Senior Project

The Development of Vegetable Yogurt

By

Ms. Krittawan Krittanusorn

ID. 4856808

A special proj ect submitted to the Faculty of Biotechnology, Assumption University in part of fulfillment of the requirement for the degree of Bachelor of Science

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Title	: The Development of Vegetable Yogurt
By	: Ms. Krittawan Krittanusorn
Advisor	: A. Napida Supbornsug
Level of Study	: Bachelor of Science
Department	: Food Technology
Faculty	: Biotechnology
Academic Year	: 2010

Napida S. Advisor

(A. Napida Supbornsug)

Abstract

This project was studied on an innovative of vegetable yogurt production. Pumpkin, carrot and kale were used to produce three kinds of vegetable yogurt by substituting vegetable meat in a portion of milk and fermenting the mixture with yogurt culture. First part was to formulate the suitable vegetable yogurt by using 9-point hedonic scale with 30 panelists. There were 20%, 30%, 40% and 50% variation of each kind of vegetable meat (pumpkin, carrot and kale). The 40% of pumpkin meat formula and the 30% of carrot meat formula were chosen as the most suitable formulas from the panelists. The 20% of kale meat formula was chosen as the most suitable formula but received very low score. Therefore, kale yogurt was regarded as unacceptable from panelists. Subsequently, the amount of sugar in vegetable yogurt formulas chosen from the previous part was varied to 6%, 8% and 10%. The 10% of sugar variation was chosen from both pumpkin yogurt and carrot yogurt. Final part was consumer acceptance test from 100 panelists, pumpkin yogurt was accepted with 79% of consumers and carrot yogurt was accepted with 86% of consumers. The consumers also would be willing to buy both products at the price of 10-15 Bath per one cup.

Acknowledgement

This project, the development of vegetable yogurt attained with the help of several co-operation. I feel obliged to thank you to those people who assisted me without hesitation.

First of all, I would like to thank my advisor, A. Napida Supbornsug, who always devoted her time to give me useful information and advised me when I encountered difficulty in completing the project.

I would like to thank the other members and staffs in Faculty of Biotechnology, who gave me advices and suggestions to my project.

I would also be a great occasion to thank Dr. Tatsawan Chonweerawong for guiding me throughout the statistic analysis.

Lastly, I owe my warmest thanks to my loving family and my friends whose support and care have encouraged me in my study.

November 2010

Krittawan Krittanusorn

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Chapter 1

Introduction

Today, Yogurt is the main dairy product that becomes dietary staple food consumed by every gender and every age of people around the world. There are many brands of yogurt available in the market and each brand provides consumers the variety of flavors. Most people consume yogurt as a quick, easy and nutritious dairy product, while enjoying the taste of yogurt and gaining the healthy benefit.

Previously mentioned, yogurt is a fermented dairy product made from milk that provides excellent unique characteristics and nutritional benefit. But in today's new generation, people are continuing to show a greater concern for better quality, healthier and more variety food. Thus, it is important to produce the product that meets the people's need by adding other ingredients in the common yogurt to create new innovative product.

The yogurt production is to ferment milk with the bacterial cultures to obtain the unique characteristics of yogurt. According to the new trend of people nowadays, the development of yogurt is to combine the vegetable into the fermentation process of yogurt. As vegetable contains high nutritional values and this could be new variety of yogurt in the market.

In this project, vegetables; pumpkin, carrot and kale were used to develop the innovative yogurt in order to improve quality, nutrition and variety of the product. The reason why pumpkin, carrot and kale were used as the main ingredient was that those vegetables provide many nutrients, good taste, good color and easy to find in the market. Other than that, to approve the product the improvement following the product development method is very important to study the consumer preference on the new variety of yogurt in terms of appearance and sensory evaluation.

Vegetable Yogurt was made by fermenting cooked vegetable and milk with friendly bacteria, mainly *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. The process was similar to the normal production of yogurt. In vegetable yogurt production, cooked vegetable meat was added and blended with milk then fermented with starter culture. The sugars were

fermented by bacteria into lactic acid, which caused the fermentation of the characteristic curd. The acid decreased pH of the yogurt to about 4.5 and inhibited the growth of food poisoning bacteria. The bacteria produced lactase which broke down the lactose in milk. Vegetable did not contain lactose but other sugars such as fructose, stachyose and raffinose.

Yogurt contains living friendly bacteria which help to improve human's immune system and also contains many nutrients for health benefit. Even though yogurt itself is an excellent healthy food but to increase other nutrients and give an innovative flavor to yogurt, vegetable was chosen to study in this research. High in nutrition, good color and local vegetables were chose to use for development of vegetable yogurt, which were pumpkin, carrot and kale.

Objectives

- To produce innovative product
- To improve nutrition and variety of yogurt
- To increase vegetable value
- To formulate vegetable yogurt

Chapter 2

Literature Review

1. Yogurt

Yogurt is made by fermenting milk with the characteristic bacterial cultures *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, which cause the fermentation of milk's sugar, lactose, into lactic acid. This process gives yogurt its refreshingly tart flavor and unique curd texture. It is a common food product throughout the world. It is a nutritional food with unique health benefits. It is nutritionally rich in protein, calcium, riboflavin, vitamin B6 and vitamin B12 (Cornell University, 2006)

1.1 Yogurt Health Benefits

- **Yogurt is easier to digest than milk**

The milk-intolerant people who have a problem with digesting milk, either because of protein allergy or lactose intolerance, can enjoy yogurt. The fermenting of yogurt culture process makes yogurt more digestible than milk. The active yogurt cultures produce lactase which is an enzyme that lactose-intolerant people lack, and another enzyme, beta-galactosidase, contained in some yogurts also helps to absorb lactose in lactase-deficient persons. Bacterial enzymes created by the culturing process, partially digest the milk protein casein, making it easier to absorb and less allergenic. The culturing process has already broken down the milk sugar lactose into glucose and galactose, two sugars that are easily absorbed by lactose-intolerant persons (William and Martha Sears, 2006).

- Yogurt contributes to colon health

Consuming yogurt makes human's colon healthy in two ways. First, yogurt contains lactic acid bacteria, which is friendly to human's intestines and give a healthy colon, and even lower the risk of colon cancer. Lactic acid bacteria, especial acidophilus, promotes the growth of

healthy bacteria in the colon and reduces the conversion of bile into carcinogenic bile acids. Lower the chance of colon diseases is the more benefit of these intestines-friendly bacteria. It seems that friendly bacteria in yogurt deactivate harmful substances (such as nitrates and nitrites before they are converted to nitrosamines) before they can become carcinogenic (William and Martha Sears, 2006).

Secondly, yogurt is a rich source of calcium and calcium helps contributing the colon health and decreases the risk of colon cancer. Calcium obstructs excess growth of the cells lining the colon, which can increase a risk of colon cancer. Calcium also binds cancer-producing bile acids and keeps them from irritating the colon wall (William and Martha Sears, 2006).

- **Yogurt improves the bioavailability of other nutrients**

Culturing of yogurt increases the absorption of calcium and B-vitamins. The lactic acid in the yogurt aids in the digestion of the milk calcium, making it easier to absorb (William and Martha Sears, 2006).

1.2 Yogurt Formulation

In yogurt production, milk is heated to kill other microorganisms that would compete with the starter culture. *Lactobacillus bulgaricus* interacts with *Streptococcus thermophilus* to form a symbiotic starter culture to ferment milk. These created yogurt cultures increase the production of lactic acid in the fermentation process. Fermentation of the milk usually happens when the milk is approximately 45 °C. *Streptococcus thermophilus* starts to grow first dropping the milks pH from 6.6 to 5.0, and produces carbon dioxide and lactic acid. These products stimulate *Lactobacillus bulgaricus* to grow and further drop the pH to 4.2. The sugar found in milk is lactose, when the starter culture is added to milk it breaks the lactose into glucose. After the sugar glucose is formed it then is fermented into lactic acid by the cultures. Acetaldehyde is also produced, this chemical compound creates the tart and sour taste of plain yogurt. The lactic acid decreases the pH of the milk and causes the casein molecules, protein found in milk, to denature and stick together. The milk then curdles to produce yogurt (Amber Kahl, 2007).

1.3 Bacterial culture

In most yogurt production, starter culture is a symbiotic blend of *Streptococcus salivarius* subsp. *thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus*. Although they can grow independently, the rate of acid production is much higher when used together than either of the two organisms grown individually. *Streptococcus thermophilus* grows faster and produces both acid and carbon dioxide. The lactic acid and carbon dioxide produced stimulate *Lactobacillus bulgaricus* growth. On the other hand, *Lactobacillus bulgaricus* produces stimulatory peptides and amino acids to stimulate *Streptococcus thermophilus*. These microorganisms are ultimately responsible for the formation of typical yogurt flavor and texture. The yogurt mixture coagulates during fermentation due to the drop in pH. The following fermentation products contribute to flavor: lactic acid, acetaldehyde, acetic acid and diacetyl (Professor Douglas Goff, 1995).

- ***Streptococcus salivarius subsp. thermophilus***

Streptococcus salivarius subsp. thermophilus (common name *Streptococcus thermophilus*) is a Gram-positive facultative anaerobe. It is a cytochrome-, oxidase- and catalase-negative organism that is nonmotile, non-spore forming and homofermentative. Streptococcus thermophilus is an alpha-hemolytic species. It is also classified as a lactic acid bacterium (LAB). *Streptococcus thermophilus* is found in fermented milk products. It is a probiotic (it survives the stomach) and generally used in the production of yogurt (Ali O. Kilic, 1 Sylvia I. Pavlova, Wen-Ge Ma, and Lin Tao1, 1996).

- ***Lactobacillus delbrueckii* subspecies *bulgaricus***

Lactobacillus delbrueckii* subspecies *bulgaricus is one of yogurt cultures used for the production of yogurt. It is a rod-shape and Gram-positive. It is also non-motile, and it does not form spores. This bacterium requires a low pH (around 5.4-4.6) in order to grow effectively. The bacterium has complex nutritional requirements, including the inability to ferment any sugar except for lactose, from which it produces lactic acid, which helps to preserve yogurt. It is often helpful to sufferers of lactose intolerance, whose digestive systems lack the enzymes to break down lactose to simpler sugars. While fermenting milk, it produces acetaldehyde, which is one of the main yogurt aroma components (A. Balows, H.G.Truper, M. Dworkin, W. Harder, K.H.Schleifer, 1991).

2. Cow milk

Cow's mammary glands produce clear white liquid which called milk. Nutrients in milk are important source of primary food for the growth of young cows before they can digest other types of food. Milk is a nutritional food which contains almost all important nutrients. Milk consists of proteins (mainly casein), fat, salts, and milk sugar, or lactose, as well as vitamins A, C, D, certain B vitamins, and other vitamin but less. Milk is a rich source of calcium and source of phosphorus. Milk is the main ingredient in yogurt process, yogurt cultures will use and turn lactose in milk to lactic acid during fermentation (George Mateljan, Founder, 2001-2010).

2.1 Health benefits

The basis of all other dairy product is cow's milk which contains high amount of calcium, vitamin K and vitamin D to promote bones health. In addition, cow's milk is a very good source of iodine which helps thyroid to function well. Riboflavin and vitamin B12 in milk are necessary for cardiovascular health and energy production. Also vitamin A in cow's milk is important for immune system, and potassium, a nutrient important for cardiovacular health (George Mateljan, Founder, 2001-2010).

In bone mineralization, calcium joins with phosphorus and from calcium phosphate which is a major component of the mineral complex (called *hydroxyapatite*). Calcium phosphate is an important role in maintaining the strength and density of bones (George Mateljan, Founder, 2001-2010).

3. Pumpkin

Pumpkins are related to squash. Most pumpkin fruits are orange, but some are white, yellow, or other colors. The outer shell of pumpkin is hard and lined inside with a thicker layer of coarse pulp. Inside that, the pumpkin's central cavity holds seeds within its stringy mass. The mature pumpkin fruit usually weighs 15 to 30 pounds (6.8 to 14 kilograms), but some giants may weigh over 800 pounds (363 kilograms). The eatable pulp of a pumpkin is rich in vitamin A and potassium. Pumpkin is an excellent source of vitamin A. It is also a very good source of vitamin

C, potassium, dietary fiber, and manganese. In addition, pumpkin is a good source of folate, omega-3 fatty acids, thiamin, vitamin B5, vitamin B6, niacin and copper (George Mateljan, Founder, 2001-2010)

3.1 Health benefits

- **Promote Lung Health**

Consuming foods rich in beta-cryptoxanthin, an orange-red carotenoid found in highest amounts in pumpkin, may significantly lower one's risk of developing lung cancer. A study published in *Cancer Epidemiology, Biomarkers and Prevention* reviewed dietary and lifestyle data collected from over 60,000 adults in China and found that those eating the most crytpoxanthin-rich foods showed a 27% reduction in lung cancer risk. When current smokers were evaluated, those who were also in the group consuming the most cryptoxanthin-rich foods were found to have a 37% lower risk of lung cancer compared to smokers who ate the least of these health-protective foods (George Mateljan, Founder, 2001-2010).

- **A Variety of Health-Promoting Nutrients**

Pumpkin is an excellent source of vitamin A (in the form of beta-carotene), a very good source of vitamin C, potassium, dietary fiber and manganese. Pumpkin also emerged as a good source of folate, omega-3 fatty acids, vitamin B1, copper, vitamin B6, niacin-vitamin B3 and pantothenic acid. Beta-carotene in pumpkin has been shown to have very powerful antioxidant and anti-inflammatory properties. Beta-carotene is able to prevent the oxidation of cholesterol in the body. Since oxidized cholesterol is the type that builds up in blood vessel walls and contributes to the risk of heart attack and stroke, getting extra beta-carotene in the diet may help to prevent the progression of atherosclerosis. It may also protect against diabetic heart disease and may be useful for preventing other complications caused by free radicals often seen in long-term diabetes. Additionally, intake of foods such as pumpkin that are rich in carotenoids may be beneficial to blood sugar regulation. Research has suggested that physiological levels, as well as dietary intake, of carotenoids may be inversely associated with insulin resistance and high blood sugar levels (George Mateljan, Founder, 2001-2010).

The potassium in pumpkin may help to lower blood pressure, and the vitamin C may be able to reduce the severity of conditions like asthma, osteoarthritis, and rheumatoid arthritis and also to prevent the progression of conditions like atherosclerosis and diabetic heart disease. In addition to its ability to lower high cholesterol levels, which reduces the risk of heart disease, the fiber found in pumpkin is also able to prevent cancer-causing chemicals from attacking colon cells. This is one of the reasons why diets high in fiber-rich foods have been associated with a reduced risk of colon cancer (George Mateljan, Founder, 2001-2010).

- **Folate to Help Prevent Birth Defects and Heart Attack and Support Colon Health**

The folate found in pumpkin may help to prevent certain birth defects if taken by women before and during pregnancy. Folate is also needed by the body to break down a dangerous metabolic byproduct called *homocysteine*, which can directly damage blood vessel walls. Since high levels of homocysteine are associated with an increased risk for heart attack and stroke, getting plenty of folate in the diet is a good for health. Folate has also been shown to help protect colon cells from the effects of cancer-causing chemicals. In fact, diets high in folate-rich foods are associated with a significantly reduced risk of colon cancer, especially in people who have a history of alcohol use (George Mateljan, Founder, 2001-2010).

4. Carrot

The carrot has a thick, fleshy, deeply colored root, which grows underground, and feathery green leaves that emerge above ground. Carrots belong to the umbelliferae family along with parsnips, fennel caraway, cumin and dill which all have the umbrella-like flower clusters that characterize this family of plants. Carrots are an excellent source of antioxidant compounds, and the richest vegetable source of the pro-vitamin A carotenes. Carrots' antioxidant compounds help protect against cardiovascular disease and cancer and also promote good vision, especially night vision (Buck Levin, 2010).

4.1 Health Benefits

- **Better Vision**

Beta-carotene helps to protect vision, especially night vision. After beta-carotene is converted to vitamin A in the liver, it travels to the retina where it is transformed into rhodopsin, a purple pigment that is necessary for night-vision. Moreover beta-carotene's powerful antioxidant actions help provide protection against macular degeneration and the development of senile cataracts, the leading cause of blindness in the elderly (George Mateljan, Founder, 2001-2010).

- **Carotenoids and Optimal Health**

Carrots are one of the richest sources of carotenoids. High carotenoid intake has been linked with a 20% decrease in postmenopausal breast cancer and up to 50% decrease in the incidence of cancers of the bladder, cervix, prostate, colon, larynx, and esophagus. Carotenoids are powerful antioxidants, protecting the cells of the body from damage caused by free radicals. Carotenoids, specifically beta-carotene, are also believed to enhance the function of the immune system (George Mateljan, Founder, 2001-2010).

- **Falcarinol in Carrots Promote Colon Health**

Carrot also contains a phytonutrient called falcarinol. Falcarinol provides protection against colon cancer, suggests a study published in the *Journal of Agricultural and Food Chemistry*. Three groups of laboratory animals in whom precancerous colon lesions (aberrant crypt foci) had been chemically-induced were fed a standard diet, one supplemented with freeze-dried carrots naturally containing falcarinol, or one supplemented with an extract of falcarinol. After 18 weeks, precancerous lesions in the animals given diets containing carrots or falcarinol were much smaller than those in the control animals, and far fewer of the lesions had grown in size or progressed to become tumors. (George Mateljan, Founder, 2001-2010).

5. Kale

The leaves of the kale plant provide an earthy flavor and more nutritional value for fewer calories than almost any other food around. It can be found in markets throughout the year. Kale is a leafy green vegetable that belongs to the brassica family, a group of vegetables including cabbage, collards and Brussels sprouts that have gained recent widespread attention due to their health promoting, sulfur-containing phytonutrients. Kale is an excellent source of vitamin A, vitamin C and manganese. It is also a very good source of dietary fiber, copper, calcium, vitamin B6 and potassium (George Mateljan, Founder, 2001-2010).

5.1 Health Benefits

- **Organosulfur Phytonutrients that Help Prevent Cancer**

In kale contains *organosulfur* compounds which have been main subject of phytonutrient research, and these include the *glucosinolates* and the *methyl cysteine sulfoxides*. Although there are over 100 different *glucosinolates* in plants, only 10-15 are present in kale and other *Brassicas*. Yet these 10-15 glucosinolates appear able to lessen the occurrence of a wide variety of cancers, including breast and ovarian cancers. Exactly how kale's sulfur-containing phytonutrients prevent cancer is not yet fully understood, but several researchers point to the ability of its *glucosinolates* and *cysteine sulfoxides* to activate detoxifing enzymes in the liver that help neutralize potentially carcinogenic substances. (These detoxifying enzymes include *quinone reductases* and *glutathione-S-transferases*). For example, scientists have found that *sulforaphane*, a potent glucosinolate phytonutrient found in kale and other *Brassica* vegetables, boosts the body's detoxification enzymes, potentially by altering gene expression, thus helping to clear potentially carcinogenic substances more quickly. Sulforaphane, which is formed when cruciferous vegetables such as kale are chopped or chewed, triggers the liver to produce enzymes that detoxify cancer-causing chemicals, inhibits chemically-induced breast cancers in animal studies, induce colon cancer cells to commit suicide (George Mateljan, Founder, 2001-2010).

- **Optimize Your Cells' Detoxification / Cleansing Ability**

Phytonutrients in kale, work at a much deeper level. These compounds actually signal our genes to increase production of enzymes involved in detoxification, the cleansing process through which our bodies eliminate harmful compounds. That result in clearing free radicals and toxins, including potential carcinogens, which may be why kale appears to significantly lower our risk of cancer (George Mateljan, Founder, 2001-2010).

- **Carotenoids that Lower Cataract Risk**

In addition to its unique organosulfur compounds, kale is well known for its carotenoids, especially *lutein* and *zeaxanthin*. These carotenoids act like sunglass filters and prevent damage to the eyes from excessive exposure to ultraviolet light (George Mateljan, Founder, 2001-2010).

- **Vitamin A in Kale**

Kale is an excellent source of vitamin A on account of its concentrated beta-carotene content. Once inside the body, beta-carotene can be converted into vitamin A, so when you eat kale, it is like getting both these beneficial nutrients at once. One cup of kale contains just 36.4 calories, but provides 192.4% of the daily value for vitamin A. Both vitamin A and beta-carotene are important vision nutrients (George Mateljan, Founder, 2001-2010).

- **A Healthy Dose of Vitamin C for Antioxidant Protection and Immune Support**

Kale is an excellent source of vitamin C, just one cup of this cooked vegetable supplies 88.8% of the daily value for vitamin C. Vitamin C is the primary water-soluble antioxidant in the body, decreasing free radicals and preventing damage in the aqueous environment both inside and outside cells. Inside cells, a potential result of free radical damage to DNA is cancer. Especially in areas of the body where cellular turnover is especially rapid, such as the digestive system, preventing DNA mutations translates into preventing cancer. A good intake of vitamin C is associated with a reduced risk of colon cancer. Free radical damage to other cellular structures and other molecules can result in painful inflammation, as the body tries to clear out the damaged parts. Vitamin C, which prevents the free radical damage that triggers the inflammatory

cascade, is thus also associated with reduced severity of inflammatory conditions, such as asthma, osteoarthritis, and rheumatoid arthritis. Free radicals also oxidize cholesterol. Only after being oxidized does cholesterol stick to artery walls, building up in plaques that may eventually grow large enough to impede or fully block blood flow, or rupture to cause a heart attack or stroke. Since vitamin C can neutralize free radicals, it can help prevent the oxidation of cholesterol. Vitamin C, which is also vital for the proper function of a healthy immune system, is good for preventing colds and may be helpful in preventing recurrent ear infections (George Mateljan, Founder, 2001-2010).

- **Manganese-Energy Production plus Antioxidant Protection**

One cup of kale will provide 27% of the day's needs for manganese. This trace mineral helps produce energy from protein and carbohydrates, and is involved in the synthesis of fatty acids that are important for a healthy nervous system and in the production of cholesterol that is used by the body to produce sex hormones. Manganese is also a critical component of an important antioxidant enzyme called *superoxide dismutase*. *Superoxide dismutase* (SOD) is found exclusively inside the body's mitochondria (the oxygen-based energy factories inside most of our cells) where it provides protection against damage from the free radicals produced during energy production (George Mateljan, Founder, 2001-2010).

- A Very Good Source of Fiber

Kale's health benefits continue with its fiber, a cup of kale provides 10.4% of the daily value for fiber, which has been shown to reduce high cholesterol levels thus helping to prevent atherosclerosis. Fiber can also help out by keeping blood sugar levels under control, so kale is an excellent vegetable for people with diabetes. Kale's fiber binds to cancer-causing chemicals, keeping them away from the cells lining the colon (George Mateljan, Founder, 2001-2010).

- **Calcium-For A Lot Less Calories and Minus the Fat in Cow's Milk**

Kale is also very good source of calcium. Calcium is one of the nutrients needed to make healthy bones, and dairy products are a heavily promoted source of this nutrient. But unlike dairy products, kale is not a highly allergenic food, nor does it contain any saturated fat-plus, a cup of kale supplies 93.6 mg of calcium (9.4% of the daily value for this mineral) for only 36.4 calories. In contrast, a cup of 2% cow's milk provides 296.7 mg of calcium, but the cost is high: 121.2 calories and 14.6% of the day's suggested limit on saturated fat (George Mateljan, Founder, 2001-2010).

6. Previous study about vegetable yogurt

6.1 Vegetable-flavored yogurt

One of previous studies about vegetable yogurt was a special project submitted in partial fulfillment of the requirement for the Bachelor degree of Science in Pharmacy, Faculty of Pharmacy, Mahidol University in 2005 by Ms. Nida Jianteerangkool and Ms. Wasinee Bhudhikanok. The study about vegetable-flavored yogurt production to produce an innovative yogurt flavor to the Thai market by using Thai vegetable as the ingredients was conducted. The process of vegetable-flavored yogurt was to sugaring the vegetables which were chopped in pieces and then added to the home made yogurt. Eight vegetable flavors, which were pumpkin, carrot, cucumber, lotus root (รากบัว), tomato, white gourd (ฟัก), aloe jelly (วุ้นว่านหางจระเข้) and ginger were produced.

Sensory evaluation was carried out in 4 replications by using 9-point Hedonic Scale method among 25 panelists. According to Analysis of Variance, pumpkin-flavored yogurt received the significant highest mean score of 7.19 ("like moderately" to "like very much") ($P<0.05$). Tomato-flavored and carrot-flavored yogurts received the mean scores of 6.38 and 6.02 ("like slightly" to "like moderately") and white gourd-flavored, lotus root-flavored and aloe jelly-flavored yogurts obtained the mean scores of 5.71, 5.68 and 5.62 ("neither like nor dislike" to "like slightly"), respectively. These flavored yogurts obtained significantly more preference ($P<0.05$) than cucumber-flavored yogurt which received the mean score of 4.60 ("dislike slightly" to "neither like nor dislike"). Ginger-flavored yogurt received the significantly lowest mean score of 3.19 ("dislike moderately" to "dislike slightly"), ($P<0.05$) (Nida Jianteerangkool and Wasinee Bhudhikanok, 2005).

6.2 Vegetable yogurt without milk

There was another study about vegetable yogurt, Remo Zuccato, an inventor of vegetable yogurt has been invented this product for his objectives to provide a process capable of achieving a product similar to yogurt obtained exclusively starting from raw materials of vegetable origin. In addition, to offer to the consumers with a plurality of vegetable substance yogurt with no fat because it was not milk based yogurt.

A process for the production of a vegetable yogurt is formed by fermentation of vegetable products such as green vegetables under the action of lactic acid bacteria. In the first phase the vegetable substrate is prepared whereby the green vegetables are homogenized, then water is added to obtain a creamy or liquid product which is then pasteurized. Afterwards the cultures of lactic acid bacteria are inoculated whereby the fermentation step is carried out at a temperature depending on the strain of lactic acid bacteria being used until the pH reaches a value of about 3.8-4.5, at which point fragrances and/or thickening agents, vegetable puree or cereals are added and the product is packed (Remo Zuccato, 2005).

Chapter 3

Materials

Ingredients used for this study:

1. Pumpkin
2. Carrot
3. Kale
4. Pasteurized cow's milk (CP Maji brand)
5. Sugar
6. Starter culture (plain yogurt Dutchie's brand)
7. Skim milk powder (Dumex brand)

Equipments used for this study:

1. Yogurt maker (Severin: Typ3520, 220V 50Hz)
2. Digital balance (Zepper: ES-3000H, 3000g x 0.1g)
3. Steamer
4. Jam jar
5. Blender (Philips Model HR-2001)
6. pH meter (Hanna instrument: pH211)
7. Thermometer
8. Cylinder (10 ml, 500 ml)
9. Beaker (50 ml, 500 ml)

Methods

1. The study of suitable vegetable yogurt formulation.

1.1 Methods for preparing milk stock

In one batch of milk stock, 10 g of sugar (5%) and 10 g of skim milk (5%) were added to 200 ml of pasteurized cow's milk. All the mixtures were mixed well and heated to 45 C for 10-15 minutes.

Table 1: Milk stock formulation

Milk stock ingredients	Quantity
1. Pasteurized cow's milk	200 ml (85%)
2. Sugar	10 g (5%)
3. Skim milk	10 g (5%)

1.2 Methods for making cooked vegetable meat

Pumpkin, carrot and kale were used in this study. Skin of pumpkin and carrot were peeled off then each vegetable were cut in to small pieces. Each vegetable was cooked by the steamer until the texture is soft. Each vegetable was mashed and weighted according to each formula.

1.3 Method for making vegetable yogurt

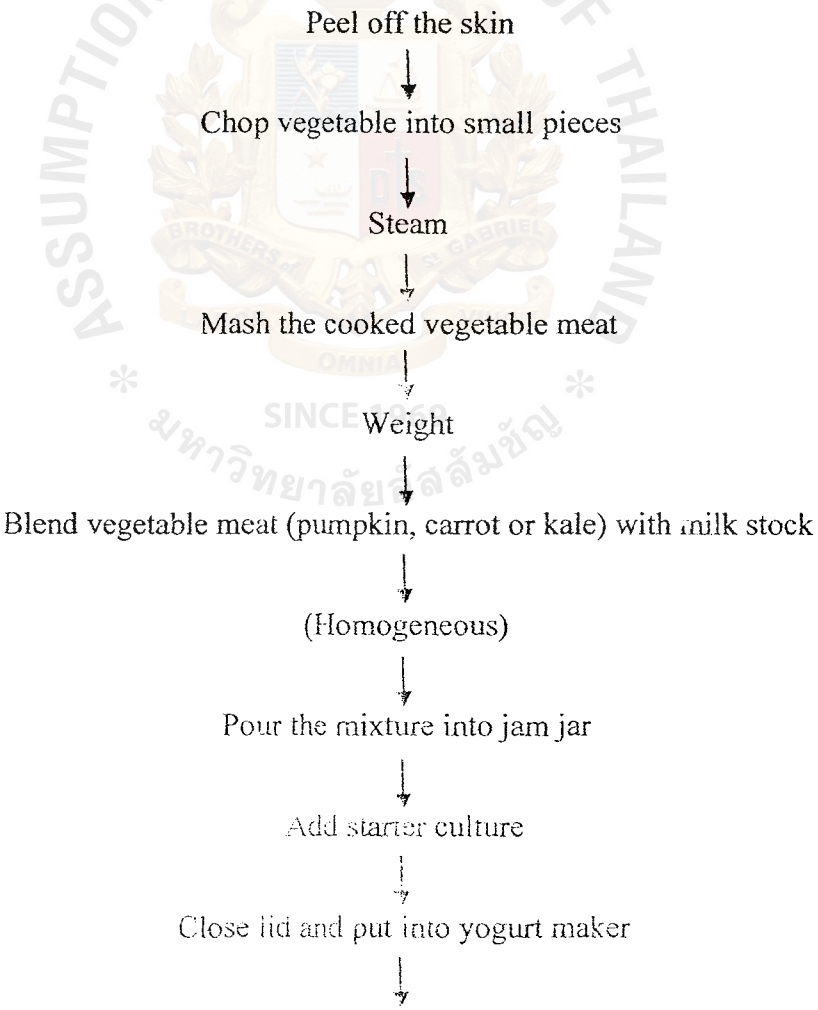
Cooked vegetable meat was blended with milk stock follow each formula. In this study, 200 ml of vegetable and milk is equal to one batch of the product, substitution of stock milk by vegetable meat (pumpkin, carrot, or kale) by 4 percentages: 20%, 30%, 40% and 50%. Formula 1: vegetable meat 40 g with milk stock 160 ml, formula 2: vegetable meat 60 g with milk stock 140 ml, formula 3: vegetable meat 80 g with milk stock 120 ml and formula 4: vegetable meat 100 g with milk stock 100 ml. Starter culture (plain yogurt) was added into jam jar which was already contained vegetable milk and the mixture was mixed well. The jam jar was closed with

lid and put into the yogurt maker, leaved for 3-4 hours (until pH drops to 4.5). Yogurt is kept in refrigerator overnight.

Table 2: Vegetable yogurt formulation

Vegetable meat varying	Vegetable meat	Milk stock	Starter culture (5%)
Formula 1	40 g (20%)	160 ml	10 ml
Formula 2	60 g (30%)	140 ml	10 ml
Formula 3	80 g (40%)	120 ml	10 ml
Formula 4	100 g (50%)	100 ml	10 ml

Vegetable yogurt process flow chart



pH reach 4.5

↓

Put into refrigerator overnight

1.4 9-Point Hedonic scale test

The treatments were evaluated for the organoleptic sensory test by using 30 taste panelists with 9-point hedonic score preference test to determine the most acceptable treatment. The data was analyzed using Randomizes Complete Block Design, RCBD and means were compared using Duncan's multiple range test. The SPSS at 95% confidence level was used for this statistical analysis.

2. The suitable amount of sugar in vegetable yogurt formula.

The most acceptable treatment in each vegetable yogurt was varied with the amount of sugar added to develop the suitable sweetness for the consumers. Sugar was increased to 6%, 8% and 10% in the milk stock for each treatment.

Table 3: Sugar varying in vegetable yogurt

Sugar varying	Sugar added in milk stock
Formula 1	12 g (6%)
Formula 2	16 g (8%)
Formula 3	20 g (10%)

2.2 Ranking preference test

Two formulas containing different kinds of the vegetable meat substitution selected from 1.4 were used in the sugar varying. The sugar variations with 3 percentages - 6%, 8%, and 10% of sugar were evaluated for the organoleptic sensory test by 30 taste panelists with ranking preference test to determine the most acceptable treatment. The data was analyzed using percentage calculation.

3. The study of consumer acceptance in suitable formula.

From the ranking preference test in 2.2, the most preferred formulas were used in the Consumer acceptance test. The data was set to determine consumer acceptant to pumpkin yogurt and carrot yogurt by using 100 taste panelists. Questionnaire included personal question such as gender, age, education level, occupation and income. Product evaluation included 9-point hedonic scale was used for the consumer preference test based on the appearance, color, flavor, sweetness, odor, texture and overall. In addition, the consumers were asked to evaluate the acceptance of the product by using yes/no answer and also rated the acceptance price of the product.

4. The analysis of the vegetable yogurt

1. pH analysis
2. Lactic acid total plate count
    1) Samples were prepared
    2) Prepared the initial 10^{-1}-10^{-6} dilutions
    3) Delivered the 0.1 ml diluted samples every series in each petri dish containing MRS media
    4) Incubated plate at 37C for 48 hours
    5) Counted colonies on plate

Chapter 4

Result and Discussion

1. The study of suitable vegetable yogurt formulation

Four formulas of pumpkin yogurt, four formulas of carrot yogurt and four formulas of kale yogurt were evaluated by using 9-point hedonic scale method to evaluate the degree of magnitudes of like or dislike of the sample.

1.1 Pumpkin yogurt

Table 4: Sensory evaluation of pumpkin yogurt with varying pumpkin percentage

Formula	Appearance	Color	Pumpkin Flavor	Yogurt flavor	Sweetness	Odor	Texture	Overall
1. Pumpkin 20%	6.73^{a}	6.43^{a}	6.10^{a}	6.47^{b}	6.00^{a}	6.43^{a}	6.53^{a}	6.53^{a}
2. Pumpkin 30%	7.17^{ab}	6.90^{ab}	6.40^{a}	6.47^{b}	6.27^{a}	6.50^{a}	6.90^{a}	6.53^{a}
3. Pumpkin 40%	7.53^{b}	7.37^{b}	7.43^{b}	7.10^{c}	6.87^{b}	7.00^{b}	7.57^{b}	7.43^{b}
4. Pumpkin 50%	6.93^{a}	6.70^{a}	6.53^{a}	6.00^{a}	6.10^{a}	6.13^{a}	6.70^{a}	6.50^{a}

Note: The same letter means: There is no significant difference at 95% confidential level

From table 1, the sensory evaluation of pumpkin yogurt showed that the most preferable formula was formula 3 with 40% of pumpkin. It received the highest score in appearance, color, pumpkin flavor, yogurt flavor, sweetness, odor, texture and overall. There were significant different in pumpkin flavor, yogurt flavor, sweetness, odor, texture and overall. It indicated that varying amount of pumpkin meat affected those attributes of pumpkin yogurt.

However, the score value of formula 2 was accepted to be the same group in formula 3 as seen in Duncan table (table 6 and 9 in appendix). There were significant different in pumpkin

flavor, yogurt flavor, sweetness, odor, texture, overall, but no significant different in appearance and color. It indicated that formula 2 (30% of pumpkin) and formula 3 (40% of pumpkin) were not affected to panelists in appearance and color. They did not feel the change in appearance or color in formula 2 and formula 3.

1.2 Carrot yogurt

Table 5: Sensory evaluation of carrot yogurt with varying carrot percentage

Formula	Appearance	Color	Carrot Flavor	Yogurt flavor	Sweetness	Odor	Texture	Overall
1. Carrot 20%	6.67^{a}	6.83^{a}	6.50^{a}	6.57^{a}	6.00^{a}	6.10^{a}	6.47^{a}	6.60^{a}
2. Carrot 30%	7.73^{b}	7.83^{b}	7.70^{b}	7.60^{b}	7.10^{b}	7.10^{b}	7.60^{b}	7.70^{b}
3. Carrot 40%	6.90^{a}	7.10^{a}	6.73^{a}	6.27^{a}	6.17^{a}	6.17^{a}	6.53^{a}	6.60^{a}
4. Carrot 50%	6.67^{a}	6.73^{a}	6.67^{a}	6.27^{a}	6.00^{a}	6.20^{a}	6.60^{a}	6.37^{a}

Note: The same letter means: There is no significant difference at 95% confidential level

From table 2, the result of sensory evaluation in carrot percentage showed that the most preferable formula was formula 2 with 30% of carrot. It received the highest score in appearance, color, carrot flavor, yogurt flavor, sweetness, odor, texture and overall. There were significant differences in carrot flavor, yogurt flavor, sweetness, odor, texture and overall. It indicated that varying amount of carrot meat affected those attributes of carrot yogurt.

1.3 Kale yogurt

Table 6: Sensory evaluation of kale percentage varying in kale yogurt

Formula	Appearance	Color	Kale Flavor	Yogurt flavor	Sweetness	Odor	Texture	Overall
1. Kale 20%	5.53^{c}	5.50^{c}	5.03^{c}	5.13^{d}	4.70^{d}	4.83^{d}	4.93^{d}	5.07^{d}
2. Kale 30%	5.13^{c}	5.17^{c}	4.43^{b}	4.50^{c}	4.27^{c}	4.30^{c}	4.40^{c}	4.63^{c}
3. Kale 40%	4.40^{b}	4.47^{b}	4.07^{b}	4.03^{b}	3.87^{b}	3.87^{b}	3.83^{b}	3.93^{b}
4. Kale 50%	3.50^{a}	3.57^{a}	3.17^{a}	3.37^{a}	3.23^{a}	3.20^{a}	2.97^{a}	3.10^{a}

Note: The same letter means: There is no significant difference at 95% confidential level

From table 3, the sensory evaluation in kale percentage showed that the most preferable formula was formula 1 with 20% of kale. It received the highest score in appearance, color, kale flavor, yogurt flavor, sweetness, odor, texture and overall. There were significant differences in appearance, color, kale flavor, yogurt flavor, sweetness, odor, texture and overall. It indicated that varying amount of kale meat affected those attributes of kale yogurt.

From the result of sensory evaluation of kale yogurt, although formula 1 was the most preferable, the scores were very low compared to pumpkin yogurt and carrot yogurt. The overall score was approximately 5, this could be implied that panelists felt neither like nor dislike the product. Some panelists also commented on the product that kale did not go well with yogurt as it gave bitter taste and the texture was not smooth like pumpkin yogurt and carrot yogurt. Since kale is the green leafy vegetable which contains high amount of fiber, leading to the rough texture of the yogurt.

It could be concluded that kale was not suitable to make vegetable yogurt and most of the panelists did not accept kale yogurt.

2 The suitable amount of sugar in vegetable yogurt formula

From the previous experiment of 9-point hedonic evaluation, most of panelists commented on the sweetness of the yogurt that they would like it to be sweeter. Therefore, the sweetness of yogurt was varied in to three formulas, formula 1 with 6% of sugar, formula 2 with 8% of sugar and formula 3 with 10% of sugar.

From the first part of the experiment, pumpkin yogurt with 40% of pumpkin meat and carrot yogurt with 30% of carrot meat were chosen to be the most suitable formulas. However, kale yogurt was unaccepted from the panelists and it would not be included in this part of the experiment. In this part, varying formulas for sweetness were evaluated by using ranking preference method to evaluate the degree of magnitudes of preference of the samples.

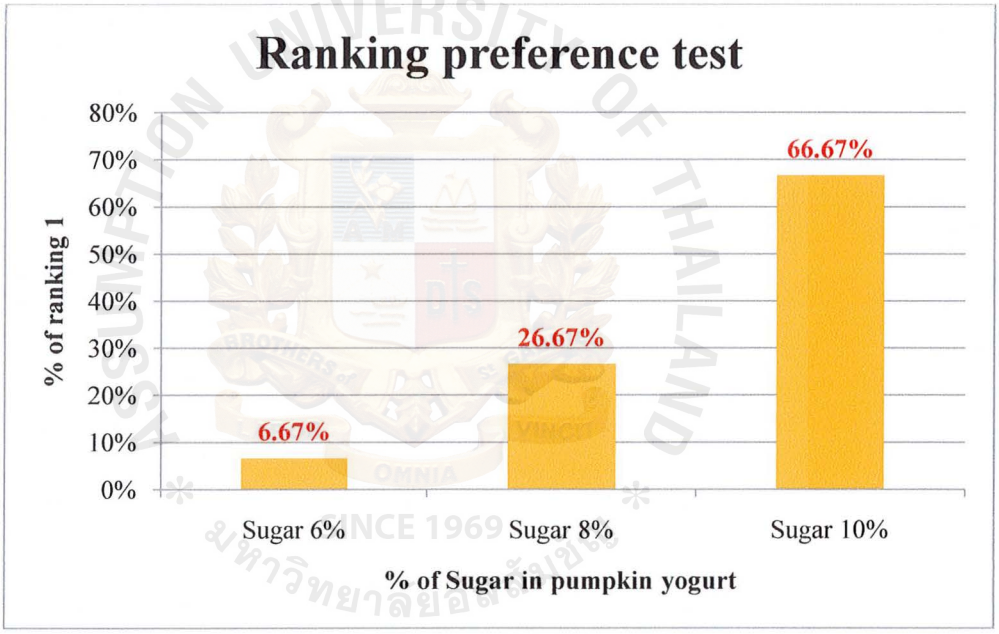


Figure 1: Ranking preference evaluation of sweetness in pumpkin yogurt

From figure 1, the ranking preference of varying sugar in pumpkin yogurt showed that most panelists ranked formula 3 with 10% of sugar highest or the most preference. There were 66.67% of panelists chose formula 3 with 10% of sugar as their most preference, 26.67% of panelists chose formula 2 with 8% of sugar as their most preference and only 6.67% of panelists chose formula 1 with 6% of sugar as their most preference. This indicated that most preference

formula was formula 3 with 10% of sugar in pumpkin yogurt, most panelists preferred the sweetest formula.

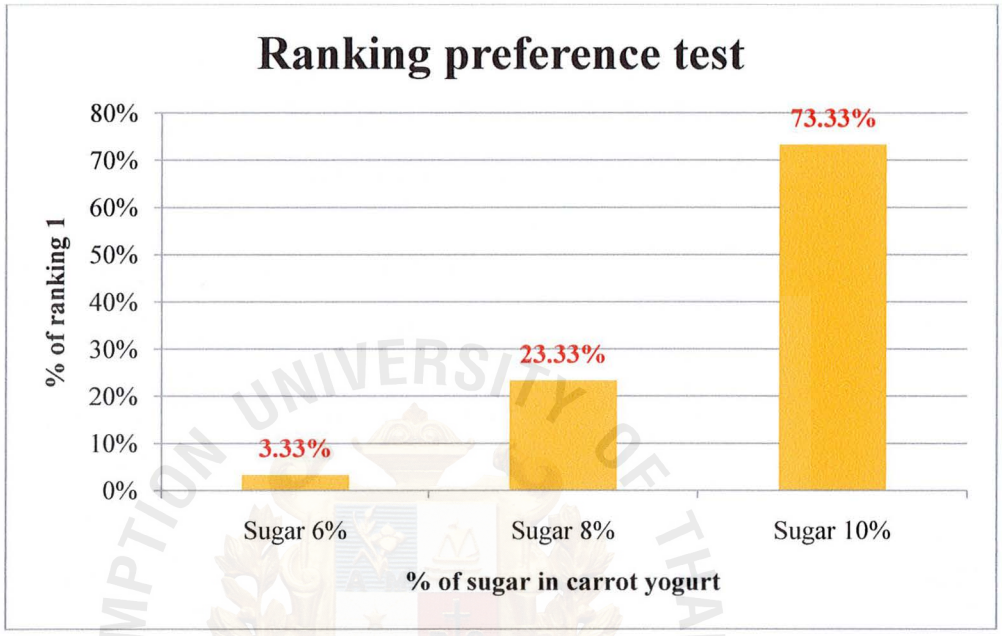


Figure 2: Ranking preference evaluation of sweetness in carrot yogurt

From figure 2, the ranking preference of varying sugar in carrot yogurt showed that most panelists ranked formula 3 with 10% of sugar highest or the most preference. There were 73.33% of panelists chose formula 3 with 10% of sugar as their most preference, 26.67% of panelists chose formula 2 with 8% of sugar as their most preference and only 6.67% of panelists chose formula 1 with 6% of sugar as their most preference. This indicated that most preference formula was formula 3 with 10% of sugar in carrot yogurt, most panelists preferred the sweetest formula.

3 The study of consumer acceptance in suitable formula

The study was conducted to determine consumer acceptance of vegetable yogurt; pumpkin yogurt and carrot yogurt, by using 100 panelists. The data was calculated into percentage.

From 100 panelists, there were 33% of male and 67% of female participated in this study.

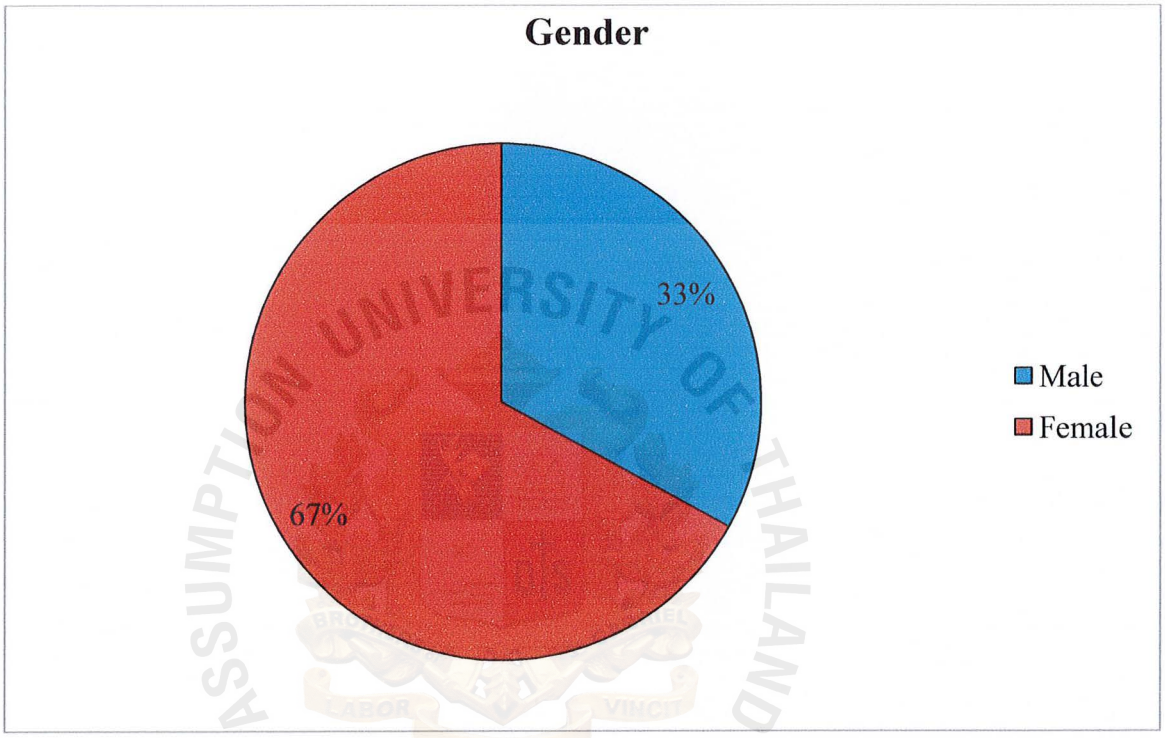


Figure 3: Pie chart showed frequency of gender

3.1 Pumpkin yogurt

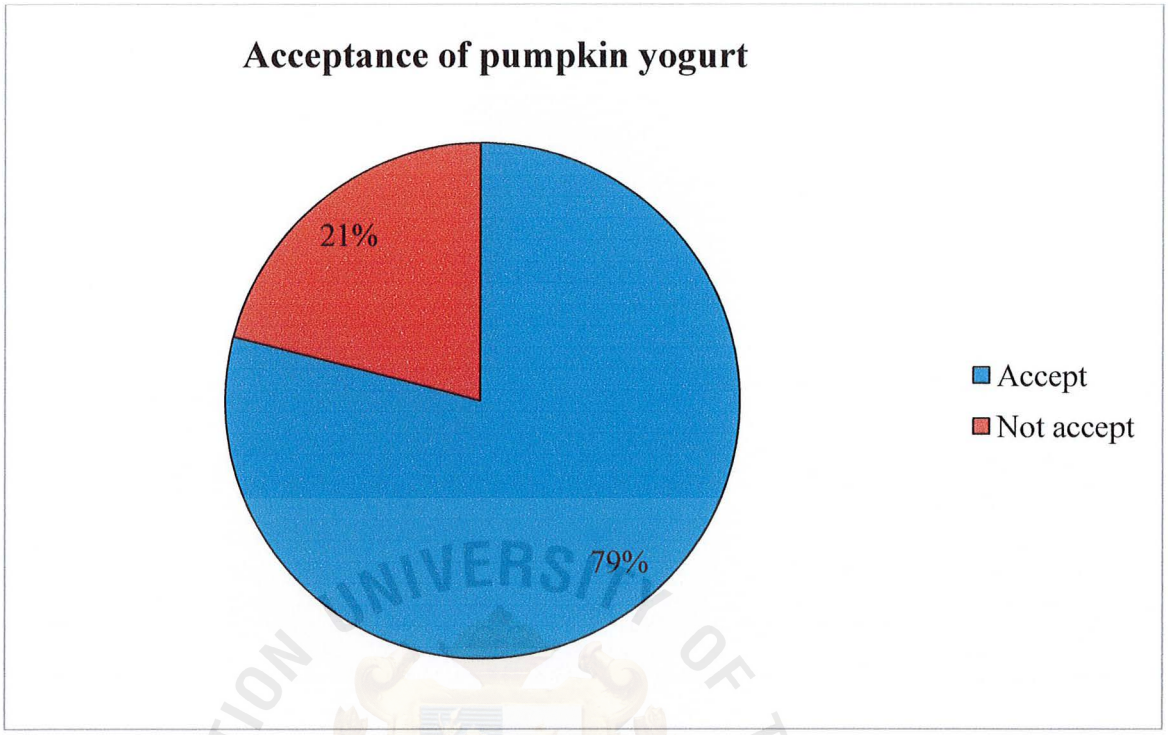


Figure 4: Pie chart showed frequency of acceptance of pumpkin yogurt

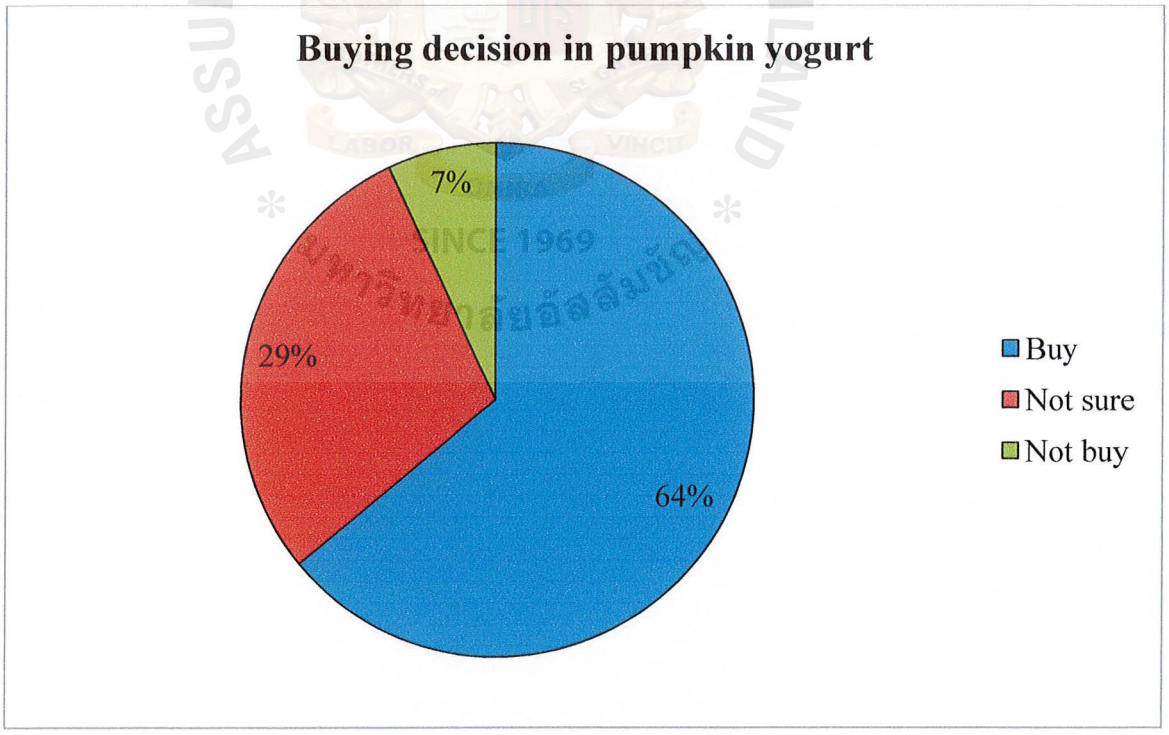


Figure 5: Pie chart showed frequency of buying decision in pumpkin yogurt

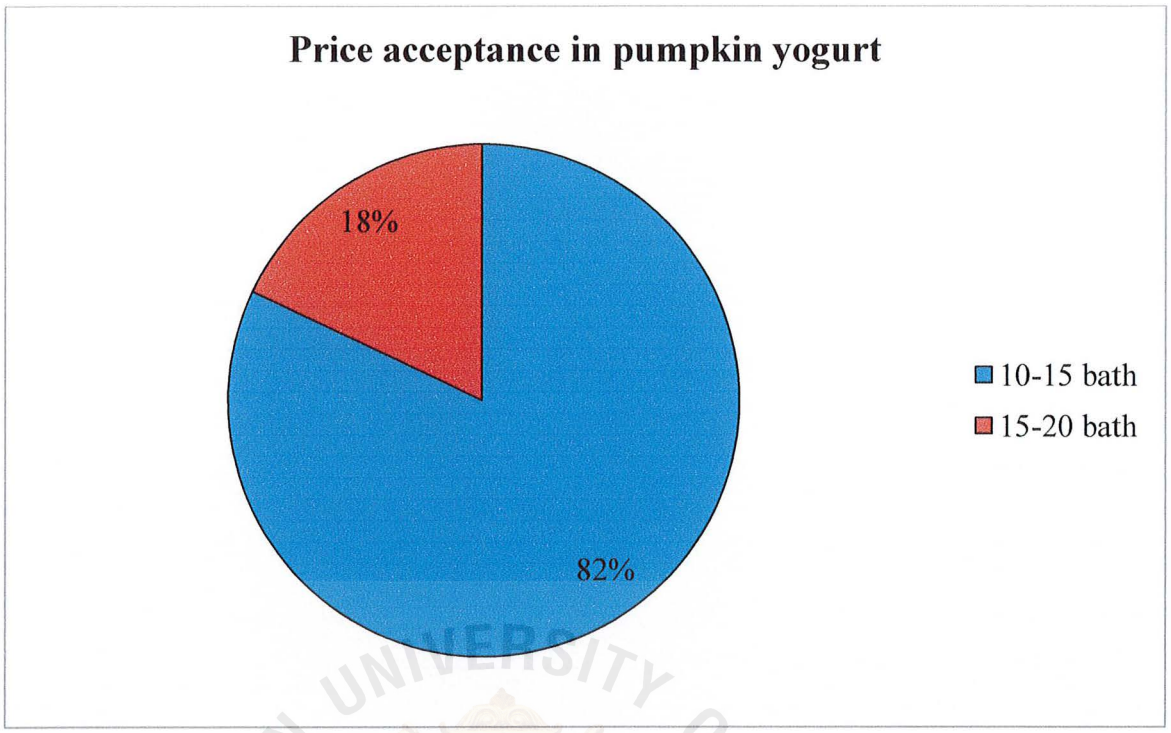


Figure 6: Pie chart showed frequency of price acceptance in pumpkin yogurt

From figure 4-6, there were 79% of consumers accepted the pumpkin yogurt. However, 21% of consumers did not accept the product. While 64% of consumers decided to buy the product if it was launched into the market, 29% of consumers were not sure that they would be willing to buy it or not and 7% of consumers decided not to buy the product. There were 82% of consumers accepted the price of product if it was set at the market price of 10-15 Bath per 1 cup containing 150 g (same as the normal yogurt sold in the market).

3.2 Carrot yogurt

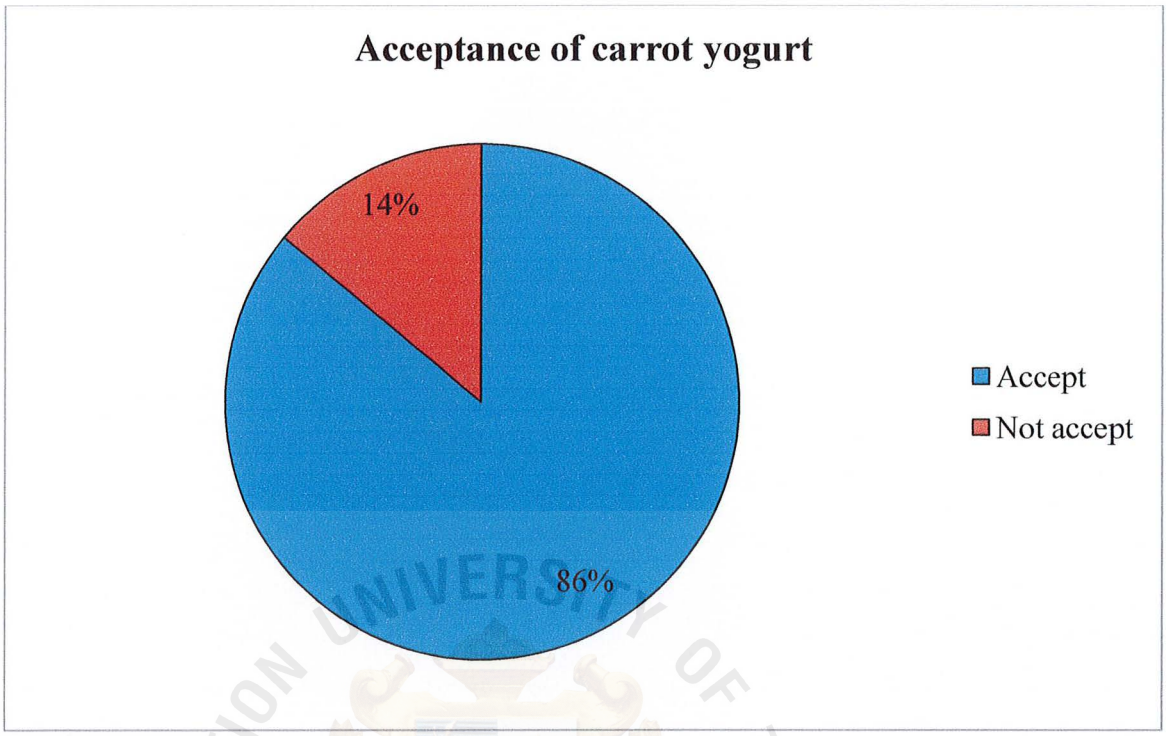


Figure 7: Pie chart showed frequency of acceptance of carrot yogurt

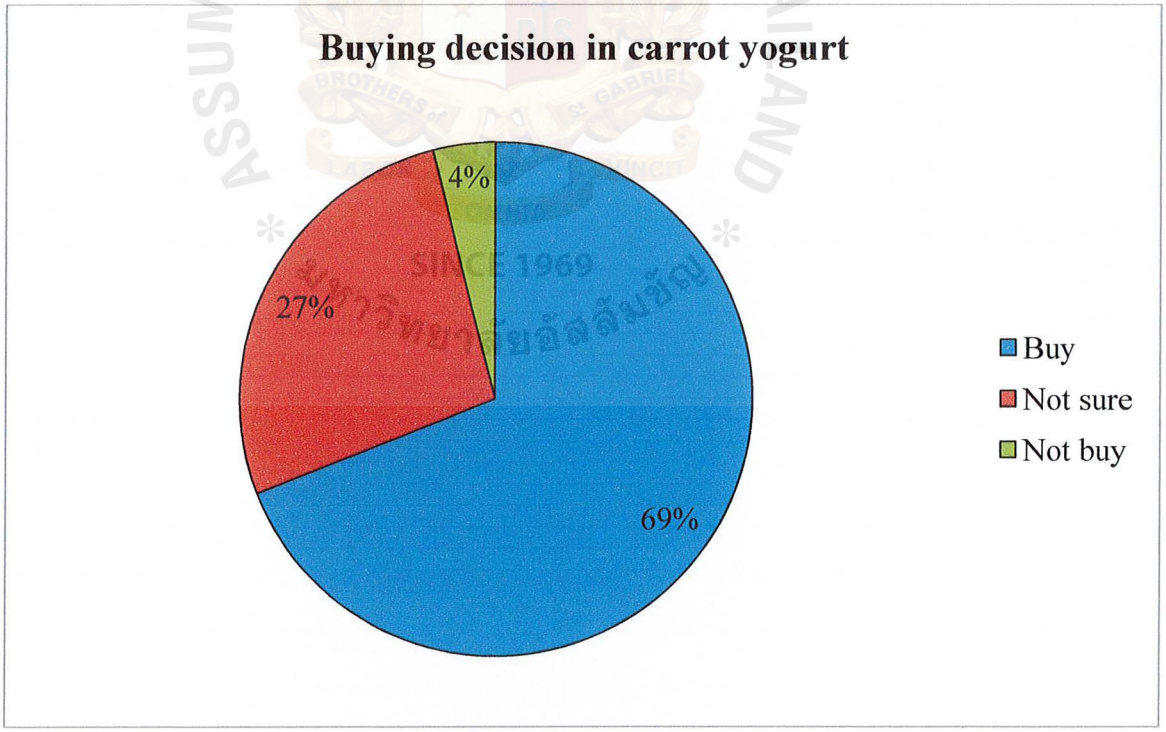


Figure 8: Pie chart showed frequency of buying decision in carrot yogurt

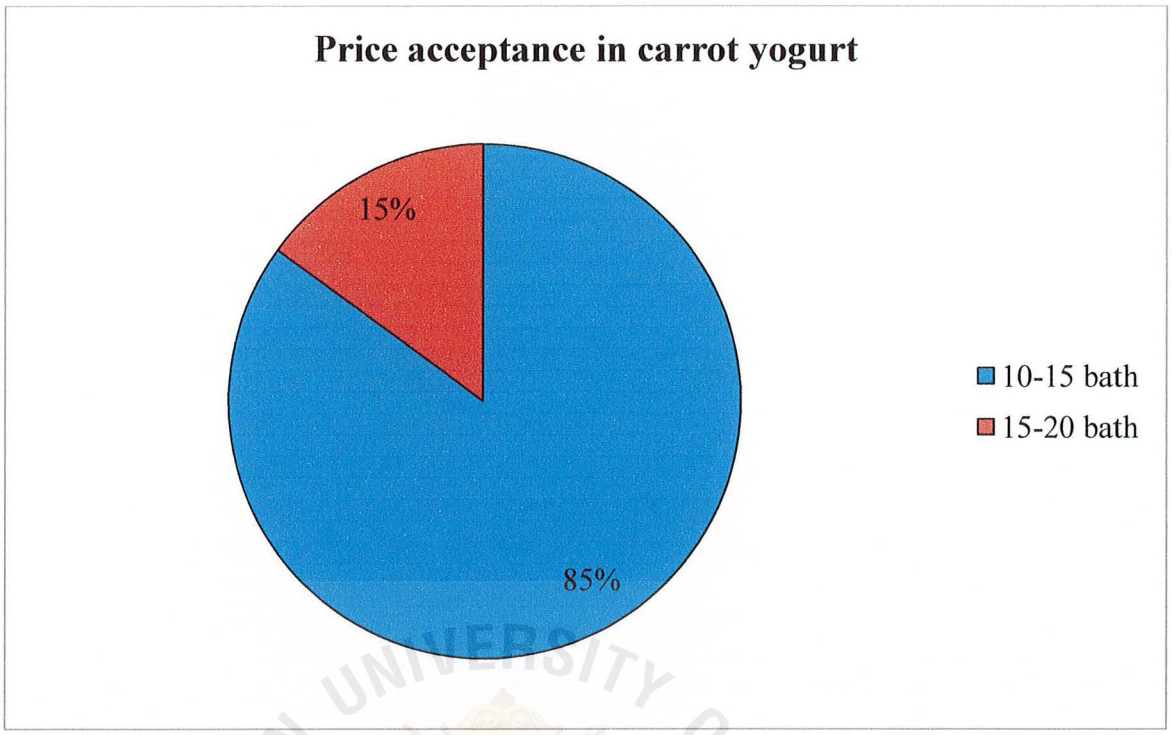


Figure 9: Pie chart showed frequency of price acceptance in carrot yogurt

From figure 7-9, there were 86% of consumers accepted the carrot yogurt. However, 14% of consumers did not accept the product. While 69% of consumers decided to buy the product if it was launched into the market, 27% of consumers were not sure that they would be willing to buy it or not and 4% of consumers decided not to buy the product. There were 85% of consumers accepted the price of product if it was set at the market price of 10-15 Bath per 1 cup containing 150 g (same as the normal yogurt sold in the market).

4. The analysis of vegetable yogurt

Table 7: Yogurt vegetable analysis

Type of yogurt	pH	LAB plate count (cfu/ml)
Plain yogurt (Dutchie brand)	4.3	4.9×10^7
Pumpkin yogurt	4.2	2.6×10^8
Carrot yogurt	4.2	1.74×10^8

Chapter 5

Conclusion

From the previous experiments, it can be seen that pumpkin and carrot were excellent raw materials used to substitute a portion of milk in vegetable yogurt. Not only pumpkin and carrot provided more nutrients, but also more variety to the consumers.

The results indicated that 40% of pumpkin meat substitution in yogurt was the most preferred formula among variations of pumpkin meat substitution with the highest score in every attribute. Furthermore, 30% of carrot meat substitution in yogurt was the most preferred formula among variations of carrot meat substitution with the highest score in every attribute.

In ranking preference test of sugar variation of vegetable yogurt, 10% of sugar in milk stock was the most ranking preference in both pumpkin yogurt and carrot yogurt.

Finally, the consumer acceptance test was carried out and the results showed that 79% of consumers accepted pumpkin yogurt and 86% of consumers accepted carrot yogurt. The consumers would be willing to buy both products at the price of 10-15 Baths for one cup of yogurt (150g).

In the further study of vegetable yogurt, other kind of vegetable might be use to produce vegetable yogurt, not only pumpkin or carrot and it would be more variety for consumers. Moreover the process of vegetable yogurt could be improved, such as addition of vegetable pieces into vegetable yogurt.

References

- Ali O. Kilic, 1 Sylvia I. Pavlova, Wen-Ge Ma, and Lin Tao1 1996, *Streptococcus thermophilus*, Available at http://en.wikipedia.org/wiki/Streptococcus_thermophilus
- Amber Kahl 2007, Yogurt production, Available at http://bioweb.uwlax.edu/bio203/s2007/kahl_ambe/yogurt_production.htm
- Balows, H.G.Truper, M. Dworkin, W. Harder, K.H.Schleifer, 1991, *Lactobacillus delbrueckii* subsp. *Bulgaricus*, Available at http://en.wikipedia.org/wiki/Lactobacillus_delbrueckii_subsp._bulgaricus
- Cornell University 2006, Yogurt production, Available at http://www.milkfacts.info/Milk%20Processing/Yogurt%20Production.htm
- George Mateljan, Founder, 2001-2010, Carrot, Available at http://www.whfoods.com/genpage.php?tname=foodspice&dbid=21
- George Mateljan, Founder, 2001-2010, Kale, Available at http://www.whfoods.com/genpage.php?tname=foodspice&dbid=38
- George Mateljan, Founder 2001-2010, Pumpkin, Available at http://www.whfoods.com/genpage.php?tname=foodspice&dbid=63
- Nida Jianteerangkool and Wasinee Bhudhikanok 2005, Vegetable yogurt flavor, Available at http://www.pharmacy.mahidol.ac.th/thai/research_special_abstract.php?num=26&year=2548
- Remo Zuccato 2005, Vegetable yogurt without milk, Available at http://www.freepatentsonline.com/6875455.pdf
- William and Martha Sears 2006, Yogurt benefit, Available at http://www.whfoods.com/genpage.php?tname=foodspice&dbid=124

Appendix

1. Questionnaire for 9-point Hedonic scale

9-point Hedonic scale test

Name _____ **Date** _____

Liking Preference Test

Product: Pumpkin yogurt/Carrot yogurt/Kale yogurt

Instruction: Please test and rate the sample on the tray for appearance, aroma, texture, flavor and overall impression. First look at the sample and then evaluate its appearance (record your evaluation). Second, taste the sample and evaluate its Odor, texture and flavor (record your evaluation). Third, taste the sample again and make an evaluation for each sample. You may taste the sample as many times as you need to. Rinse your mouth with water any time you would like to.

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		

Sample	Appearance	Color	Pumpkin flavor	Yogurt flavor	Sweetness	Odor	texture	Over all
950								
341								
428								
607								

Comment.....

---Thank you---

2. Questionnaire of ranking Preference test

Ranking preference test

Name_____ Date_____

Ranking preference test

Product: Pumpkin yogurt/Carrot yogurt

Instruction: Rank these samples according to your preference. The most preferred sample is ranked first, the second most preferred sample is ranked second, and the least preferred sample is ranked third. Please test the sample in the following order.

Taste Order	695	128	431
Preference Order			

3. Consumer acceptance

Consumer Acceptance

Title: This questionnaire is a part of senior project of Ms. Krittawan Krittanusorn, student of Biotechnology faculty, Assumption University. Please test this product and answer the questions. All of your information would be helpful for us. Thank you for your cooperation.

Instruction: Please fill √ in the space ( ) that match your opinion.

Part 1: Demographic Data

1. Gender

☐ Male ☐ Female

2. Age

☐ Lower than 20 years old ☐ 21-25 years old ☐ 26-30 years old

☐ 31-35 ears old ☐ 36-40 years old ☐ 40-45 years old

☐ More than 45 years old

3. Education

☐ Lower than high school student ☐ High school student

☐ Vocational school ☐ Bachelor degree

☐ Higher than Bachelor degree

4. Occupation

☐ Student ☐ Government officer

☐ Employee ☐ Other.....

5. Income

☐ Less than 5,000 baht ☐ 5,001-10,000 baht

☐ 10,001-15,000 baht ☐ 15,001-20,000 baht

☐ More than 20,000 baht

Part 2: Question about the product

6. Please test the product and fill √ into the space according to your opinion.

Product	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
Appearance									
Color									
Flavor									
Sweetness									
Odor									
Texture									
Overall									

Comment.....
.....
.....

7. Do you accept Pumpkin yogurt/carrot yogurt or not.

☐ Accept, because.....

☐ Not accept, because.....

8. What the price should be for one cup of Pumpkin yogurt/carrot yogurt containing 150g

☐ 10-15 bath ☐ 15-20 bath

9. Would you be willing to buy pumpkin yogurt/carrot yogurt if it is launched in the market?

☐ Yes, because.....

☐ Not sure, because.....

☐ No, because.....

---Thank you ---

4. Statistical Analysis

4.1 Pumpkin yogurt in pumpkin meat varying

4.1.1 Appearance

Table 8: Descriptive Statistics in Appearance

Dependent variable: appearance

Appearance

Pumpkin	Mean	N	Std. Deviation
20%	6.7333	30	1.20153
30%	7.1667	30	1.05318
40%	7.5333	30	.81931
50%	6.9333	30	.86834
Total	7.0917	120	1.02896

Table 9: Tests of Between-Subjects Effects in appearance

Dependent Variable: Appearance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	65.367[a]	32	2.043	2.931	.000
Intercept	6035.008	1	6035.008	8660.548	.000
trt	10.625	3	3.542	5.082	.003
rep	54.742	29	1.888	2.709	.000
Error	60.625	87	.697		
Total	6161.000	120			
Corrected Total	125.992	119			

a. R Squared = .519 (Adjusted R Squared = .342)

Table 10: Homogeneous subsets

Appearance

	Pumpkin	N	Subset 1	Subset 2
Duncan[a]	20%	30	6.7333	
	50%	30	6.9333	
	30%	30	7.1667	7.1667
	40%	30		7.5333
	Sig.		.060	.092

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .697.

a. Uses Harmonic Mean Sample Size = 30.000.

4.1.2 Color

Table 11: Descriptive Statistics in Color

Dependent variable: color

Color

Pumpkin	Mean	N	Std. Deviation
20%	6.4333	30	1.30472
30%	6.9000	30	1.02889
40%	7.3667	30	.92786
50%	6.7000	30	1.14921
Total	6.8500	120	1.14972

Table 12: Tests of Between-Subjects Effects in color

Dependent Variable: Color

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	64.767[a]	32	2.024	1.903	.010
Intercept	5630.700	1	5630.700	5293.994	.000
trt	13.967	3	4.656	4.377	.006
rep	50.800	29	1.752	1.647	.040
Error	92.533	87	1.064		
Total	5788.000	120			
Corrected Total	157.300	119			

a. R Squared = .412 (Adjusted R Squared = .195)

Table 13: Homogeneous subsets

Color

	Pumpkin	N	Subset 1	Subset 2
Duncan[a]	20%	30	6.4333	
	50%	30	6.7000	
	30%	30	6.9000	6.9000
	40%	30		7.3667
	Sig.		.101	.083

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = 1.064.

a. Uses Harmonic Mean Sample Size = 30.000

4.1.3 Pumpkin flavor

Table 14: Descriptive Statistics in Pumpkin flavor

Dependent variable: pumpkin flavor

Pumpkin flavor

Pumpkin	Mean	N	Std. Deviation
20%	6.1000	30	1.12495
30%	6.4000	30	1.13259
40%	7.4333	30	.97143
50%	6.5333	30	1.52527
Total	6.6167	120	1.29110

Table 15: Tests of Between-Subjects Effects in pumpkin flavor

Dependent Variable: Pumpkin flavor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	138.500[a]	32	4.328	6.290	.000
Intercept	5253.633	1	5253.633	7634.734	.000
trt	29.633	3	9.878	14.355	.000
rep	108.867	29	3.754	5.455	.000
Error	59.867	87	.688		
Total	5452.000	120			
Corrected Total	198.367	119			

a. R Squared = .698 (Adjusted R Squared = .587)

Table 16: Homogeneous subsets

Pumpkin flavor

	Pumpkin	N	Subset 1	Subset 2
Duncan[a]	20%	30	6.1000	
	30%	30	6.4000	
	50%	30	6.5333	
	40%	30		7.4333
	Sig.		.058	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .688.

a. Uses Harmonic Mean Sample Size = 30.000.

4.1.4 Yogurt flavor

Table 17: Descriptive Statistics in Yogurt flavor

Dependent variable: yogurt flavor

Yogurt flavor

Pumpkin	Mean	N	Std. Deviation
20%	6.4667	30	1.22428
30%	6.4667	30	1.10589
40%	7.1000	30	.95953
50%	6.0000	30	1.23176
Total	6.5083	120	1.18815

Table 18: Tests of Between-Subjects Effects in yogurt flavor

Dependent Variable: Yogurt flavor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	109.600[a]	32	3.425	5.103	.000
Intercept	5083.008	1	5083.008	7573.370	.000
trt	18.358	3	6.119	9.118	.000
rep	91.242	29	3.146	4.688	.000
Error	58.392	87	.671		
Total	5251.000	120			
Corrected Total	167.992	119			

a. R Squared = .652 (Adjusted R Squared = .525)

Table 19: Homogeneous subsets

Yogurt flavor

	Pumpkin	N	Subset 1	Subset 2	Subset 3
Duncan[a]	50%	30	6.0000		
	20%	30		6.4667	
	30%	30		6.4667	
	40%	30			7.1000
	Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .671.

4.1.5 Sweetness

Table 20: Descriptive Statistics in Sweetness

Dependent variable: sweetness

Sweetness

Pumpkin	Mean	N	Std. Deviation
20%	6.0000	30	1.41421
30%	6.2667	30	1.22990
40%	6.8667	30	1.33218
50%	6.1000	30	1.34805
Total	6.3083	120	1.35842

Table 21: Tests of Between-Subjects Effects in yogurt flavor

Dependent Variable: Sweetness

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	160.900[a]	32	5.028	7.453	.000
Intercept	4775.408	1	4775.408	7078.697	.000
trt	13.558	3	4.519	6.699	.000
rep	147.342	29	5.081	7.531	.000
Error	58.692	87	.675		
Total	4995.000	120			
Corrected Total	219.592	119			

a. R Squared = .733 (Adjusted R Squared = .634)

Table 22: Homogeneous subsets

Sweetness

	Pumpkin	N	Subset 1	Subset 2
Duncan[a]	20%	30	6.0000	
	50%	30	6.1000	
	30%	30	6.2667	
	40%	30		6.8667
	Sig.		.240	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .675.

a. Uses Harmonic Mean Sample Size = 30.000.

4.1.6 Odor

Table 23: Descriptive Statistics in Odor

Dependent variable: odor

Odor

Pumpkin	Mean	N	Std. Deviation
20%	6.4333	30	1.04000
30%	6.5000	30	.97379
40%	7.0000	30	1.31306
50%	6.1333	30	1.10589
Total	6.5167	120	1.14483

Table 24: Tests of Between-Subjects Effects in odor

Dependent Variable: Odor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	99.100[a]	32	3.097	4.738	.000
Intercept	5096.033	1	5096.033	7796.393	.000
trt	11.633	3	3.878	5.933	.001
rep	87.467	29	3.016	4.614	.000
Error	56.867	87	.654		
Total	5252.000	120			
Corrected Total	155.967	119			

a. R Squared = .635 (Adjusted R Squared = .501)

Table 25: Homogeneous subsets

Odor

	Pumpkin	N	Subset 1	Subset 2
Duncan[a]	50%	30	6.1333	
	20%	30	6.4333	
	30%	30	6.5000	
	40%	30		7.0000
	Sig.		.100	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .654.

a. Uses Harmonic Mean Sample Size = 30.000.

4.1.7 Texture

Table 26: Descriptive Statistics in Texture

Dependent variable: texture

Texture

Pumpkin	Mean	N	Std. Deviation
20%	6.5333	30	1.16658
30%	6.9000	30	.99481
40%	7.5667	30	.97143
50%	6.7000	30	.91539
Total	6.9250	120	1.07814

Table 27: Tests of Between-Subjects Effects in texture

Dependent Variable: Texture

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	73.067[a]	32	2.283	3.044	.000
Intercept	5754.675	1	5754.675	7671.920	.000
trt	18.492	3	6.164	8.217	.000
rep	54.575	29	1.882	2.509	.001
Error	65.258	87	.750		
Total	5893.000	120			
Corrected Total	138.325	119			

a. R Squared = .528 (Adjusted R Squared = .355)

Table 28: Homogeneous subsets

Texture

	Pumpkin	N	Subset 1	Subset 2
Duncan[a]	20%	30	6.5333	
	50%	30	6.7000	
	30%	30	6.9000	
	40%	30		7.5667
	Sig.		.125	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .750.
a. Uses Harmonic Mean Sample Size = 30.000.

4.1.8 Overall

Table 29: Descriptive Statistics in Overall

Dependent variable: overall

Overall

Pumpkin	Mean	N	Std. Deviation
20%	6.5333	30	.89955
30%	6.5333	30	.81931
40%	7.4333	30	.93526
50%	6.5000	30	.82001
Total	6.7500	120	.94602

Table 30: Tests of Between-Subjects Effects in overall

Dependent Variable: Overall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	61.200[a]	32	1.912	3.673	.000
Intercept	5467.500	1	5467.500	10500.497	.000
trt	18.700	3	6.233	11.971	.000
rep	42.500	29	1.466	2.815	.000
Error	45.300	87	.521		
Total	5574.000	120			
Corrected Total	106.500	119			

a. R Squared = .575 (Adjusted R Squared = .418)

Table 31: Homogeneous subsets

Overall

	Pumpkin	N	Subset 1	Subset 2
Duncan[a]	50%	30	6.5000	
	20%	30	6.5333	
	30%	30	6.5333	
	40%	30		7.4333
	Sig.		.868	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .521.
a. Uses Harmonic Mean Sample Size = 30.000.

4.2 Carrot yogurt in carrot meat varying

4.2.1 Appearance

Table 32: Descriptive Statistics in Appearance

Dependent variable: appearance

Appearance

Carrot	Mean	N	Std. Deviation
20%	6.6667	30	1.37297
30%	7.7333	30	.78492
40%	6.9000	30	1.18467
50%	6.6667	30	1.15470
Total	6.9917	120	1.21265

Table 33: Tests of Between-Subjects Effects in appearance

Dependent Variable: Appearance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	117.333[a]	32	3.667	5.533	.000
Intercept	5866.008	1	5866.008	8851.153	.000
trt	23.092	3	7.697	11.614	.000
rep	94.242	29	3.250	4.903	.000
Error	57.658	87	.663		
Total	6041.000	120			
Corrected Total	174.992	119			

a. R Squared = .671 (Adjusted R Squared = .549)

Table 34: Homogeneous subsets

Appearance

	Carrot	N	Subset 1	Subset 2
Duncan[a]	20%	30	6.6667	
	50%	30	6.6667	
	40%	30	6.9000	
	30%	30		7.7333
	Sig.		.300	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .663.
a. Uses Harmonic Mean Sample Size = 30.000.

4.2.2 Color

Table 35: Descriptive Statistics in Color

Dependent variable: Color

Color

Carrot	Mean	N	Std. Deviation
20%	6.8333	30	1.23409
30%	7.8333	30	1.01992
40%	7.1000	30	1.29588
50%	6.7333	30	1.38796
Total	7.1250	120	1.30005

Table 36: Tests of Between-Subjects Effects in color

Dependent Variable :Color

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	137.600[a]	32	4.300	5.889	.000
Intercept	6091.875	1	6091.875	8343.064	.000
trt	22.225	3	7.408	10.146	.000
rep	115.375	29	3.978	5.449	.000
Error	63.525	87	.730		
Total	6293.000	120			
Corrected Total	201.125	119			

a. R Squared = .684 (Adjusted R Squared = .568)

Table 37: Homogeneous subsets

Color

	Carrot	N	Subset 1	Subset 2
Duncan[a]	50%	30	6.7333	
	20%	30	6.8333	
	40%	30	7.1000	
	30%	30		7.8333
	Sig.		.120	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .730.

a. Uses Harmonic Mean Sample Size = 30.000.

4.2.3 Carrot flavor

Table 38: Descriptive Statistics in Carrot flavor

Dependent variable: Carrot flavor

Carrot flavor

Carrot	Mean	N	Std. Deviation
20%	6.5000	30	1.22474
30%	7.7000	30	.59596
40%	6.7333	30	1.28475
50%	6.6667	30	1.44636
Total	6.9000	120	1.25959

Table 39: Tests of Between-Subjects Effects in carrot flavor

Dependent Variable: Carrot flavor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	118.767[a]	32	3.711	4.611	.000
Intercept	5713.200	1	5713.200	7097.312	.000
trt	26.467	3	8.822	10.960	.000
rep	92.300	29	3.183	3.954	.000
Error	70.033	87	.805		
Total	5902.000	120			
Corrected Total	188.800	119			

a. R Squared = .629 (Adjusted R Squared = .493)

Table 40: Homogeneous subsets

Carrot flavor

	Carrot	N	Subset 1	Subset 2
Duncan[a]	20%	30	6.5000	
	50%	30	6.6667	
	40%	30	6.7333	
	30%	30		7.7000
	Sig.		.348	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .805.

a. Uses Harmonic Mean Sample Size = 30.000.

4.2.4 Yogurt flavor

Table 41: Descriptive Statistics in Yogurt flavor

Dependent variable: Yogurt flavor

Yogurt flavor

Carrot	Mean	N	Std. Deviation
20%	6.5667	30	1.30472
30%	7.6000	30	.67466
40%	6.2667	30	1.31131
50%	6.2667	30	1.38796
Total	6.6750	120	1.31035

Table 42: Tests of Between-Subjects Effects in yogurt flavor

Dependent Variable: Yogurt flavor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	123.100[a]	32	3.847	4.120	.000
Intercept	5346.675	1	5346.675	5726.817	.000
trt	36.025	3	12.008	12.862	.000
rep	87.075	29	3.003	3.216	.000
Error	81.225	87	.934		
Total	5551.000	120			
Corrected Total	204.325	119			

a. R Squared = .602 (Adjusted R Squared = .456)

Table 43: Homogeneous subsets

Yogurt flavor

	Carrot	N	Subset 1	Subset 2
Duncan[a]	50%	30	6.2667	
	40%	30	6.2667	
	20%	30	6.5667	
	30%	30		7.6000
	Sig.		.262	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .934.

a. Uses Harmonic Mean Sample Size = 30.000.

4.2.5 Sweetness

Table 44: Descriptive Statistics in Sweetness

Dependent variable: Sweetness

Sweetness

Carrot	Mean	N	Std. Deviation
20%	6.0000	30	1.38962
30%	7.1000	30	1.32222
40%	6.1667	30	1.44039
50%	6.0000	30	1.36458
Total	6.3167	120	1.43769

Table 45: Tests of Between-Subjects Effects in sweetness

Dependent Variable: Sweetness

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	196.567[a]	32	6.143	10.818	.000
Intercept	4788.033	1	4788.033	8432.366	.000
trt	25.100	3	8.367	14.735	.000
rep	171.467	29	5.913	10.413	.000
Error	49.400	87	.568		
Total	5034.000	120			
Corrected Total	245.967	119			

a. R Squared = .799 (Adjusted R Squared = .725)

Table 46: Homogeneous subsets

Sweetness

	Carrot	N	Subset 1	Subset 2
Duncan[a]	20%	30	6.0000	
	50%	30	6.0000	
	40%	30	6.1667	
	30%	30		7.1000
	Sig.		.425	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .568.

a. Uses Harmonic Mean Sample Size = 30.000.

4.2.6 Odor

Table 47: Descriptive Statistics in Odor

Dependent variable: Odor

Odor

Carrot	Mean	N	Std. Deviation
20%	6.1000	30	1.18467
30%	7.1000	30	1.24152
40%	6.1667	30	1.28877
50%	6.2000	30	1.27035
Total	6.3917	120	1.29832

Table 48: Tests of Between-Subjects Effects in odor

Dependent Variable: Odor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	142.567[a]	32	4.455	6.680	.000
Intercept	4902.408	1	4902.408	7350.444	.000
trt	20.225	3	6.742	10.108	.000
rep	122.342	29	4.219	6.325	.000
Error	58.025	87	.667		
Total	5103.000	120			
Corrected Total	200.592	119			

a. R Squared = .711 (Adjusted R Squared = .604)

Table 49: Homogeneous subsets

Odor

	Carrot	N	Subset 1	Subset 2
Duncan[a]	20%	30	6.1000	
	40%	30	6.1667	
	50%	30	6.2000	
	30%	30		7.1000
	Sig.		.659	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .667.

a. Uses Harmonic Mean Sample Size = 30.000.

4.2.7 Texture

Table 50: Descriptive Statistics in Texture

Dependent variable: Texture

Texture

Carrot	Mean	N	Std. Deviation
20%	6.4667	30	1.22428
30%	7.6000	30	.81368
40%	6.5333	30	1.07425
50%	6.6000	30	1.24845
Total	6.8000	120	1.18534

Table 51: Tests of Between-Subjects Effects in texture

Dependent Variable: Texture

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	81.067[a]	32	2.533	2.559	.000
Intercept	5548.800	1	5548.800	5604.632	.000
trt	25.867	3	8.622	8.709	.000
rep	55.200	29	1.903	1.923	.011
Error	86.133	87	.990		
Total	5716.000	120			
Corrected Total	167.200	119			

a. R Squared = .485 (Adjusted R Squared = .295)

Table 52: Homogeneous subsets

Texture

	Carrot	N	Subset 1	Subset 2
Duncan[a]	20%	30	6.4667	
	40%	30	6.5333	
	50%	30	6.6000	
	30%	30		7.6000
	Sig.		.629	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .990.

a. Uses Harmonic Mean Sample Size = 30.000.

4.2.8 Overall

Table 53: Descriptive Statistics in Overall

Dependent variable: Overall

Overall

Carrot	Mean	N	Std. Deviation
20%	6.6000	30	.85501
30%	7.7000	30	.74971
40%	6.6000	30	.85501
50%	6.3667	30	.96431
Total	6.8167	120	.99565

Table 54: Tests of Between-Subjects Effects in overall

Dependent Variable: Overall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	69.767[a]	32	2.180	3.935	.000
Intercept	5576.033	1	5576.033	10064.624	.000
trt	32.300	3	10.767	19.434	.000
rep	37.467	29	1.292	2.332	.001
Error	48.200	87	.554		
Total	5694.000	120			
Corrected Total	117.967	119			

a. R Squared = .591 (Adjusted R Squared = .441)

Table 55: Homogeneous subsets

Overall

	Carrot	N	Subset 1	Subset 2
Duncan[a]	50%	30	6.3667	
	20%	30	6.6000	
	40%	30	6.6000	
	30%	30		7.7000
	Sig.		.257	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .554.

a. Uses Harmonic Mean Sample Size = 30.000.

4.3 Kale yogurt in kale meat varying

4.3.1 Appearance

Table 56: Descriptive Statistics in Appearance

Dependent variable: appearance

Appearance

Kale	Mean	N	Std. Deviation
20%	5.5333	30	1.65536
30%	5.1333	30	1.75643
40%	4.4000	30	1.95818
50%	3.5000	30	2.23992
Total	4.6417	120	2.04486

Table 57: Tests of Between-Subjects Effects in appearance

Dependent Variable: Appearance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	443.800[a]	32	13.869	22.431	.000
Intercept	2585.408	1	2585.408	4181.512	.000
trt	71.958	3	23.986	38.794	.000
rep	371.842	29	12.822	20.738	.000
Error	53.792	87	.618		
Total	3083.000	120			
Corrected Total	497.592	119			

a. R Squared = .892 (Adjusted R Squared = .852)

Table 58: Homogeneous subsets

Appearance

	Kale	N	Subset		
			1	2	3
Duncan[a]	50%	30	3.5000		
	40%	30		4.4000	
	30%	30			5.1333
	20%	30			5.5333
	Sig.		1.000	1.000	.052

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .618.

a. Uses Harmonic Mean Sample Size = 30.000.

4.3.2 Color

Table 59: Descriptive Statistics in Color

Dependent variable: Color

Color

Kale	Mean	N	Std. Deviation
20%	5.5000	30	1.79559
30%	5.1667	30	1.85850
40%	4.4667	30	2.09652
50%	3.5667	30	2.35889
Total	4.6750	120	2.14657

Table 60: Tests of Between-Subjects Effects in color

Dependent Variable: Color

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	470.900[a]	32	14.716	16.535	.000
Intercept	2622.675	1	2622.675	2947.016	.000
trt	65.825	3	21.942	24.655	.000
rep	405.075	29	13.968	15.696	.000
Error	77.425	87	.890		
Total	3171.000	120			
Corrected Total	548.325	119			

a. R Squared = .859 (Adjusted R Squared = .807)

Table 61: Homogeneous subsets

Color

	Kale	N	Subset 1	Subset 2	Subset 3
Duncan[a]	50%	30	3.5667		
	40%	30		4.4667	
	30%	30			5.1667
	20%	30			5.5000
	Sig.		1.000	1.000	.175

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .890.

a. Uses Harmonic Mean Sample Size = 30.000.

4.3.3 Kale flavor

Table 62: Descriptive Statistics in Kale flavor

Dependent variable: Kale flavor

Kale flavor

Kale	Mean	N	Std. Deviation
20%	5.0333	30	1.88430
30%	4.4333	30	1.77499
40%	4.0667	30	2.06670
50%	3.1667	30	2.08580
Total	4.1750	120	2.04842

Table 63: Tests of Between-Subjects Effects in kale flavor

Dependent Variable: Kale flavor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	430.033[a]	32	13.439	16.873	.000
Intercept	2091.675	1	2091.675	2626.228	.000
trt	54.958	3	18.319	23.001	.000
rep	375.075	29	12.934	16.239	.000
Error	69.292	87	.796		
Total	2591.000	120			
Corrected Total	499.325	119			

a. R Squared = .861 (Adjusted R Squared = .810)

Table 64: Homogeneous subsets

Kale flavor

	Kale	N	Subset 1	Subset 2	Subset 3
Duncan[a]	50%	30	3.1667		
	40%	30		4.0667	
	30%	30		4.4333	
	20%	30			5.0333
	Sig.		1.000	.115	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .796.

a. Uses Harmonic Mean Sample Size = 30.000.

4.3.4 Yogurt flavor

Table 65: Descriptive Statistics in Yogurt flavor

Dependent variable: Yogurt flavor

Yogurt flavor

Kale	Mean	N	Std. Deviation
20%	5.1333	30	1.85199
30%	4.5000	30	1.67641
40%	4.0333	30	1.99107
50%	3.3667	30	2.09241
Total	4.2583	120	1.99367

Table 66: Tests of Between-Subjects Effects in yogurt flavor

Dependent Variable: Yogurt flavor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	422.833[a]	32	13.214	22.919	.000
Intercept	2176.008	1	2176.008	3774.303	.000
trt	50.092	3	16.697	28.961	.000
rep	372.742	29	12.853	22.294	.000
Error	50.158	87	.577		
Total	2649.000	120			
Corrected Total	472.992	119			

a. R Squared = .894 (Adjusted R Squared = .855)

Table 67: Homogeneous subsets

Yogurt flavor

	Kale	N	Subset 1	2	3	4
Duncan[a]	50%	30	3.3667			
	40%	30		4.0333		
	30%	30			4.5000	
	20%	30				5.1333
	Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .577.

a. Uses Harmonic Mean Sample Size = 30.000.

4.3.5 Sweetness

Table 68: Descriptive Statistics in Sweetness

Dependent variable: Sweetness

Sweetness

Kale	Mean	N	Std. Deviation
20%	4.7000	30	1.87819
30%	4.2667	30	1.70057
40%	3.8667	30	2.01260
50%	3.2333	30	1.95965
Total	4.0167	120	1.94454

Table 69: Tests of Between-Subjects Effects in sweetness

Dependent Variable: Sweetness

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	405.433[a]	32	12.670	24.752	.000
Intercept	1936.033	1	1936.033	3782.221	.000
trt	34.967	3	11.656	22.770	.000
rep	370.467	29	12.775	24.957	.000
Error	44.533	87	.512		
Total	2386.000	120			
Corrected Total	449.967	119			

a. R Squared = .901 (Adjusted R Squared = .865)

Table 70: Homogeneous subsets

Sweetness

	Kale	N	Subset 1	2	3	4
Duncan[a]	50%	30	3.2333			
	40%	30		3.8667		
	30%	30			4.2667	
	20%	30				4.7000
	Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .512.

a. Uses Harmonic Mean Sample Size = 30.000.

4.3.6 Odor

Table 71: Descriptive Statistics in Odor

Dependent variable: Odor

Odor

Kale	Mean	N	Std. Deviation
20%	4.8333	30	1.83985
30%	4.3000	30	1.98529
40%	3.8667	30	2.22421
50%	3.2000	30	2.10746
Total	4.0500	120	2.10581

Table 72: Tests of Between-Subjects Effects in odor

Dependent Variable: Odor

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	479.667[a]	32	14.990	27.150	.000
Intercept	1968.300	1	1968.300	3565.068	.000
trt	42.967	3	14.322	25.941	.000
rep	436.700	29	15.059	27.275	.000
Error	48.033	87	.552		
Total	2496.000	120			
Corrected Total	527.700	119			

a. R Squared = .909 (Adjusted R Squared = .875)

Table 73: Homogeneous subsets

Odor

	Kale	N	Subset 1	Subset 2	Subset 3	Subset 4
Duncan[a]	50%	30	3.2000			
	40%	30		3.8667		
	30%	30			4.3000	
	20%	30				4.8333
	Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .552.

a. Uses Harmonic Mean Sample Size = 30.000.

4.3.7 Texture

Table 74: Descriptive Statistics in Texture

Dependent variable: Texture

Texture

Kale	Mean	N	Std. Deviation
20%	4.9333	30	1.83704
30%	4.4000	30	1.92264
40%	3.8333	30	2.03560
50%	2.9667	30	1.86591
Total	4.0333	120	2.02892

Table 75: Tests of Between-Subjects Effects in Texture

Dependent Variable: Texture

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	435.033[a]	32	13.595	21.570	.000
Intercept	1952.133	1	1952.133	3097.306	.000
trt	63.667	3	21.222	33.672	.000
rep	371.367	29	12.806	20.318	.000
Error	54.833	87	.630		
Total	2442.000	120			
Corrected Total	489.867	119			

a. R Squared = .888 (Adjusted R Squared = .847)

Table 76: Homogeneous subsets

Texture

	Kale	N	Subset 1	2	3	4
Duncan[a]	50%	30	2.9667			
	40%	30		3.8333		
	30%	30			4.4000	
	20%	30				4.9333
	Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .630.

4.3.8 Overall

Table 77: Descriptive Statistics in Overall

Dependent variable: Overall

Overall

Kale	Mean	N	Std. Deviation
20%	5.0667	30	1.87420
30%	4.6333	30	1.84733
40%	3.9333	30	1.99885
50%	3.1000	30	2.00603
Total	4.1833	120	2.04973

Table 78: Tests of Between-Subjects Effects in overall

Dependent Variable: Overall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	442.533[a]	32	13.829	20.948	.000
Intercept	2100.033	1	2100.033	3181.130	.000
trt	66.567	3	22.189	33.612	.000
rep	375.967	29	12.964	19.638	.000
Error	57.433	87	.660		
Total	2600.000	120			
Corrected Total	499.967	119			

a. R Squared = .885 (Adjusted R Squared = .843)

Table 79: Homogeneous subsets

Overall

	Kale	N	Subset 1	2	3	4
Duncan[a]	50%	30	3.1000			
	40%	30		3.9333		
	30%	30			4.6333	
	20%	30				5.0667
	Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = .660.

a. Uses Harmonic Mean Sample Size = 30.000.

4.4 Consumer Acceptance

Table 80: Frequency of gender

Gender	Frequency	Percentage	Valid percentage	Cumulative percentage
Male	33	33.0	33.0	33.0
Female	67	67.0	67.0	100.0
Total	100	100.0	100.0	

Table 81: Frequency of age

Age	Frequency	Percentage	Valid percentage	Cumulative percentage
Less than 20 years	27	27.0	27.0	27.0
21-25 years	32	32.0	32.0	59.0
26-30 years	25	25.0	25.0	84.0
31-35 years	8	8.0	8.0	92.0
41-45 years	4	4.0	4.0	96.0
More than 45 years	4	4.0	4.0	100.0
Total	100	100.0	100.0	

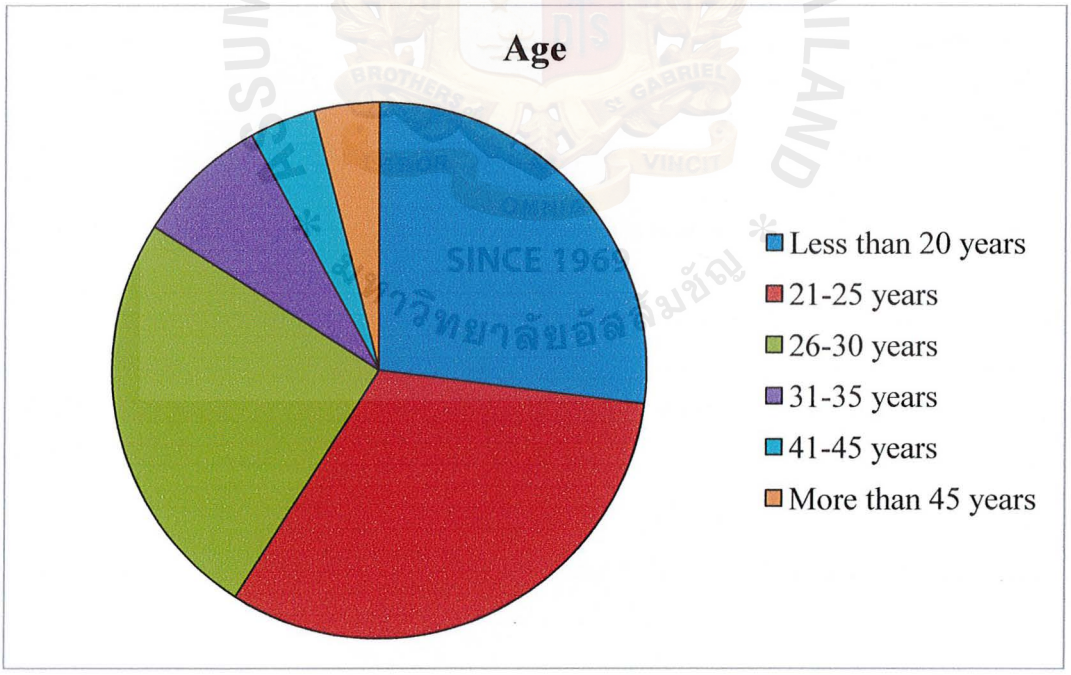


Figure 10: Pie chart showed frequency of age

Table82: frequency of education

Education	Frequency	Percentage	Valid percentage	Cumulative percentage
Lower high school	5	5.0	5.0	5.0
High school	19	19.0	19.0	24.0
Vocational school	2	2.0	2.0	26.0
Undergraduate	53	53.0	53.0	79.0
Graduate or higher	21	21.0	21.0	100.0
Total	100	100.0	100.0	

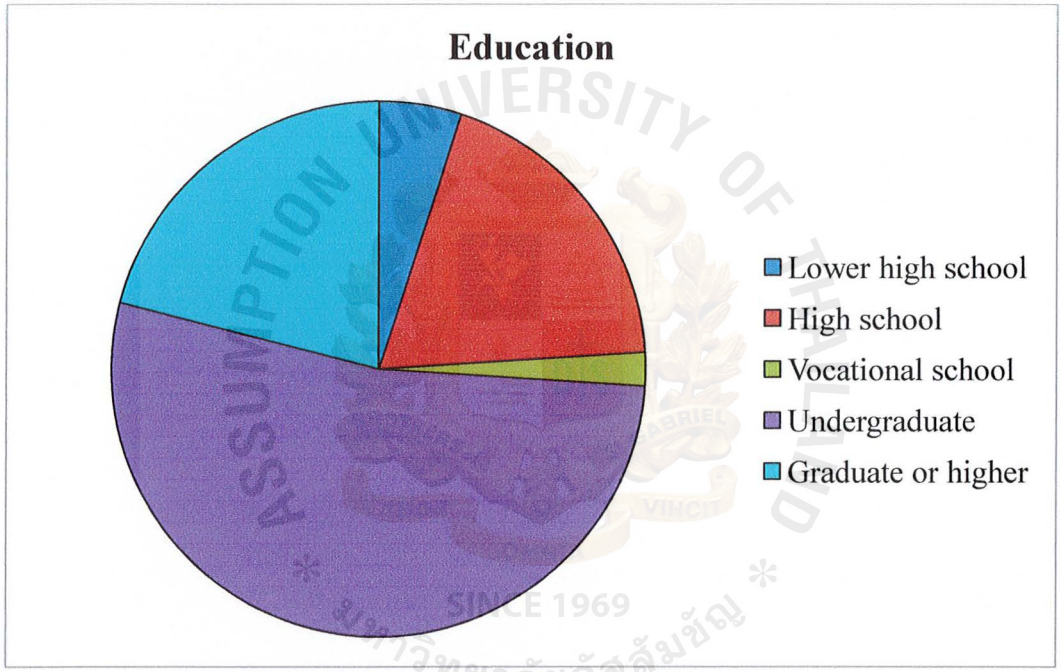


Figure 11: Pie chart showed frequency of education

Table 83: Frequency of occupation

Occupation	Frequency	Percentage	Valid percentage	Cumulative percentage
Student	77	77.0	77.0	77.0
Government officer	2	2.0	2.0	79.0
Employee	19	19.0	19.0	98.0
Other	2	2.0	2.0	100.0
Total	100	100.0	100.0	

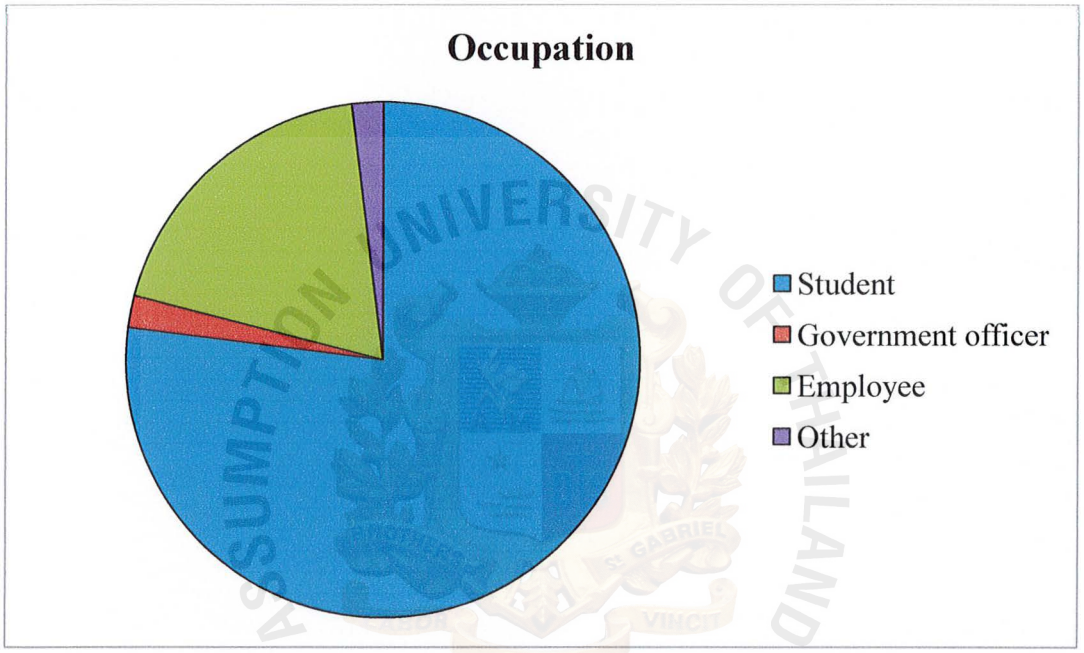


Figure 12: Pie chart showed frequency of occupation

Table 84: Frequency of income

Income	Frequency	Percentage	Valid percentage	Cumulative percentage
Less than 5,000 bath	8	8.0	8.0	8.0
5,001-10,000 bath	54	54.0	54.0	62.0
10,001-15,000 bath	17	17.0	17.0	79.0
15,001-20,000 bath	19	19.0	19.0	98.0
More than 20,000 bath	2	2.0	2.0	100.0
Total	100	100.0	100.0	

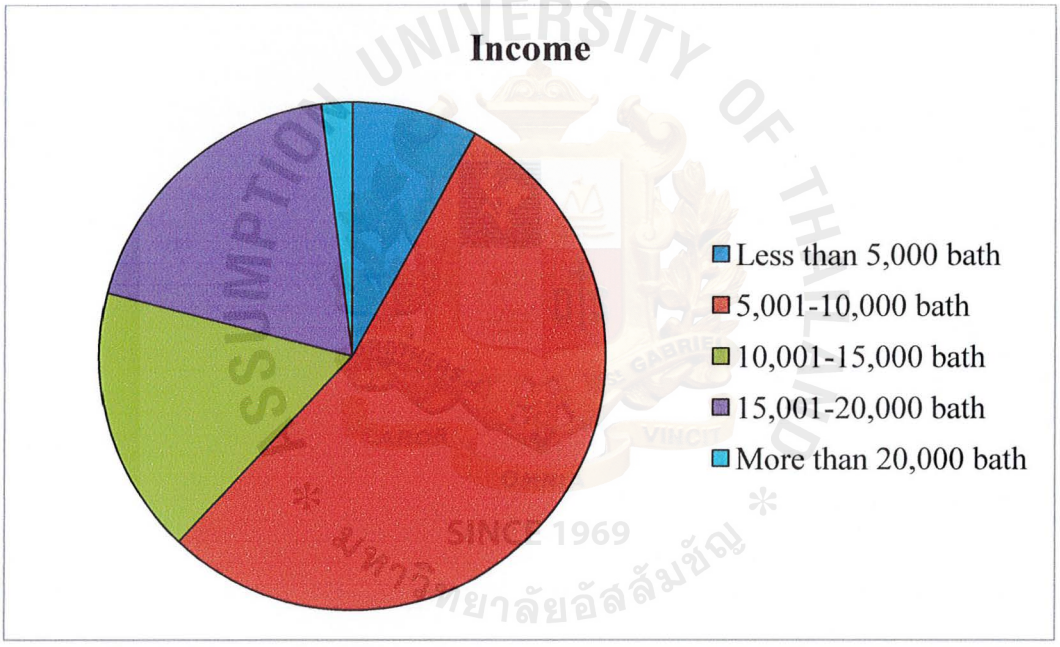


Figure 13: Pie chart showed frequency of income

Table 85: Descriptive statistic of final product of Pumpkin yogurt in each attributes

Attribute	N	Minimum	Maximum	Mean	Std. Deviation
Appearance	100	5.00	9.00	7.40	0.82878
Color	100	6.00	9.00	7.17	0.87132
Flavor	100	4.00	9.00	7.78	0.84154
Sweetness	100	5.00	9.00	7.29	0.79512
Odor	100	4.00	8.00	7.44	0.64071
Texture	100	4.00	9.00	7.48	0.91541
Overall	100	5.00	9.00	7.52	0.88169
Valid N	100				

Table 86: Descriptive statistic of final product of Carrot yogurt in each attributes

Attribute	N	Minimum	Maximum	Mean	Std. Deviation
Appearance	100	5.00	9.00	7.51	0.85865
Color	100	6.00	9.00	7.79	0.83236
Flavor	100	4.00	9.00	7.44	1.14874
Sweetness	100	5.00	9.00	7.43	0.85582
Odor	100	5.00	9.00	7.36	0.82291
Texture	100	5.00	8.00	7.31	0.80019
Overall	100	6.00	9.00	7.56	0.76963
Valid N	100				

Table 87: Pumpkin yogurt acceptance

Acceptance	Frequency	Percentage	Valid percentage	Cumulative percentage
Accept	79	79.0	79.0	79.0
Not accept	21	21.0	21.0	100.0
Total	100	100.0	100.0	

Table 88 : Carrot yogurt acceptance

Acceptance	Frequency	Percentage	Valid percentage	Cumulative percentage
Accept	90	90.0	90.0	90.0
Not accept	10	10.0	10.0	100.0
Total	100	100.0	100.0	

Table 89: Frequency of buying decision in pumpkin yogurt

Decision	Frequency	Percentage	Valid percentage	Cumulative percentage
Buy	64	64.0	64.0	64.0
Not sure	29	29.0	29.0	93.0
Not buy	7	7.0	7.0	100.0
Total	100	100.0	100.0	

Table 90: Frequency of buying decision in carrot yogurt

Decision	Frequency	Percentage	Valid percentage	Cumulative percentage
Buy	69	69.0	69.0	69.0
Not sure	27	27.0	27.0	96.0
Not buy	4	4.0	4.0	100.0
Total	100	100.0	100.0	

Table 91: Frequency of price that consumer accept in pumpkin yogurt

Price	Frequency	Percentage	Valid percentage	Cumulative percentage
10-15 bath	82	82.0	82.0	82.0
15-20 bath	18	18.0	18.0	100.0
Total	100	100.0	100.0	

Table 92: Frequency of price that consumer accept in carrot yogurt

Price	Frequency	Percentage	Valid percentage	Cumulative percentage
10-15 bath	85	85.0	85.0	85.0
15-20 bath	15	15.0	15.0	100.0
Total	100	100.0	100.0	