie filling.

1.4.4 Adjusting the formula

From JAR test, flower aroma, saltiness, and size of Nata de Coco, were consider to be just right by more than 50% of the panelists and needed no adjustment in pie formula However, sweetness and the amount of Nata de Coco were considered to be somewhat too much. Therefore, these two attributes were adjusted. The amount of sugar was reduced by 5% of its original content. While the amount of Nata de Coco was decreased by 5% and 10% of its original content. Three treatments were formulated as followed:

Control: Sugar decreased by 5%, no varying in the amount of Nata de Coco

Treatment A: Sugar decreased by 5%, the amount of Nata de Coco decreased by 5 %

Treatment B: Sugar decreased by 5%, the amount of Nata de Coco decreased by 10%

Three pie samples were prepared and tested by 20 untrained test panelists in a 9-point hedonic scale preference test and the results were shown in Table 10. Five attributes were studied that included flower aroma, sweetness, saltiness, size of Nata de Coco and the amount of Nata de Coco.

<u>Table 11</u>: The average score of 9-point hedonic scale preference test for Chrysanthemum pie with Nata de Coco

Attributes	Average scores±SD of Chrysanthemum drink pie*		
	Control	Treatment A	Treatment B
Flower Aroma	7.4±0.7	7.5±0.9	7.4±0.9
Sweetness	5.6±1.0	5.8±0.8	5.6±0.9
Saltiness	7.6±0.7	7.7±0.7	7.6±0.7
Size of Nata de Coco	7.6±0.5	7.7±0.5	7.4±0.6
Amount of Nata de Coco	6.4±0.8	6.4±0.6	6.6±0.6

Note: * There were no significant different at $p < 0.05$

Table 10 showed that there was no significant different in all treatments in all studied attributes ($p<0.05$). The variation of fillings that were adjusted to the Chrysanthemum drink pie with Nata de Coco gave rise to no significant different in the average scores of each attribute.

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For sweetness, it was seen that the average preference scores in all treatments were declined from the previous results before reducing the amount of sugar (5%) in all treatments, 5.6±1.0 for control, 5.8±0.8 for 5% reduction of Nata de Coco, and 5.6±0.9 for 10% reduction of the Nata de Coco. These pie samples were rated lower than 6 or slightly like in the range of neither like nor dislike, 5. As the amount of sugar was decreased in the pie samples, the test panelists had observed that the bitter taste was presented in the pie filling which was the main reason for the declining of the preference scores on the sweetness. The bitterness could come from the Chrysanthemum drink itself. In the previous studies, the amount of sugar was high enough to mask the bitter taste but in the adjusted formula, it was reduced so as to unmask the bitter taste. Thus, it could be concluded that the amount of sugar should not be reduced in the pie filling.

For amount of Nata de Coco, it was seen that the test panelists rated the treatment with no significant difference even though the amount of Nata de Coco was reduced by 5% and 10%. Control, 5% reduction, and 10% reduction in the amount of Nata de Coco were rated as 6.4±0.8, 6.4±0.6, and 6.6±0.6, respectively.

As a conclusion, the sweetness was not adjusted since the bitter taste was detected and the pie was too branded. Since the amount of Nata de Coco showed no significant difference in average scores of all pie samples, thus, 10% decreased amount of Nata de Coco was chosen for economic purpose and it obtained the highest average score.

1.4.5 Confirmation of prototype formula

Readjusted formula according to the results from 1.4.4 included 10% reduction of the amount of Nata de Coco. The pie sample was rated in a 9-point hedonic scale preference test on 6 attributes to confirm preference level from the test panelists. The results of the average scores in all attributes were presented in Table 11.

Table 12: The average score of 9-point hedonic scale preference test for Chrysanthemum pie with Nata de Coco

Attributes	Average scores±SD of Chrysanthemum drink pie
Appearance	7.4±0.7
Chrysanthemum Aroma	7.4±0.5
Saltiness	7.6±0.6
Sweetness	7.4±0.8
Texture	7.7±0.8
Overall Liking	7.7±0.6

Table 11 showed that the average scores of the Chrysanthemum drink pie with Nata de Coco for each attribute was higher than 7 or in the moderately like which indicated that it was in acceptable range from the 9-point scale. This indicated that this formula could be used as the prototype formula of the Chrysanthemum drink pie. The prototype formulas for pie dough and Chrysanthemum drink with Nata de Coco filling were given in Table 12 and Table 13, respectively. Figure 15 showed the prototype Chrysanthemum drink pie.

Table 13: Prototype formula for pie dough

Ingredients	Amount	Percentage as FWB
All-purpose flour	500 grams	100
Salted butter	75 grams	15
Puffin margarine	300 grams	60
Salt	5 grams	1
Cold water	250 Milliliters	50

Table 14: Prototype formula for Chrysanthemum drink with Nata de Coco filling

Ingredients	Amount/ Volume	Percentage
Nata de Coco	36 grams	18.2
Sugar	50 grams	25.3
Chrysanthemum extract	98 grams	49.7
Salt	1.5 grams	0.8
All-purpose flour	11.8 grams	6.0

Figure 15: Chrysanthemum pie with Nata de Coco in prototype formula

1.5 Consumer acceptance test of final product

Upon achieving a satisfactory product, a consumer test was conducted to see the marketability of the Nata de Coco-Chrysanthemum drink pie. The test panelists were normal consumers in three locations – Siam square, Siam Paragon and Central World area.

Results from demographic information of the consumers were shown in Figure 16 to Figure 19.

Gender

42.00%

58.00%
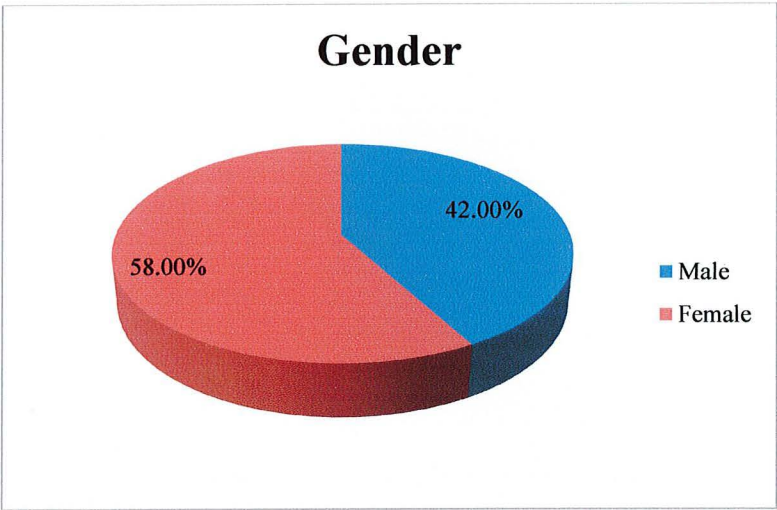
■ Male
■ Female

Figure 16: The percentage of consumer who done the test

Age

6.50% 1.50%

9.00%

11.00%

24.00%

48.00%

■ Less than 18 years old
■ 18-25 years old
■ 26-35 years old
■ 36-45 years old
■ 46-60 years old
■ More than 60 years old
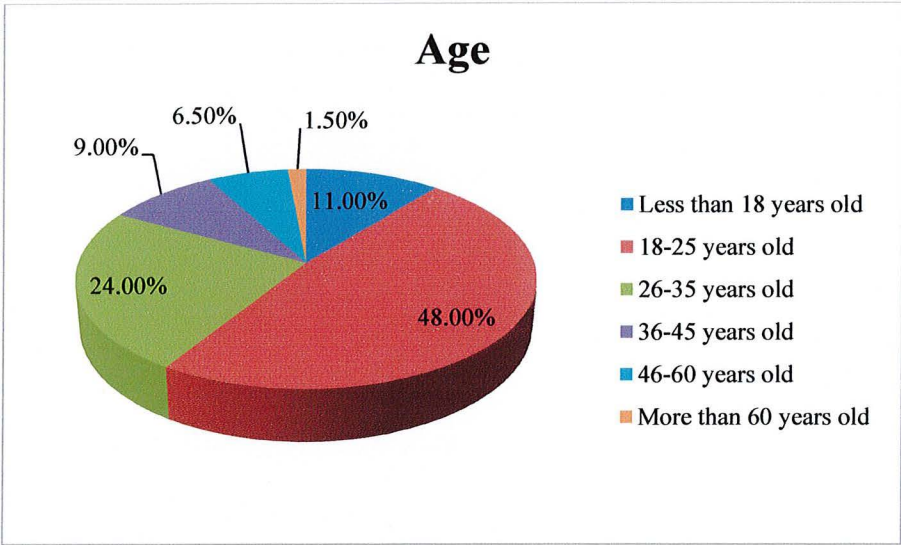
Figure 17: The age of consumer who done the test

From Figure 16 and Figure 17, the consumers used were male, 42%, and female, 58%. The majority of the consumers had the age from 18-25 years old, 48%, since they belonged to the age group that was mostly visiting in these areas. The next age group was 26-35 years old (24%) belonging to working class found in Siam Square. The third group had the age less than 18 years old with 11%, the remaining were 9% from 36-45 years old, 6.5% from 46-60 years old, and 1.5% of more than 60 years old.

40
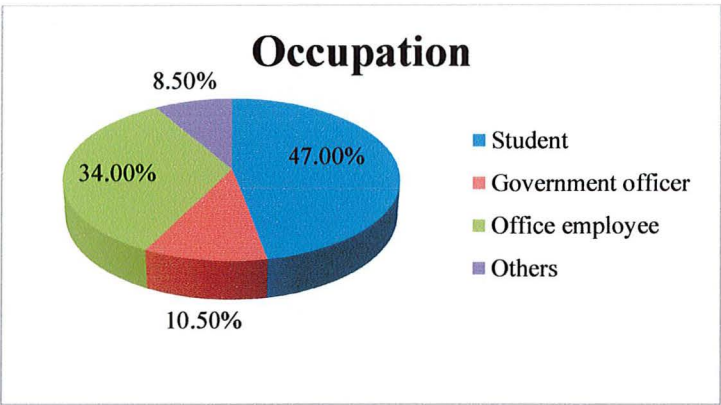
Figure 18: The occupation of consumer who done the test
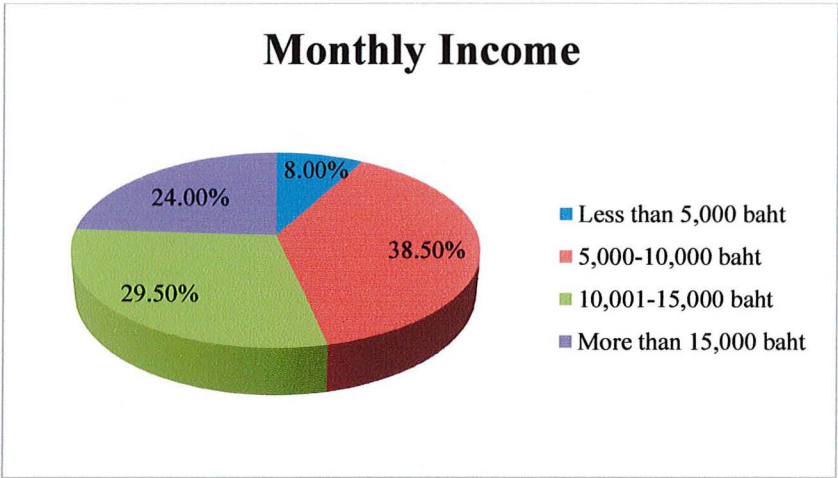
Figure 19: The income of consumer who done the test per month

Figure 18 showed that most of the consumers were university students with 47%, followed by office employee, 34 %. The results were agreed with the age group in Figure 17. The monthly income of them was mostly 5,000-10,000 Baht for 38.5% for most students, 29.5% had monthly income of 10,001-15,000 Baht for working young adults, 24% had monthly income more than 15,000 Bath and only 8% with less than 5,000 Bath income.

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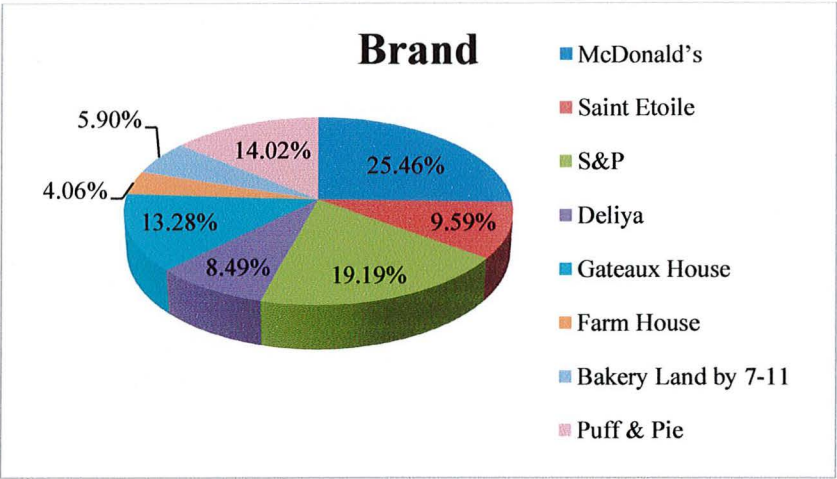
Figure 20: The brands of the pie consumed
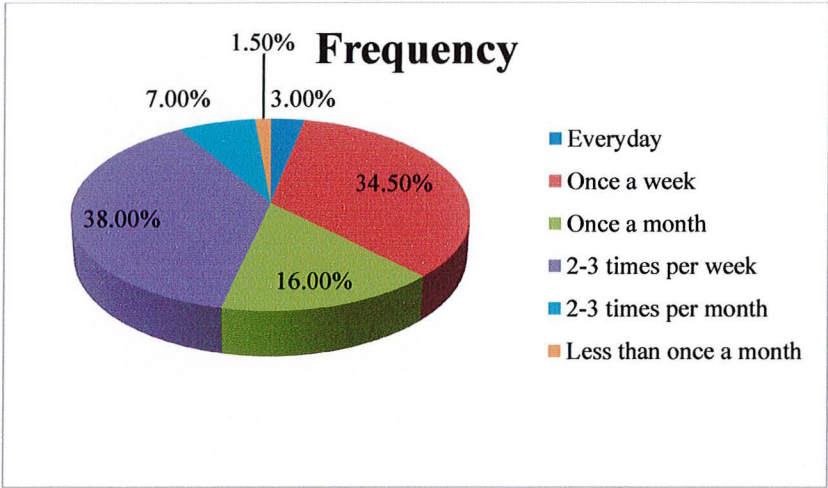
Figure 21: The frequency of pie consumption

Figure 22: The price of pie consumed

42
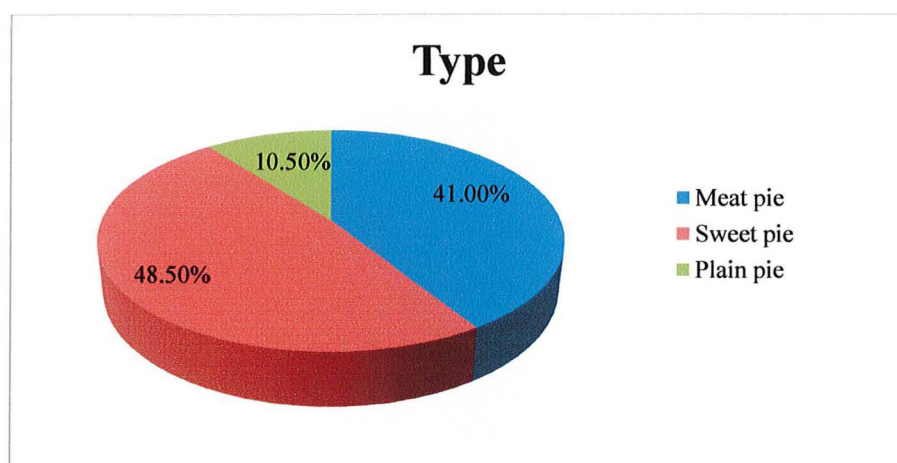
Type

Figure 23: The type of pie consumed

Pie consumption information, the brand of pie most popular among the consumers was McDonald's, 25.5%, followed by S&P, 19.2% and 10.5% for Plain pie. The results were in line with the consumer survey at the beginning of the research. The first two were the two most popular brands in shopping areas as Siam Square, Paragon, and Central World. The frequency of pie consumption was mostly 2-3 times per week with 38%, followed by once a week at 34.5%. The results were different from the first consumer survey that had 38% for once a month consumption. The consumers usually spent more than 30 Baht with 44% and 16-30 Baht for 43% in purchasing the pie. The majority consumed sweet pie with 48.5%, followed by meat pie of 41% and 10.5% for plain pie.

Upon testing the Nata de Coco-Chrysanthemum drink pie, the consumers rated the pie sample at 7.2±0.8 out of 9-point scale for the preference score. The result was in agreed with the sensory test in Assumption University. The preference score was rated as slightly like (7) which considered acceptable. This result indicated that the consumers were satisfied with the prototype product in overall acceptance.

Product Acceptance

8.50%

91.50%
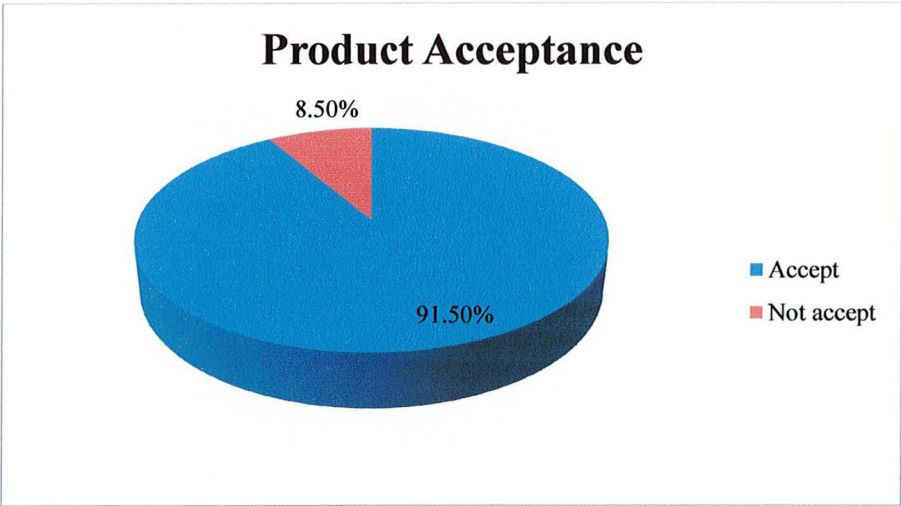
■ Accept
■ Not accept

Figure 24: The percentage of product acceptance

Figure 24 demonstrated the result from the product acceptance and it was found that 91.5% of the consumers accepted the product while only 8.5% not accept the product. With the result, therefore, the prototype product would likely to be success in the market.

Acceptable Price

17.50%   15.50%

67.00%

■ Less than 15 baht
■ 16 – 30 baht
■ More than 30 baht
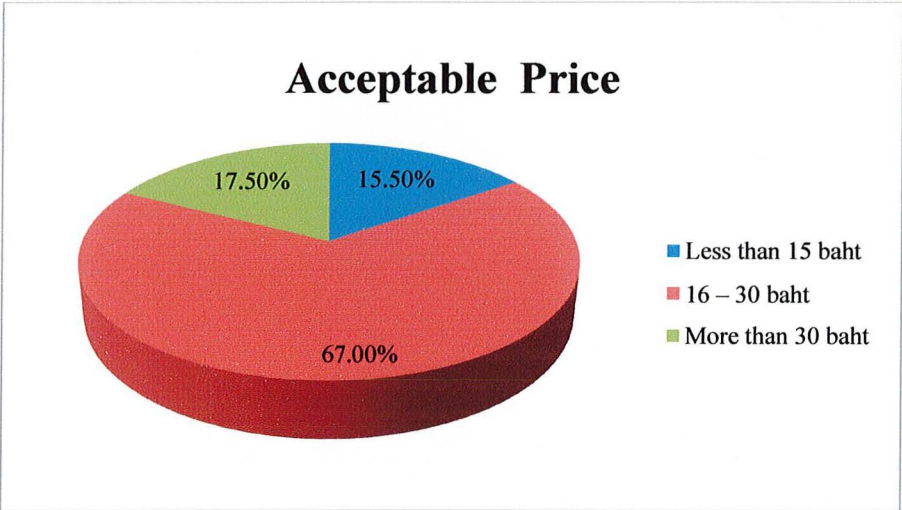
Figure 25: The acceptable price for product

44
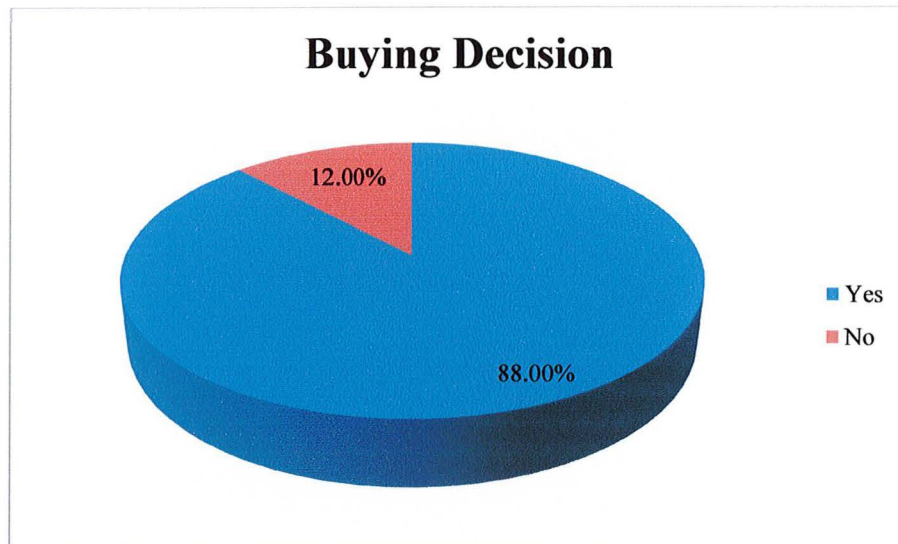
Figure 26: The product buying decision

Buying price and buying intention, in Figure 25 and Figure 26. The majority of the consumers, 67%, selected the price for the Nata de Coco – Chrysanthemum drink pie at 16 - 30 Baht per piece. This implied that the consumers viewed the product as a quality product and were willing to pay at even a slightly higher than the standard price of normal pie. As for buying decision, 88% of the consumers were willing to buy the product, reflecting that the prototype product was most likely marketable.

The reason why the majority of the consumers surveyed were willing to pay as high as 16-30 Baht, rather than the cheaper price of less than 15 Baht could be because of the fact that the area surveyed was conducted around Siam and Central World. It was the prime area of Bangkok where the purchasing power was comparatively high. Also, the majority of the people participated in the survey were students and office employees. They were the group of people who possessed high purchasing power and high potential to spend money for new food. Furthermore, the price range of 16-30 Baht actually fell in the range of the market price, which was about 25 Baht. These were the reasons why the consumers were willing to pay a higher price of 16-30 Baht, rather than less than 15 Baht.

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Figure 27: Sixty-five grams Chrysanthemum pie with Nata de Coco (Top) and 100 grams Chrysanthemum pie with Nata de Coco (Bottom)

Conclusion

- Sweet pie was the most suitable for application of Chrysanthemum drink as a pie filling.

- Nata de Coco could be cooperated into the Chrysanthemum drink pie and gave the most satisfying result because its ability to absorb the Chrysanthemum drink upon soaking.

- Large size of the pie prevented the Chrysanthemum drink pie filling from leakage.

- Addition 30% of the Chrysanthemum drink to the pie filling containing 70% of the Chrysanthemum drink helped retaining the Chrysanthemum aroma in the pie filling.

- Sweetness of the pie was needed to mask the bitter taste from the dried Chrysanthemum flower.

- The Nata de Coco – Chrysanthemum drink pie was marketable because 88% of consumers were willing to purchase the product. The consumers were willing to pay more than 30 Baht, 67%. The price was higher than many pies in the market.

Recommendation

- A method to further enhance the Chrysanthemum aroma should be studied.

- An electronic oven is recommended for better control of temperature.

- With the success of Chrysanthemum drink pie, this tea may be used to develop into other forms of pastry, such as croissant.

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Appendix A:

Consumers' Opinion

Appendix A-1

Questionnaire

Please ✓ for your answer in the given space

Part 1: Thai consumers' attitude and behavior toward the bakery product (pie)

1. Have you ever eaten pie?

    ____Yes   ____ No (skip to question number 8)

2. How often do you eat pie?

    ____ Less than once a month   ____ Once a month

    ____ Less than once a week   ____ 1 – 3 times per week

    ____ More than 4 times per week

3. What are the reasons of choosing pie? (can choose more than 1 choice)

    ____ Tasty   ____ Crispy   ____ Nutritional benefit

    ____ Convenience   ____ Aroma   ____ Cheap

    ____ Quantity   ____ Others (Specify) _____

4. What brand of pie do you preferred? (can choose more than 1 choice)

    ____ McDonald's   ____ Gateaux House   ____ Saint Etoile

    ____ Farm House   ____ S&P   ____ Bakery Land by 7-11

    ____ Deliya   ____ Puff & Pie   ____ Little Home Bakery

    ____ Others (Specify) _____

5. How much do you usually spend on a piece of pie?

    ____ Less than 15 Baht   ____ 16 – 30 baht   ____ More than 30 baht

6. What type of pie do you like? (can choose more than 1 choice)

    ____ Meat Pie   ____ Sweet Pie   ____ Plain Pie

7. What is your favorite pie?

_____ Chicken Pie _____ Tuna Pie _____ Shredded pork with crab stick pie

_____ Mushroom Pie _____ Spinach Pie _____ Roasted red pork with salted egg

_____ Beef Pie _____ Ham Cheese Pie _____ Chicken Curry Pie

_____ Ham Egg Pie _____ Corn Pie _____ Pineapple Pie

_____ Taro Pie _____ Apple Pie _____ Coconut Pie

_____ Mixed Fruit Pie _____ Palmyra Palm Pie

_____ Others (Specify) _____

8. Which type of food do you think has a potential to be applied as pie filling?

_____ Tom-Yum _____ Canned Fish _____ Fried Rice

_____ Fish Maw _____ Steamed Curry _____ Curried Cake

_____ Oyster omelet _____ Pad Thai _____ Stir-Fried Meat and Basil

_____ Pa-lo _____ Fried Vegetable _____ Thai rice noodle roll

_____ Spicy salad _____ Spicy Curry _____ Stir-Fried Meat and Chili

_____ Salad _____ Stew _____ Chinese Spaghetti

_____ Papaya Salad _____ Spicy pork salad _____ Sukiyaki

_____ Others (Specify) _____

9. Which type of dessert do you think has a potential to be applied as pie filling?

_____ Taro Balls _____ Ginkgo _____ Sweet Soy Bean

_____ Sweet Sticky Rice _____ Job's Tear _____ Banana in Coconut Milk

_____ Thai Custard _____ Tapioca Balls _____ Tapioca in Syrup

_____ Thai Sweetmeat _____ O-Nee-Pae Guay _____ Mung Bean Rice Crepe

_____ Jam _____ Nata de Coco _____ Sweet Condense Milk

_____ Fruit (Specify) _____

_____ Others (Specify) _____

10. Do you like Chrysanthemum drink?

_____ Yes _____ No

11. What category of food do you think can go along with Chrysanthemum?

_____ Meat _____ Dessert

12. What food do you think can go along with Chrysanthemum and be made into pie filling?

_____ Crispy Fish	_____ Shredded Pork	_____ Boiled Egg
_____ Tom-Yum	_____ Canned Fish	_____ Fried Rice
_____ Fish Maw	_____ Steamed Curry	_____ Curried Cake
_____ Oyster omelet	_____ Pad Thai	_____ Stir-Fried Meat and Basil
_____ Pa-lo	_____ Fried Vegetable	_____ Thai rice noodle roll
_____ Spicy salad	_____ Spicy Curry	_____ Stir-Fried Meat and Chili
_____ Salad	_____ Stew	_____ Chinese Spaghetti
_____ Papaya Salad	_____ Spicy pork salad	_____ Sukiyaki
_____ Others (Specify) _____		

13. What dessert do you think can go along with Chrysanthemum and be made into pie filling?

_____ Lotus Seed	_____ Sweet Kidney Bean	_____ Sweet Mung Bean
_____ Taro Balls	_____ Ginkgo	_____ Sweet Soy Bean
_____ Sweet Sticky Rice	_____ Job's Tear	_____ Banana in Coconut Milk
_____ Thai Custard	_____ Tapioca Balls	_____ Tapioca in Syrup
_____ Thai Sweetmeat	_____ O-Nee-Pae Guay	_____ Mung Bean Rice Crepe
_____ Jam	_____ Nata de Coco	_____ Sweet Condense Milk
_____ Fruit (Specify) _____		
_____ Others (Specify) _____		

Part II Personal Information

1. Gender

   ____ Male   ____ Female

2. Age

   ____ 18 – 25 years old   ____ 26 – 30 years old   ____ 31 - 35 years old

   ____ 36 – 40 years old   ____ 41 - 45 years old   ____ 46 – 50 years old

   ____ More than 51 years old

3. Status

   ____ Single   ____ Married   ____ Divorced, Widow

4. Education

   ____ Less than Primary School   ____ Primary School

   ____ High School   ____ Technical College

   ____ Undergraduate   ____ Master Degree or higher

5. Occupation

   ____ Student   ____ Housewife   ____ Government officer

   ____ Businessman ____ Freelance   ____ Employee

   ____ Others (Specify) _____

6. Income

   ____ Less than 10,000 baht   ____ 10,001 – 15,000 baht

   ____ 15,001 – 20,000 baht   ____ 20,001 – 25,000 baht

   ____ 25,001 – 30,000 baht   ____ More than 30,000 baht

Appendix A-2

Frequency of consumers' attitude and behavior toward the bakery product

Have you ever eaten pie?

	Frequency	Percentage	Cumulative Percentage
Yes	90	90	90
No	10	10	100
Total	100	100	

Frequency

	Frequency	Percentage	Cumulative Percentage
Less than once a month	16	17.78	17.78
Once a month	32	35.56	53.33
Less than once a week	20	22.22	75.56
1 – 3 times per week	14	15.56	91.11
More than 4 times per week	8	8.89	100.00
Total	90	100	

Reasons

	Frequency	Percentage	Cumulative Percentage
Tasty	28	29.79	29.79
Crispy	23	24.47	54.26
Benefit	2	2.13	56.38
Convenience	18	19.15	75.53
Aroma	12	12.77	88.30
Cheap	7	7.45	95.74
Quantity	3	3.19	98.94
Others	1	1.06	100.00
Total	94	100	

Brands

	Frequency	Percentage	Cumulative Percentage
McDonald's	26	28.89	28.89
Saint Etoile	3	3.33	32.22
Farm House	3	3.33	35.56
Gateaux House	10	11.11	46.67
S&P	18	20.00	66.67
Bakery Land by 7-11	14	15.56	82.22
Deliya	3	3.33	85.56
Puff & Pie	8	8.89	94.44
Little Home Bakery	3	3.33	97.78
Others	2	2.22	100.00
Total	90	100.00	

Price

	Frequency	Percentage	Cumulative Percentage
Less than 15 Baht	2	4.35	4.35
16 – 30 baht	32	69.57	73.91
More than 30 baht	12	26.09	100.00
Total	46	100.00	

Types

	Frequency	Percentage	Cumulative Percentage
Meat Pie	17	29.31	29.31
Sweet Pie	35	60.34	89.66
Plain Pie	6	10.34	100.00
Total	58	100.00	

Favorite

	Frequency	Percentage	Cumulative Percentage
Chicken Pie	12	12.50	12.50
Tuna Pie	10	10.42	22.92
Shredded pork with crab stick pie	3	3.13	26.04
Mushroom Pie	9	9.38	35.42
Spinach Pie	2	2.08	37.50
Roasted red pork with salted egg	2	2.08	39.58
Beef Pie	0	0.00	39.58
Chicken Curry Pie	1	1.04	40.63
Ham Cheese Pie	3	3.13	43.75
Ham Egg Pie	6	6.25	50.00
Corn Pie	13	13.54	63.54
Pineapple Pie	14	14.58	78.13
Taro Pie	8	8.33	86.46
Apple Pie	3	3.13	89.58
Coconut Pie	6	6.25	95.83
Palmyra Palm Pie	2	2.08	97.92
Mixed Fruit Pie	2	2.08	100.00
Others	0	0.00	100.00
Total	96	100.00	

Which type of food do you think has a potential to be applied as pie filling?

	Frequency	Percentage	Cumulative Percentage
Tom-Yum	11	12.94	12.94
Canned Fish	8	9.41	22.35
Fried Rice	3	3.53	25.88
Fish Maw	2	2.35	28.24
Steamed Curry	11	12.94	41.18
Curried Cake	2	2.35	43.53
Oyster omelet	1	1.18	44.71
Pad Thai	3	3.53	48.24
Stir-Fried Meat and Basil	9	10.59	58.82
Pa-lo	0	0.00	58.82
Thai rice noodle roll	2	2.35	61.18
Fried Vegetable	4	4.71	65.88
Spicy salad	4	4.71	70.59
Spicy Curry	0	0.00	70.59
Stir-Fried Meat and Chili	2	2.35	72.94
Salad	7	8.24	81.18
Stew	2	2.35	83.53
Chinese Spaghetti	0	0.00	83.53
Papaya Salad	0	0.00	83.53
Spicy pork salad	13	15.29	98.82
Sukiyaki	1	1.18	100.00
Others	0	0.00	100.00
Total	85	100.00	

Which type of dessert do you think has a potential to be applied as pie filling?

	Frequency	Percentage	Cumulative Percentage
Taro Balls	5	5.81	5.81
Sweet Boiled Bean	5	5.81	11.63
Sweet Soy Bean	3	3.49	15.12
Sweet Sticky Rice	5	5.81	20.93
Banana in Coconut Milk	5	5.81	26.74
Job's Tear	1	1.16	27.91
Thai Custard	14	16.28	44.19
Tapioca Balls	3	3.49	47.67
Tapioca in Syrup	2	2.33	50.00
Filled Wheat Flour Dumpling	3	3.49	53.49
O-Nee-Pae Guay	7	8.14	61.63
Thai Sweetmeat	0	0.00	61.63
Sweet Condense Milk	6	6.98	68.60
Jam	7	8.14	76.74
Nata de Coco	15	17.44	94.19
Fruit	5	5.81	100.00
Others	0	0.00	100.00
Total	86	100.00	

Do you like Chrysanthemum drink?

	Frequency	Percentage	Cumulative Percentage
Yes	82	82.00	82.00
No	18	18.00	100.00
Total	100	100.00	

60

What category of food do you think can go along with Chrysanthemum?

	Frequency	Percentage	Cumulative Percentage
Meat	12	12.00	12.00
Dessert	88	88.00	100.00
Total	100	100.00	

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What food do you think can go along with Chrysanthemum and be made into pie filling?

	Frequency	Percentage	Cumulative Percentage
Crispy Fish	4	6.25	6.25
Shredded Pork	11	17.19	23.44
Boiled Egg	1	1.56	25.00
Tom-Yum	10	15.63	40.63
Canned Fish	1	1.56	42.19
Fried Rice	4	6.25	48.44
Fish Maw	2	3.13	51.56
Steamed Curry	3	4.69	56.25
Curried Cake	3	4.69	60.94
Oyster omelet	1	1.56	62.50
Pad Thai	2	3.13	65.63
Stir-Fried Meat and Basil	1	1.56	67.19
Pa-lo	2	3.13	70.31
Thai rice noodle roll	0	0.00	70.31
Fried Vegetable	3	4.69	75.00
Spicy salad	2	3.13	78.13
Spicy Curry	1	1.56	79.69
Stir-Fried Meat and Chili	3	4.69	84.38
Salad	3	4.69	89.06
Stew	0	0.00	89.06
Chinese Spaghetti	0	0.00	89.06
Papaya Salad	2	3.13	92.19
Spicy pork salad	2	3.13	95.31
Sukiyaki	1	1.56	96.88
Others	2	3.13	100.00
Total	64	100.00	

What dessert do you think can go along with Chrysanthemum and be made into pie filling?

	Frequency	Percentage	Cumulative Percentage
Lotus Seed	10	10.53	10.53
Sweet Kidney Bean	7	7.37	17.89
Sweet Mung Bean	4	4.21	22.11
Taro Balls	2	2.11	24.21
Gingko Seed	12	12.63	36.84
Sweet Soy Bean	2	2.11	38.95
Sweet Sticky Rice	5	5.26	44.21
Banana in Coconut Milk	3	3.16	47.37
Job's Tear	8	8.42	55.79
Thai Custard	5	5.26	61.05
Tapioca Balls	6	6.32	67.37
Tapioca in Syrup	3	3.16	70.53
Mung Bean Rice Crepe	0	0.00	70.53
O-Nee-Pae Guay	6	6.32	76.84
Thai Sweetmeat	2	2.11	78.95
Sweet Condense Milk	2	2.11	81.05
Jam	1	1.05	82.11
Nata de Coco	16	16.84	98.95
Fruit	1	1.05	100.00
Others	0	0.00	100.00
Total	95	100.00	

Gender

	Frequency	Percentage	Cumulative Percentage
Male	34	35.42	35.42
Female	62	64.58	100.00
Total	96	100.00	

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Age

	Frequency	Percentage	Cumulative Percentage
18 – 25 years old	58	61.70	61.70
26 – 30 years old	18	19.15	80.85
31 - 35 years old	8	8.51	89.36
36 – 40 years old	0	0.00	89.36
41 - 45 years old	0	0.00	89.36
46 – 50 years old	0	0.00	89.36
More than 51 years old	10	10.64	100.00
Total	94	100.00	

Status

	Frequency	Percentage	Cumulative Percentage
Single	76	79.17	79.17
Married	20	20.83	100.00
Divorced, Widow	0	0.00	100.00
Total	96	100.00	

Education

	Frequency	Percentage	Cumulative Percentage
Less than Primary School	2	2.08	2.08
Primary School	0	0.00	2.08
High School	14	14.58	16.67
Technical College	10	10.42	27.08
Undergraduate	56	58.33	85.42
Master Degree or higher	14	14.58	100.00
Total	96	100.00	

Occupation

	Frequency	Percentage	Cumulative Percentage
Student	60	62.50	62.50
Housewife	4	4.17	66.67
Government officer	2	2.08	68.75
Businessman	18	18.75	87.50
Freelance	6	6.25	93.75
Employee	6	6.25	100.00
Others	0	0.00	100.00
Total	96	100.00	

Income

	Frequency	Percentage	Cumulative Percentage
Less than 10,000 baht	40	45.45	45.45
10,001 – 15,000 baht	18	20.45	65.91
15,001 – 20,000 baht	12	13.64	79.55
20,001 – 25,000 baht	2	2.27	81.82
25,001 – 30,000 baht	6	6.82	88.64
More than 30,000 baht	10	11.36	100.00
Total	88	100.00	

Appendix B:

Development of Chrysanthemum Pie

Appendix B-1
Questionnaire

Please test the different samples and score each sample following the preference test of 9-point hedonic scale below

The of 9-point hedonic scale of preference test

9 = Like Extremely   4 = Dislike Slightly

8 = Like Very Much   3 = Dislike Moderately

7 = Like Moderately   2 = Dislike Very Much

6 = Like Slightly   1 = Dislike Extremely

5 = Neither Like or Dislike

The preference test the of 9-point hedonic scale of each sample

Attributes	Sample No.		
	_____	_____	_____
Color	_____	_____	_____
Appearance	_____	_____	_____
Chrysanthemum Flavor	_____	_____	_____
Saltiness	_____	_____	_____
Sweetness	_____	_____	_____
Texture	_____	_____	_____
Overall Liking	_____	_____	_____

Comment:

_____

_____

Appendix B-2

1.4.1

ANOVA table of Chrysanthemum pie with different ingredients in each attribute

Color

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	17.27	19.00	0.91	2.39	0.01	1.87
Filling	0.23	2.00	0.12	0.31	0.74 [NS]	3.24
Error	14.43	38.00	0.38			
Total	31.93	59.00				

P-value > 0.05 $\therefore$ Reject H_0

Appearance

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	38.98	19.00	2.05	3.90	0.00	1.87
Filling	0.70	2.00	0.35	0.67	0.52 [NS]	3.24
Error	19.97	38.00	0.53			
Total	59.65	59.00				

P-value > 0.05 $\therefore$ Reject H_0

Chrysanthemum Flavor

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	31.65	19.00	1.67	3.00	0.00	1.87
Filling	0.23	2.00	0.12	0.21	0.81 [NS]	3.24
Error	21.10	38.00	0.56			
Total	52.98	59.00				

P-value > 0.05 $\therefore$ Reject H_0

Saltiness

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	19.40	19.00	1.02	2.79	0.00	1.87
Filling	0.10	2.00	0.05	0.14	0.87 [NS]	3.24
Error	13.90	38.00	0.37			
Total	33.40	59.00				

P-value > 0.05   ∴ **Reject H$_0$**

Sweetness

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	43.07	19.00	2.27	7.16	0.00	1.87
Filling	0.63	2.00	0.32	1.00	0.38 [NS]	3.24
Error	12.03	38.00	0.32			
Total	55.73	59.00				

P-value > 0.05   ∴ **Reject H$_0$**

Texture

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	25.60	19.00	1.35	5.89	0.00	1.87
Filling	0.63	2.00	0.32	1.38	0.26 [NS]	3.24
Error	8.70	38.00	0.23			
Total	34.93	59.00				

P-value > 0.05   ∴ **Reject H$_0$**

Overall

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	15.92	19.00	0.84	2.27	0.02	1.87
Filling	0.63	2.00	0.32	0.86	0.43[NS]	3.24
Error	14.03	38.00	0.37			
Total	30.58	59.00				

P-value > 0.05 $\therefore$ **Reject H$_0$**

Appendix B-3

1.4.2

ANOVA table of Chrysanthemum pie with different ingredients in each attribute

Color

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	58.60	19.00	3.08	7.71	0.00	1.87
Filling	0.13	2.00	0.07	0.17	0.85 NS	3.24
Error	15.20	38.00	0.40			
Total	73.93	59.00				

P-value > 0.05 $\therefore$ **Reject H_0**

Appearance

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	55.07	19.00	2.90	3.72	0.00	1.87
Filling	3.70	2.00	1.85	2.37	0.11 NS	3.24
Error	29.63	38.00	0.78			
Total	88.40	59.00				

P-value > 0.05 $\therefore$ **Reject H_0**

Chrysanthemum Flavor

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	38.60	19.00	2.03	2.51	0.01	1.87
Filling	0.53	2.00	0.27	0.33	0.72 NS	3.24
Error	30.80	38.00	0.81			
Total	69.93	59.00				

P-value > 0.05 $\therefore$ **Reject H_0**

Saltiness

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	43.73	19.00	2.30	4.52	0.00	1.87
Filling	2.63	2.00	1.32	2.58	0.09 [NS]	3.24
Error	19.37	38.00	0.51			
Total	65.73	59.00				

P-value > 0.05 $\therefore$ **Reject H_0**

Sweetness

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	29.92	19.00	1.57	1.63	0.10	1.87
Filling	2.03	2.00	1.02	1.05	0.36 [NS]	3.24
Error	36.63	38.00	0.96			
Total	68.58	59.00				

P-value > 0.05 $\therefore$ **Reject H_0**

Texture

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelis	40.32	19.00	2.12	2.90	0.00	1.87
Filling	0.83	2.00	0.42	0.57	0.57 [NS]	3.24
Error	27.83	38.00	0.73			
Total	68.98	59.00				

P-value > 0.05 $\therefore$ **Reject H_0**

Overall

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	16.00	19.00	0.84	1.62	0.10	1.87
Filling	0.30	2.00	0.15	0.29	0.75 [NS]	3.24
Error	19.70	38.00	0.52			
Total	36.00	59.00				

P-value > 0.05 $\therefore$ **Reject H$_0$**

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Appendix B-4

1.4.2

ANOVA table of Chrysanthemum pie with different ingredients in each attribute

Color

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	55.92	19.00	2.94	4.26	0.00	1.87
Filling	4.43	2.00	2.22	3.21	0.051^{NS}	3.24
Error	26.23	38.00	0.69			
Total	86.58	59.00				

P-value > 0.05   ∴ **Reject H_0**

Appearance

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	42.58	19.00	2.24	3.09	0.00	1.87
Filling	3.10	2.00	1.55	2.14	0.13^{NS}	3.24
Error	27.57	38.00	0.73			
Total	73.25	59.00				

P-value > 0.05   ∴ **Reject H_0**

Chrysanthemum Flavor

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	77.52	19.00	4.08	2.90	0.00	1.87
Filling	3.90	2.00	1.95	1.39	0.26^{NS}	3.24
Error	53.43	38.00	1.41			
Total	134.85	59.00				

P-value > 0.05   ∴ **Reject H_0**

Saltiness

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	59.92	19.00	3.15	4.26	0.00	1.87
Filling	1.20	2.00	0.60	0.81	0.45 [NS]	3.24
Error	28.13	38.00	0.74			
Total	89.25	59.00				

P-value > 0.05   ∴ **Reject H_0**

Sweetness

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	92.58	19.00	4.87	6.10	0.00	1.87
Filling	3.63	2.00	1.82	2.27	0.12 [NS]	3.24
Error	30.37	38.00	0.80			
Total	126.58	59.00				

P-value > 0.05   ∴ **Reject H_0**

Texture

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	24.18	19.00	1.27	2.22	0.02	1.87
Filling	2.23	2.00	1.12	1.95	0.16 [NS]	3.24
Error	21.77	38.00	0.57			
Total	48.18	59.00				

P-value > 0.05   ∴ **Reject H_0**

Overall liking

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	18.75	19.00	0.99	1.85	0.05	1.87
Filling	2.03	2.00	1.02	1.90	0.16 [NS]	3.24
Error	20.30	38.00	0.53			
Total	41.08	59.00				

P-value > 0.05 $\therefore$ **Reject H$_0$**

Appendix C:

Just-About-Right-Test

Questionnaire

Please test the sample and score it following the just about right test scale in the table

Attributes	Too little	Somewhat too little	Just right	Somewhat too much	Too much
Flower aroma					
Sweetness					
Saltiness					
Size of Nata de coco					
Amount of Nata de coco					

Comments: _____

THANK YOU

Appendix C-2

Frequency of Just-About-Right-Test on Chrysanthemum pie product

Flower Aroma

	Frequency	Percentage	Cumulative percentage
Too little	0	0	0
Somewhat too little	3	15	15
Just right	15	75	90
Somewhat too much	2	10	100
Too much	0	0	100
Total	20	100	

Sweetness

	Frequency	Percentage	Cumulative percentage
Too little	0	0	0
Somewhat too little	0	0	0
Just right	12	60	60
Somewhat too much	8	40	100
Too much	0	0	100
Total	20	100	

Saltiness

	Frequency	Percentage	Cumulative percentage
Too little	0	0	0
Somewhat too little	2	10	10
Just right	15	75	85
Somewhat too much	3	15	100
Too much	0	0	100
Total	20	100	

Size of Nata de Coco

	Frequency	Percentage	Cumulative percentage
Too little	0	0	0
Somewhat too little	0	0	0
Just right	12	60	60
Somewhat too much	8	40	100
Too much	0	0	100
Total	20	100	

Amount of Nata de Coco

	Frequency	Percentage	Cumulative percentage
Too little	0	0	0
Somewhat too little	0	0	0
Just right	9	45	45
Somewhat too much	11	55	100
Too much	0	0	100
Total	20	100	

Appendix C-3

Questionnaire

Please test the different samples and score each sample following the preference test of 9-point hedonic scale below

The of 9-point hedonic scale of preference test

9 = Like Extremely   4 = Dislike Slightly

8 = Like Very Much   3 = Dislike Moderately

7 = Like Moderately   2 = Dislike Very Much

6 = Like Slightly   1 = Dislike Extremely

5 = Neither Like or Dislike

The preference test the of 9-point hedonic scale of each sample

Attributes   Sample No.

	_____	_____	_____
Flower Aroma	_____	_____	_____
Sweetness	_____	_____	_____
Saltiness	_____	_____	_____
Size of Nata de Coco	_____	_____	_____
Amount of Nata de Coco	_____	_____	_____

Comment:

_____

_____

Appendix C-4

ANOVA table of Chrysanthemum pie with Nata de Coco in each attribute

Flower Aroma

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	14.73	19.00	0.78	1.24	0.28	1.87
Treatment	0.23	2.00	0.12	0.19	0.83	3.24
Error	23.77	38.00	0.63			
Total	38.73	59.00				

P-value > 0.05 $\therefore$ **Reject H_0**

Sweetness

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	23.33	19.00	1.23	2.14	0.02	1.87
Treatment	0.23	2.00	0.12	0.20	0.82	3.24
Error	21.77	38.00	0.57			
Total	45.33	59.00				

P-value > 0.05 $\therefore$ **Reject H_0**

Saltiness

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	13.07	19.00	0.69	1.97	0.04	1.87
Treatment	0.10	2.00	0.05	0.14	0.87	3.24
Error	13.23	38.00	0.35			
Total	26.40	59.00				

P-value > 0.05 $\therefore$ **Reject H_0**

Size of Nata de Coco

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	4.27	19.00	0.22	0.71	0.79	1.87
Treatment	0.63	2.00	0.32	1.00	0.38	3.24
Error	12.03	38.00	0.32			
Total	16.93	59.00				

P-value > 0.05 $\therefore$ **Reject H$_0$**

Amount of Nata de Coco

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Panelist	12.93	19.00	0.68	1.88	0.05	1.87
Treatment	0.23	2.00	0.12	0.32	0.73	3.24
Error	13.77	38.00	0.36			
Total	26.93	59.00				

P-value > 0.05 $\therefore$ **Reject H$_0$**

Appendix D:

Confirmation of Prototype Formula

Appendix D-1

Questionnaire

Please test the different samples and score each sample following the preference test of 9-point hedonic scale below

The of 9-point hedonic scale of preference test

9 = Like Extremely   4 = Dislike Slightly

8 = Like Very Much   3 = Dislike Moderately

7 = Like Moderately   2 = Dislike Very Much

6 = Like Slightly   1 = Dislike Extremely

5 = Neither Like or Dislike

The preference test the of 9-point hedonic scale of each sample

Attributes	Sample
	_____
Color	_____
Appearance	_____
Chrysanthemum Flavor	_____
Saltiness	_____
Sweetness	_____
Texture	_____
Overall Liking	_____

Comment:

_____

_____

Appendix D-2

Average scores of Chrysanthemum pie with nata de coco

Attributes	Mean±SD
Color	7.85±0.59
Appearance	7.35±0.67
Chrysanthemum Aroma	7.40±0.50
Saltiness	7.55±0.60
Sweetness	7.40±0.82
Texture	7.65±0.75
Overall Liking	7.70±0.57

Appendix E:

Consumer Acceptance Test

Consumers' Acceptance Survey

"Chrysanthemum Pie"

This survey is a part of a special project (FT 4190) under a title "An Application of Chrysanthemum as Pie Filling" for Bachelor of Science, Faculty of Biotechnology, Assumption University.

Please kindly complete the questions by checking in the provided spaces.

Part 1: Demographic information

1. **Gender**

   ☐ Male   ☐ Female

2. **Age**

   ☐ Less than 18 years old   ☐ 18-25 years

   ☐ 26-35 years old   ☐ 36-45 years old

   ☐ 46-60 years old   ☐ More than 60 years old

3. **Occupation**

   ☐ Student

   ☐ Government officer

   ☐ Office employee

   ☐ Others, please specify _____

4. Monthly income

☐ Less than 5,000 baht

☐ 5,000-10,000 baht

☐ 10,001-15,000 baht

☐ More than 15,000 baht

Part2: Basic information of consumer's behavior on pie in the market

5. From which store do you normally buy pie? (Can choose more than 1)

☐ McDonald's   ☐ Gateaux House

☐ Saint Etoile   ☐ Farm House

☐ S&P   ☐ Bakery Land by 7-11

☐ Deliya   ☐ Puff & Pie

☐ Little Home Bakery   ☐ Other, please specify _____

6. How often do you consume pie?

☐ Everyday   ☐ 2-3 times per week

☐ Once a week   ☐ 2-3 times per month

☐ Once a month   ☐ Less than once a month

7. How much do you spend in buying pie per time?

☐ Less than 15 baht

☐ 16 – 30 baht

☐ More than 30 baht

8. **What type of pie do you prefer?**

   ☐ Meat pie

   ☐ Sweet pie

   ☐ Plain pie

Part 3: **Information of consumer's behavior on product**

Instructions: **Please taste the product and answer the following questions.**

9. **Would you rate the product using 9-point Hedonic scale below**

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

   Score _____

10. **Do you accept this product?**

    ☐ Accept   ☐ Not accept

11. **What price will be acceptable for the 65 grams (1 piece) of the product?**

    ☐ Less than 15 baht

    ☐ 16 – 30 baht

    ☐ More than 30 baht

12. **Will you buy this product if it is sold in the market with the market price?**

    ☐ Yes   ☐ No, because _____

Suggestion;

_____

_____

_____

Thank you very much for your cooperation

Appendix E-2

Frequency of consumer acceptance survey on Chrysanthemum pie product

Gender

	Frequency	Percentage	Cumulative Percentage
Male	84	42	42
Female	116	58	100
Total	200	100	

Age

	Frequency	Percentage	Cumulative Percentage
Less than 18 years old	22	11	11
18-25 years old	96	48	59
26-35 years old	48	24	83
36-45 years old	18	9	92
46-60 years old	13	6.5	98.5
More than 60 years old	3	1.5	100
Total	200	100	

Occupations

	Frequency	Percentage	Cumulative Percentage
Student	94	47	47
Government officer	21	10.5	57.5
Office employee	68	34	91.5
Others	17	8.5	100
Total	200	100	

Monthly Income

	Frequency	Percentage	Cumulative Percentage
Less than 5,000 baht	16	8	8
5,000-10,000 baht	77	38.5	46.5
10,001-15,000 baht	59	29.5	76
More than 15,000 baht	48	24	100
Total	200	100	

Brands

	Frequency	Percentage	Cumulative Percentage
McDonald's	69	25.46	25.46
Saint Etoile	26	9.59	35.06
S&P	52	19.19	54.24
Deliya	23	8.49	62.73
Gateaux House	36	13.28	76.01
Farm House	11	4.06	80.07
Bakery Land by 7-11	16	5.90	85.98
Puff & Pie	38	14.02	100
Total	271	100	

Frequency

	Frequency	Percentage	Cumulative Percentage
Everyday	6	3	3
Once a week	69	34.5	37.5
Once a month	32	16	53.5
2-3 times per week	76	38	91.5
2-3 times per month	14	7	98.5
Less than once a month	3	1.5	100
Total	200	100	

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Buying Price

	Frequency	Percentage	Cumulative Percentage
Less than 15 baht	26	13	13
16 – 30 baht	86	43	56
More than 30 baht	88	44	100
Total	200	100	

Types

	Frequency	Percentage	Cumulative Percentage
Meat pie	82	41.00	41
Sweet pie	97	48.50	89.5
Plain pie	21	10.50	100
Total	200	100	

Preference Score

Score: 7.23±0.85 (Mean±SD)

Product Acceptance

	Frequency	Percentage	Cumulative Percentage
Accept	183	91.5	91.5
Not accept	17	8.5	100
Total	200	100	

Acceptable Price

	Frequency	Percentage	Cumulative Percentage
Less than 15 baht	31	15.5	15.5
16 – 30 baht	134	67	82.5
More than 30 baht	35	17.5	100
Total	200	100	

Buying Decision

	Frequency	Percentage	Cumulative Percentage
Yes	176	88	88
No	24	12	100
Total	200	100	