Development of Herbal Tea Incorporated with Asiatic Pennywort Extract for Elderly

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ABSTRACT

Development of Herbal Tea Incorporated with Asiatic Pennywort Extract for Elderly

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World population right now is an increasing median age. Meaning, it is a shift in the distribution of a country's population towards old ages. People are more concern in healthy products such as organic product and antioxidant products. Asiatic Pennywort has known as medical plant that used for treating bruises and reducing swelling. From the previous research lately, it reported that Asiatic Pennywort has properties to improve memory recognition and promote healthy skin. Asiatic Pennywort is herbal plant that available in the market, it has been developed to enhance the amount of antioxidant. This study was aimed to study the changes in consumer acceptance after repeated consumption of with Asiatic Pennywort tea by using survey with 100 elderly people for study attitude, behavior and opinion of elderly people towards tea products. There are 100% of Thai people ever consume herbs and herbal tea, they consume as beverage. Half of consumer surveys are no chronic health conditions. Safety, certification from FDA and Nutrition of product are the most factors that can effect to purchasing decision. They are not care about trend and brand of the products when they consume. The consumers are agree (73%) in nutrition value that presented on label as it's clamed on the package. Result from this study shown that roasted and kneading process is highest mean score from consumer's preference in overall liking 7.1 ± 1.5 ($P \leq 0.05$). This process get highest total phenolic compound 30.53 ± 4.9 (µg/ml GAE dried weight). The best temperature and time for brewing is 85°C at 5 minutes because it can extract the highest amount of antioxidant 57.56 ± 2.4 (µg/ml GAE dried weight). Ratio between Asiatic pennyworth and goji berry is 1:2. Ethanol extraction and gelatin nanoparticle was used that nanoparticle tea can get more antioxidant activity than normal tea leave for 7 times in total phenolic content. Final product testing has consumer acceptance for 76 percent, from who accept this product will buy if they are launched for 63.4 percent. This product has mean score of overall liking at 6.6 ± 1.7 ($P \leq 0.05$). There is no negative result in overall like after finish repeated exposure method.

Keyword: Asiatic Pennyworth, Herbal tea, Repeated exposure

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INTRODUCTION

Nowadays, there are several countries that concern in health and have long life above 100 years old. Which the World Health Organization (WHO) reported that the proportion of the global population will become 'Aging Society' during healthier lifestyles, new advance technologies especially in medical profession and lower fertility rates of people. The elderly population is continue increase 60.4% in a year or reach 22 % by 2050. The countries leading of Aging Society are Italy, Japan, Greece, Germany and Switzerland. Thailand has chance to be the Aging Society because elderly population is increase 10.05 percent of the country's population in a year. Japan is a country full of elderly people which has age average 110 years old from the Guinness Book of World Records. They use only 3 methods with their life that is eat good things, positive thinking and be happy. Foods are the most important role because 80 percent of good health comes from food consumption.

According to new technologies in herbal industry, this technology can improve and create new beverages mixed with herb and spice that include several nutrients in one time of consuming which it can meet the demand of consumers. For example, herbal extracted concentration mixed with high concentration of fruit to create the new flavors that include with zinc, vitamin A, vitamin C, vitamin E, anthocyanin and bioflavonoid. Additionally, people in new generation are very concern in their health which they might use their knowledge to make decision for purchasing or compare the products by reading the ingredient information. Most of beverages are low calories, low fat and sugar free. These herbal beverages can make people live longer and less chance to get diseases such as heart disease, high blood pressure, stork, diabetes mellitus and kidney disease. On the other hand, herbal beverages still have some problems in taste, flavor and characteristics which can effect to consumer purchasing.

From above information can predict next big market segment that should create for elderly people with herbal beverages. Most of herbal beverages are success in market due to their benefits but not in taste. Aging Society has its own special needs and purchasing power or services. Elderly people will concern the qualities and properties of products more than price or brands. Recently, the repeated exposure test has been used to increase the consumption of particular foods such as increase familiarity and acceptance level of children with novel foods. Furthermore, this methodology never been used with elderly people as panelists. The aim of this project was to study the influent effect of repeated exposures and investigate consumer behavior, acceptance level, intake and liking level for Aging Society's market.

AIM

To develop a herbal tea from Asiatic Pennywort extract for elderly

OBJECTIVES

1. To study attitude, behavior and opinion of elderly people towards tea products
2. To study To study effect of roasting and kneading and study effected brewing time and temperature of Asiatic pennywort tea on antioxidant activity and consumer acceptance
3. To optimize the Asiatic pennywort tea product with dried fruit and determine optimize the ratio for dried fruit
4. To study preparation of Asiatic pennywort tea with ethanol extract-loaded gelatin nanoparticles method
5. To study acceptance of elderly people with the Asiatic pennywort tea nanoparticle mixed with Goji berry and repeated exposure method

LITERATURE REVIEW

World population

Nowadays, there are more than 7 billion living humans on earth and it is increasing in every day. In 1900, there are 1.5 billion humans but in 2000 the world population was three times greater than previous century which is 6.1 billion humans within 100 years. The rate of natural population in each country is increasing that is determined by births and deaths. United Nations Population Fund (UNFPA) tells that humans are the key changes in population growth that the amount of population is fully 5 billion on 11 July 1,987 (AD). UNFPA expected that the amount of population will reach 8 billion in 2,025 and increase to 10 billion in 2,083. The number of population can more than this expectation but it is depending on other factors. Asia is the most populous region in the world or 60% of world population which China is the highest population in the world and follows with India. Rank of Thailand is 19 which have 68 million humans. United Nations Population Fund (UNFPA) reported that the world population has less amount of children population that means elderly population are increasing. The world society will change to Ageing Society. The world population can divided into two numerically equal groups by using median age which half of the people are older than the median age indicated and half are younger (World Population Prospects: The 2015 Revision). The median age of world population are increasing continually by has median age at 25 in 1995, 27 in 2005 and 30 in 2015 but it is opposite to fertility rate that decline from 3.04 in 1995, 2.62 in 2005 and 2.51 in 2015(United Nations, Department of Economic and Social Affairs, Population Division). Europe is the highest amount in Ageing Society such as Italy, Greece and Germany. The Sweden publishes data on both deaths and births in year 1800. Sweden population was improved the standard of health and living especially for children. The result show that death rates were falling but birth rates are constant which effect population level and create a gap between the frequency of deaths and the frequency of births(Demographic change and economic growth in Sweden: 1750–2050, David de la Croix, 2009).

Thailand population

On 1 January 2017, Thailand population was estimated to be 68 million people that increase 0.38% or 256,731 people compared amount population in the year before. This increase was positive because the number of births exceeded the number of deaths. Thailand trend to be Aging Society because the rate of elderly population is 5.7% in 2527 and grow up to 9.6% in 2546. In future, elderly population can increase to 14.7% in 2562. Therefore to get ready for

Aging Society, every countries needs planning to develop new society and new economic which has elderly people more than children.

Elderly definition

Elderly is old person in characteristic of later life that world countries have accepted the chronological age more than 60 years old or someone who are retire from work. On the other hand, most developed world countries have accepted the chronological age of 65 years as a definition of 'elderly' or older person, but many westernized concepts does not adapt. The UN agreed cutoff is 60+ years to refer to the older population. (World Health Organization, 2010) A definition of more traditional countries is to be developed stage that definitions of an elder or elderly person correlate with the chronological ages of 50 to 65 years, depending on the setting, the region and the country.

Classification of elderly population

1. The young-old 60 – 69 years old is the older people who can almost do activities by themselves. They will face with some differentiations in this period such as retirement, death from close friends or couples.

2. The middle-aged old 70 – 79 years old is the older people who start to sick or illness with their health, they might have medical problems and less society

3. The Oldest-Old 80-89 years is old people who need helping from other people and more private. They might need more time to adapt with environments around themselves.

4. The very oldest-old 90-99 years old. There are a few people can reach this stage. This very oldest-old must have medical problem. They should have some slow activities for movements.

Aging Changes in the Senses

When entering old age, the way your senses (taste, smell, touch, vision, and hearing) are able to give you information about the changing. Senses become less acute and have some trouble with communication, enjoyment of activities, and social interactions. All of the senses receive information of some type from the environment such as light, sound vibrations. This information is converted to a nerve impulse and carried to the brain, where it is interpreted into a meaningful sensation. Everyone requires a certain minimum amount of stimulation before a sensation is perceived. This minimum level is called the threshold. All senses can be affected by aging or increases this threshold. Changes in the body part related to the sensation account for

most of the other sensation changes. A few studies have shown that the optimal concentrations of sucrose, sodium chloride or lipids differed with the food, probably due to a different taste perception. (Drqewnowski & Schwartz, 1990; Drewnowski, Shrager, Lipsky, Stellar, & Greenwood, 1989) Young male age between 8 and 10 had a higher anterior papillae density than the adult's male that make adolescents more sensitive to sweet flavors. There is some change in taste perception in children grow into teenagers who have high ability to distinguish flavors.

Perception with aging

1. Hearing

There are two jobs for ears that is hearing and maintaining balance. Ear structures deteriorate during aging. The eardrum often thickens and difficult to maintain balance. Hearing decline in high frequency sounds which slightly beginning about age 50. It might possibly cause by changes in the auditory nerve. The brain may have a slightly decreased ability to translate vibration into meaningful information. Some hearing loss is almost inevitable. It is estimated that 30% of all people over 65 have significant hearing impairment. Hearing loss involves decreased ability of the inner ear, auditory nerve, or the brain.

2. Vision

All of the eye structures change with aging. Age-related eye changes may begin as early 30 years old during causes of produce less tears. By the time you turn 60, your pupils decrease to about one-third of the size they were when you were 20. The pupil may slow response in darkness and bright light. The lens becomes yellows and less flexible. The eye muscles less able to fully rotate the eyes. Most people older than 55 years need glasses to help their visions for focusing.

3. Touch

Many studies have shown that with aging, you may have reduced or changed sensations of touch. It is hard to tell for example, to tell the difference between cool and cold, whether these changes are related to aging itself or to the disorders that occur more often in the elderly. Some changes of aging are caused by decreased blood flow to the touch receptors or to the brain and spinal cord. After age 50, many people have reduced sensitivity to pain. However, some people develop an increased sensitivity to light touch because of thinner skin especially people older than 70.

4. Taste and Smell

The senses of taste and smell interact closely, helping you appreciate food. Most taste really comes from odors. Human have approximately 9,000 taste buds. The taste buds are primarily responsible for sensing sweet, salty, sour, and bitter tastes. For example, at age 20 - 40, you use

one teaspoon of sugar, but at age 65 you may need 3 teaspoons of sugar to get the same perceived sweetness. Smelling detect aroma of foods and help to identify flavors in foods such as vanilla flavor, noxious gases, and smoke. People can know their changing on taste buds when reach 50 in women and 60 in men. They will less able to detect salty and sweet tastes and followed by bitter and sour. Additionally, mouth produce less saliva that effect to swallowing more difficult0. The sense of smell may diminish after age 70. This may be related to loss of nerve endings in the nose. Research shows that older people add more sugar and salt to food to boost the flavor as their sense of smell fades. This adding may allow elderly person easily get medical problem from foods.

Herbs and spices

Historically, herbs and spices have used a rich tradition of use for their flavor enhancement characteristics and for their medicinal properties. Herbs and spices are small plant that does not produce woody persistent tissues and has medicinal properties for treat diseases. By using different parts of plant through processes such as roasting, smoked, fermented or fresh, this knowledge has been used from the ancestors who have observed which plants are used to treat the disease, what's properties? and they learn using the herbs from them experience. Herbs and spices are consumed in small amounts that their intake became an important because of its compounds that contain the antioxidant properties of these aromatic plants which can provide health benefits for consumers (Ferrucci et al., 2010; Kaefer & Milner, 2008; Lampe, 2003; Low Dog, 2006) Thai people have consumed herbal plant as medicines. Herbal plant can use in many ways. For example, some people consume the herbs as raw foods and beverages. Some people use the herbs as a treatment lotion, shampoo or toothpaste. During the qualities of herbal plants have become increasingly major concerns in health sector (Ekor, 2014).

Tea

Tea is dried leaves steeped in usually hot water which made a small bunch of *Camellia sinensis* plant that contain all kinds of great properties, including vitamins (E, C), caffeine and antioxidants. These combine for an agreeable flavor. Each tea is use different parts and different processes to create the specific flavors. There is a separate category for herbal blends and fruit infusions, which are more properly characterized as tisanes. A tisane refers to a caffeine-free blend consisting of herbs, botanicals or fruits prepared like a tea, but

technically not a tea. If the drink does not have tea leaves from *Camellia Sinensis*, it is not a tea. It is most likely a tisane. Therefore, it would be an oxymoron to call something an herbal tea because it can only be one or the other

Herbal Tea

Herbal tea can called as "tisanes" (tea zahn) that is commonly used plants from herbs or spices but normal tea use *Camellia sinensis* plant such as green tea, black tea and oolong etc. They can be both infusion of decoration drinking. Herbal tea is the beverage that can get from using parts of herbs or spices then pass though air dried or fermentation process by pass through soaking, brewing or boiling process as normal tea that tae has consumed more than 1,000 years ago which China is the first country to know tea. Hot herbal tea can give the specific aroma that make consumers relax when they drink. Moreover, herbs contain several in health benefits in term of heal and prevent diseases. For example, ginger tea help to relieve fevers and stuffed nose during ginger contain special aromatherapy which is heat power that can expel fever and also help to increase fat burning for 20% of body.

Tea Market in Thailand

Tea is one of the most popular soft drinks in the world, which secondly from drinking water. Due to the healthy trend is very popular in Thailand and there are many research papers said that there are many benefits from consuming tea that can reduce the risk of cancer, heart disease, diabetes and blood vessel that make a lot of people turn to consume tea. From the past, the tea beverage will only popular in the elderly group. But nowadays, a lot of range ages are turn to consume tea whether is green tea, white tea, black tea, fruit tea or herbal tea. In the last 5 years, the tea market has grown by 4.16 percent per year that is a very small percentage out of from consumption of hot drinks. It is found that most of Thai people have consumed tea only 6.4 percent because most of Thai people prefer coffee more than tea. As a result, Thai people are consuming less tea that the rate of consuming tea in one year average only at 0.93 grams per person. If it is compared with the rate of consuming tea in Turkey in one year, they will consume 7.54 kilograms of tea per person. From this information, there are more opportunities to expand the tea market in Thailand.

Asiatic Pennywort

There are several herbs that are popular in Thailand and contain several benefits with human health. However, there are the most popular one is 'Asiatic Pennywort' or *Centella asiatica* or Gotu kola. Thailand has 4 herbs popular products which is Gotu kola (Asiatic Pennywort), Tumeric, Phlai (Zingiber cassumunar) and Black galingale (Kaempferia parviflora Wallich. ex Baker.) that is Thailand's Signature of herbal products. The main active constitients of C. asitica are pentacyclic triterpenes such as Asiatic acid, Asiaticoside, Medecasic acid and Madecassoside that resistant with anti-oxidation reaction. The triterpenic fractions will activate the collagen synthesis under skin that good for use to healing the wound quickly. Moreover, Asiaticoside gave a better effect on antibacterial and fungicidal activity against bacteria and fungi [Hausen, 1993]. Not only in Thailand has interested benefits in this herb. Asiatic Pennywort is native herbal plant of Southeast Asian countries as well as South Africa (Orhan, 2012). Asiatic Pennywort contains biological activities compounds for human health such as wound healing (Suguna et al., 1996), anti-inflammation (Somchit et al., 2004). For the medicinal uses, Asiatic Pennywort can help to reduce swelling and improve blood flow in varicose veins (Antani 1990). The increasing number of triterpenoids can exhibit cytotoxicity against a variety of cancer cells without manifesting any toxicity in normal cells [Setzer W, 2003]

Antioxidant Activity

Oxidative stress causes by overproduction of reactive species and decreased level or dysfunction of antioxidants. Reactive species (ROS) is low stable molecule, it need an electron to make itself more stable. So, reactive species will bring electron form other cells as a cycle that effect to mitochondria membrane and cell damage. There are 2 groups of antioxidant compounds; non-enzymatic antioxidants such as phenolic compounds, carotenoid, vitamin E (tocopherol), vitamin C (ascorbate) and enzymatic antioxidants such as Superoxide dismutases (SOD), Catalase, Glutathione peroxidase. Protection against free radicals can be enhanced by intake of dietary antioxidants which may be major importance in disease prevention.

Antioxidant capacities are contain in tea beverages that there are several methods to determine antioxidant in the sample. First, radical scavenging activity DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) is an antioxidant assay, to determine the free radical based on electron-transfer. This free radical, stable at room temperature, is reduced in the presence of an antioxidant molecule; the use of the DPPH assay provides an easy and rapid way to evaluate

antioxidants by spectrophotometer. Second, ferric reducing antioxidant power (FRAP assay), this assay will use to determine ability of antioxidant. Ferric tripyridyltriazine complex(Fe^{3+}-TPTZ) are reduced ion to ferrous tripyridyltriazine complex(Fe^{2+}-TPTZ) which form blue color and evaluate by spectrophotometer. Total phenolic content is the method that use to studying the electron ion base on redox reaction. Folic-Ciocalteu reagent has yellow color, after it get electron ion from antioxidant compounds the color will change to blue color and observe density by spectrophotometer.

Nanotechnology

Nanotechnology is interested more than 40 years which was found by physicist Richard Feynman. Nano science and Nanotechnology is studying all science fields such as chemistry, biology, physics, materials science, and engineering in nanoscale which is about 1 – 100 nanometer as small as an atom is impossible to see with the naked eye. Nanotechnology can find in everywhere which is applied in all industry such as electronics, textiles, foods and medicines. There are several terms about food that use nanotechnology; nanosensor for pathogen, nano-coating for packaging and nano-encapsulation for food ingredients. Nanotechnology can help to protect food deterioration and shelf life from microbial contamination. For example silver nanotechnology widely used nanomaterials, as antimicrobials, in the food industry. Metal oxide nanomaterials have been utilized in food packaging and coating which it allows excessive formation of reaction oxygen species on membrane protein to oxidative stress and cell damage. (Haohao Wu, 2014) Nanomaterials as delivery systems to improve the bioavailability of bioactive compounds (Laura S, 2016) Solubility can improve by altering particle size that makes increase surface area to more affect bioaccessibility. Nanotechnology also helps to protection against chemical ingredients. For example, antioxidant carrier polymeric nanoparticles are suggested for the encapsulation of bioactive compounds (e.g., flavonoids and vitamins) and to release them in acidic environments (i.e., stomach) [Hector P,2012]. Nanoparticle can make by using several chemicals to make it more concentrate which the ethanol extract of all parts of *C. asiatica* exhibited significantly (P<0.05) higher antioxidative activity than the water extract. More concentration of both extracting are increases antioxidative activity [Hamid A, 2002]. Using 50% ethanol extract of C. asiatica contained significantly higher amount of polyphenol, flavonoid while moderate amount of carotene and tannin but the lowest amount of vitamin C compared to 100% ethanol and water extract. [Mijanur R, 2013]

Repeated exposure and previous research

The repeated exposure is one of the most effective strategies which can increase liking and preference in food appeared. (Birch LL 1979) Even exposure to infant (Mennella JA, Jagnow CP, Beauchamp GK. 2001) Preferences may change over time. (Levy & Köster, 1999; Levy, Mac Rae, & Köster, 2006; Zandstra, Weegels, Van Spronsen, & Klerk, 2004) Children of all ages tend to reject unfamiliar foods or bitter, but preference for sweet and salty foods. (Birch, 1999) The effect of rejection to unfamiliar foods referred to as neophobia, is highly associated with lower intake of vegetables by children (Birch, 1999; Cooke et al., 2004). Initial preferred of foods may start with low score of preferred but preferred score of foods may be increasingly appreciated after repeated exposure (Kinnear & de Kock, 2011). There is a success with children' liking by frequently exposure of unfamiliar foods that can effect acceptance of children (Birch,McPhee, Shoba, Pirok, & Steinberg, 1987; Loewen & Pliner, 1999) More researches involving preschool aged children were tested by paring novel vegetables with a sweet vegetable taste, children's intake is positive. (Caton et al., 2013; Hausner, Olsen, & Moller, 2012; Remy, Issanchou, Chabanet, & Nicklaus, 2013) Older people rated high concentrations of sucrose and sodium chloride as pleasanter than did younger subjects.

METHODOLOGY

Material

- **Raw material**
    o Asiatic pennyworth (*Centella asiatica L.*)
    o Drinking water (Neptune)
    o Dried goji berry
    o Dried cranberry
- **Chemical reagent**
    o Gelatin powder
    o 0.2% glutaraldehyde (GA)
    o 2% Mannitol
    o Ethanol 95%
    o Folin–Ciocalteu phenol reagent
    o DPPH reagent
    o FRAP solution

Equipment

- **Kitchenware (pan, steamer pan, water boiler)**
    o Air dried oven (Memmert UM500)
    o Tea bag filter paper size 5.5 cm × 7 cm. (KOII)
    o Table Top weighing scale (Want® balance instrument)
    o Thermometer (Checktemp 1, Hanna instruments)
- **Chemical analysis equipment**
    o Beaker 600 ml (Pyrex® USA)
    o Pipette 10 mL
    o Beaker 100 mL
    o Cylinder 500 ml
    o Filter paper no.4. (Whatman)
    o UV-vis spectrophotometer
    o Freeze-dried machine
    o Blender machine (DXFILL DMX 1000)
    o Evaporator (BUCHI Rotavapor R-205)
    o Micro pipette 10-100 µl , 200 – 1,000 µl
    o Centrifugal machine (Harmle Z 200 M/H)
- **Questionnaire**
- **Statistic program**

1. Study attitude, behavior and opinion of elderly people towards tea products

Questionnaire survey will be used to collect the information on attitude, behavior, and opinion of elderly people towards tea products. The questionnaire consisted of 6 parts including Part I: Consumer's behavior about herbs and tea, Part II: Consumer's attitude and purchasing behavior, Part III: The factors influence purchasing decision, Part IV: Food consumption behavior based on their knowledge and Part V: Demographic Information. There will be at least 100 consumers that have age between 50-75 years old participate in the survey. SAS 9.4 will be used to process the obtained data. The data analysis includes Descriptive statistics, ANOVA, and multiple comparisons at $\propto \leq 0.05$.

2. To study To study effect of roasting and kneading and study effected brewing time and temperature of Asiatic Pennywort tea on antioxidant activity and consumer acceptance

2.1 To study effect of roasting and kneading on Asiatic Pennywort tea

The effect of roasting and kneading was studied on Asiatic Pennywort tea. Randomized Completely Block design was applied in the experiment. There were 4 treatments including (1) kneading and roasting (KR) applied in the process, (2) only kneading applied in the process (KNR), (3) only roasting applied (NKR), and (4) both kneading and roasting (NKNR) were applied in the process.

The process of tea making is as followed

1. Remove yellow leaves and leaved that were eaten by insects
2. Wash Asiatic pennywort with tap water
3. Pick the leaves from the stem.
4. Stream the clean leaves for 5 minutes.
5. Add 250 ml. of water and kneading by using the hands for 2 minutes (only kneading processes) and left the leaves at room temperature for 30 minutes.
6. Roast the Asiatic pennywort leaves at 45 °C for 25 minutes (only roasting processes)
7. Dry the Asiatic pennywort leaves using hot air oven at 80 °C for 2 hours

The Asiatic pennywort tea then was determined it's sensory
Sensory analysis and chemical analysis were used to consider tea sensory quality and its antioxidant activity. 9-point hedonic scale was used to obtain the consumer's attitude towards color, green aroma, roasted aroma, sweetness, bitterness, green flavor, roasted flavor, green aftertaste, astringency, and overall liking. There were 30 consumers participated in the test. SAS

9.4 will be used to process the obtained data. The data analysis includes Descriptive statistics, ANOVA, and multiple comparison at $\propto \leq 0.05$. The treatment that consumer like the most will be chosen for the further study.

Chemical analysis that used to determine antioxidant activity such as antioxidant activity by DPPH radical scavenging activity, Total phenolic content, antioxidant activity by Ferric Reducing Antioxidant Potential Assay (FRAP).

1. Antioxidant activity by DPPH radical Scavenging Activity

Tea sample will prepare for 2.0 ml and add 2.0 ml of DPPH concentration 200 μM, mix well. The mixture will be shaken vigorously and stand for 30 minutes in room temperature without the light. After that, the mixture will be analyzed the optical density (OD) at 517 nm. The result will be expressed as percentage reduction of DPPH10. All measurements should analyze in triplication and three replications. (Zaeoung al., 2005)

$$\text{Percentage reduction of DPPH} = 100 \left(\frac{A_0 - A_c}{A_0} \right)$$

Where A0 is the initial absorbance and AC is the value for add sample concentration (Kittiya K., et.al. 2017)

2. Antioxidant activity by Ferric Reducing Antioxidant Potential Assay (FRAP)

The tea sample will be pipette for 0.2 ml and add FRAP solution 3.8 ml, mix well. The mixture will be kept in the dark at room temperature for 10 minutes. After that, the mixture solution will be analyzed the optical density (OD) at 593 nm. The value will be calculated as mmol Fe^{2+}/mg of sample. All measurements should analyze in triplication and three replications. (Benzie and Strain, 1996) (Kittiya K., 2017)

3. Antioxidant activity by Total Phenolic Content

The Asiatic Pennywort crude and Asiatic Pennywort nanoparticle 20 μl of 10 mg/ml will be dissolved in 1.58 ml of distilled water and 100 μl Folin–Ciocalteu phenol reagent. The samples will be stand for 8 minutes 30 seconds, then add 300 μl saturated sodium carbonate solution. Next, the sample will be incubated without the light at room temperature for 30 minutes. After that, the samples will be observed the optical density (OD) at 765 nm. The result will be expressed as microgram garlic acid equivalent (μgGAE/ml). The experiment was done in triplicate and three replications independently (Kittiya K., 2017)

The data obtained from all of these three antioxidant activity determinations will be analyzed by SAS software version 9.4. The analysis included descriptive statistics, ANOVA, and multiple comparisons at $\propto \leq 0.05$.

Both findings from sensory analysis and determination of antioxidant activity were considered in order to choose the most liked sample from the sensory test and the highest antioxidant activity sample from the chemical analysis.

2.2 To study effected brewing time and temperature of Asiatic pennywort tea

The effect of brewing was study by varying time and temperature. Factorial design with Randomized Complete Block Design (RCBD) was applied as experimental design. Tea brewing process was divided into 12 treatments or 4 sets serving depend on time brewing. There are 4 treatments for time including 2, 3, 4 and 5 minutes. The temperature was applied at 80 ℃, 85 ℃ and 90 ℃.

Brewing and serving methods

1. Prepare boiled water 200 ml for 3 cups
2. First set was started to soak tea leaves for 2 minutes at 80 ℃, 85 ℃ and 90 ℃.
3. Second set was started to soak tea leaves for 3 minutes at 80 ℃, 85 ℃ and 90 ℃.
4. Third set was started to soak tea leaves for 4 minutes at 80 ℃, 85 ℃ and 90 ℃.
5. Last set was started to soak tea leaves for 5 minutes at 80 ℃, 85 ℃ and 90 ℃.
6. Serving temperature of tea was used between 65 – 75 °C.

The Asiatic pennywort tea then was determined it's sensory

Sensory analysis and chemical analysis were used to consider tea sensory quality and its antioxidant activity. 9-point hedonic scale, consumer paricipated was used to obtain and ask as previous study. SAS 9.4 will be used to process the obtained data. The data analysis includes Descriptive statistics, ANOVA, and multiple comparison at $\propto \leq 0.05$. The treatment that consumer like the most will be chosen for the further study. Chemical analysis was determined as previous study.

Both findings from sensory analysis and determination of antioxidant activity were considered in order to choose the most liked sample from the sensory test and the highest antioxidant activity sample from the chemical analysis.

3. To optimize the Asiatic Pennywort tea product from Asiatic Pennywort with dried fruit and optimize the ratio of dried fruit

3.1 To optimize the Asiatic Pennywort tea product from Asiatic Pennywort between Goji berry and Cranberry

The effect of dried fruits was studied on Asiatic Pennywort tea. Randomized Completely Block design was applied in the experiment. There were 2 treatments including (1) dried Gojiberry and (2) dried cranberry were applied in the process. Tea was prepared same weight between dried fruit for 1 g and tea leaves for 1 g. Tea was brewing from previous study and tea was served together. Sensory analysis and chemical analysis were used to consider tea sensory quality and its antioxidant activity.

Sensory analysis and chemical analysis were used to consider tea sensory quality and its antioxidant activity. 9-point hedonic scale, consumer participated was used to obtain and ask as previous study. SAS 9.4 will be used to process the obtained data. The data analysis includes Descriptive statistics, ANOVA, and multiple comparison at $\propto \leq 0.05$. The treatment that consumer like the most will be chosen for the further study. Chemical analysis was determined as previous study.

Both findings from sensory analysis and determination of antioxidant activity were considered in order to choose the most liked sample from the sensory test and the highest antioxidant activity sample from the chemical analysis.

3.2 To optimize the ratio of herbal tea product from Asiatic Pennywort and goji berry

The effect of ratio between Asiatic Pennywort tea and dried fruits was studied. Randomized Completely Block design was applied in the experiment. There were 3 treatments for ratio between Asiatic Pennywort tea and dried fruits including 1:1, 1:1.5 and 1:2. Tea brewing was used from previous results. Sensory analysis and chemical analysis were used to consider tea sensory quality and its antioxidant activity.

Sensory analysis and chemical analysis were used to consider tea sensory quality and its antioxidant activity. 9-point hedonic scale, consumer participated was used to obtain and ask as previous study. SAS 9.4 will be used to process the obtained data. The data analysis includes Descriptive statistics, ANOVA, and multiple comparisons (LSD) at $\propto \leq 0.05$. The treatment that consumer like the most will be chosen for the further study. Chemical analysis was determined as previous study.

Both findings from sensory analysis and determination of antioxidant activity were considered in order to choose the most liked sample from the sensory test and the highest antioxidant activity sample from the chemical analysis.

4. To study Preparation of Asiatic Pennywort tea with ethanol extract-loaded gelatin nanoparticles method

The effect of roasting and kneading was studied on Asiatic Pennywort tea. Randomized Completely Block design was applied in the experiment.

Preparation Asiatic Pennywort crude ethanol extract

1. Asiatic Pennywort dried leaves was finely ground into powder.
2. The powder sample was extracted with 95% ethanol using 1:10 ratio (g/ml). The mixture was macerated at room temperature, centrifuged 120 rpm, for 48 hours and then it was filtered using whatman filter paper no.4.
3. The crude extract was concentrated using rotary evaporators at 45°C (BUCHI Rotavapor R-205) and then it was kept at 20°C before use. (Kittiya K., et.al. 2017)

Preparation Asiatic Pennywort extract-loaded gelatin nanoparticles

1. Distill water 30 m; was boiled at 45°C in 100 ml beaker and put magnetic bar,
2. pH was adjust at 2.5, after that gelatin was added 0.6 g in the beaker (control pH at 2.5).
3. Acetone 30 ml was slowly dropped in the solution. After finish dropping of acetone, add 0.2% glutaraldehyde for 60 µl.
4. Asiatic Pennywort crude extracts was weight 0.3 g in 100 ml beaker.
5. The solution from previous beaker was poured into Asiatic Pennywort crude extracts beaker with magnetic bar and stirred for 2 hours without heating.
6. The particles were centrifuged at 4000 rpm for 5 minutes and washed with distilled water for 2-3 times.
7. The centrifuged particles was re-suspended and disperse in 2% Mannitol of the volume solution, then freeze-dried for 48 hours and kept at room temperature before use. (Kittiya K., et.al. 2017)

The chemical analysis was determined and compare amount of antioxidant between tea leaves and nanoparticle tea as above methods. Sensory analysis and chemical analysis were used to consider tea sensory quality and its antioxidant activity. 9-point hedonic scale, consumer

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participated was used to obtain and ask as previous study. The data analysis includes Descriptive statistics, ANOVA, and multiple comparison(LSD) at $\propto \leq 0.05$. The treatment that consumer like the most will be chosen for the further study.

Both findings from sensory analysis and determination of antioxidant activity were considered in order to choose the most liked sample from the sensory test and the highest antioxidant activity sample from the chemical analysis.

5. To study acceptance of elderly people with the Asiatic pennywort tea nanoparticle mixed with Goji berry and repeated exposure method

5.1 To study acceptance of elderly people with the Asiatic Pennywort tea Nanoparticle

There are 100 people was participated in the test. They can consume herbal tea. Elderly consumers have age between 45-75 years old which are male and female. All consumers are harm no know allergic and willing to participate in the test. There are 3 parts for consumer testing for asking about liking score. Part I : Consumer behavior of consuming beverage and tea. Part II : Product testing, the product was asked about liking score with 9 point hedonic scale. Part III : Demographic Information. To analysis and processing by using SAS software version 9.4 which includes descriptive statistics and ANOVA (analysis of variance) with multiple comparison at $\propto \leq 0.05$.

5.2 Study the changes in elderly people acceptance with repeated exposure method

There are 22 people were participated in the test and been screened by questionnaire (5.1). They were male and female during working age. Panelists were tested for 7 times continuous within 2 week which in every time of testing ballot were asked about the general attributes and liking score with 9 point hedonic scale. To analysis and process by using SAS software version 9.4 was used to analyze the data together with crosstab Excel. To test for significant effects, the different liking score between exposures in each time and all tests that will focus on liking level which result can be increase or decrease in liking level.

RESULT AND DISCUSSION

1. Study attitude, behavior and opinion of elderly people towards tea products

Demographic information

Table 1: Demographic information from survey questionnaire from 100 people of elderly people.

Gender	
Male	35
Female	65
Age	
51 - 55 years old	48
56 - 60 years old	31
61 - 65 years old	17
60 - 70 years old	1
>70 years old	3
Status	
Single	19
Married	67
Divorce	5
Widow	9
House member	
Alone	10
2 - 3 people	33
4 - 5 people	46
> 5 people	11
Nationality	
Thai	100
Level of education	
Lower than High school	20
High school	13
Diploma: Vocational Certificate/High Vocational Certificate	11
Bachelor Degree	37
Master Degree or higher	19
Income per month	
<10,000 ฿	13
10,001 - 20,000 ฿	19
20,001 – 30,000 ฿	21
30,001 - 40,000 ฿	9

40,001 - 50,000 ฿	13
>50,000 ฿	25
Chronic health conditions	
Diabetes mellitus	12(10%)
Heart disease	2(2%)
Nephropathy	2(2%)
Hypertension	26(22%)
Dyslipidemia	18(15%)
Postural hypotension	1(1%)
Obesity and overweight	7(6%)
No health conditions	47 (39%)
other	4 (3%)

There are 100 percent of Thai people who are ever consume herbs and herbals teas. Most of them are no health conditions or chronic health (39%). They consume Thai herbs (66%) and consume as beverage (42%), as medicines (31%) and eat as food in meals (27%). The highest herbal teas that consumers ever consumes is Chrysanthemum tea (16%), Ginger tea(14%) and Lemon grass tea (13%), the last three of herbal tea is Mulberry leaf tea(5%), Asiatic Pennywort (4%) and Indian Gooseberry tea (2%). They are like to consume tea from tea bag (34%) and consume only 1 time in a month (23%) which no specific the time to consume herbal tea (45%), in morning (26%) and afternoon (21%). Consumers purchase herbal tea at hypermarket (37%), supermarket (19%) and convenient market (17%) and in each time will purchase more than 75 baht (41%) for herbal tea. The consumers are agree (73%) in nutrition value that presented on label as it's clamed on the package which they think that their body will absorb the nutrients from herbal teas only 50 percent (39%), 25 percent (33%) and 75 percent(24%). The reason of consumers consume herbal tea is contain medical benefit (28%),   make them feel fresh (23%) and relax stress (18%)

Table 2: The important factor effect on purchasing decision

Factor	Mean ± SD
Safety	4.5 ± 0.9^a
Certification	4.3 ± 1.0^b
Nutrition	4.3 ± 1.0^b
Taste	4.1 ± 0.9^{bc}
Medical properties	4.0 ± 1.0^c
Organic	3.7 ± 1.2^d
Source	3.6 ± 1.2^{de}
Package	3.4 ± 1.2^{ef}
NET	3.3 ± 1.1^{ef}
Brands	3.2 ± 1.1^{fg}
Trend	3.1 ± 1.2^g

There were significant different between factors effect on purchasing decision ($p<0.05$). The most important factor is a safety; it means that they like to safe in consume the tea. Next factors are certification, nutrition, and taste. It means that consumer want to consume good products which should has approved from FDA or other warranties due to their age. The taste is also significantly important in the same level as medical properties. Taste relate to perception of consumer that should be good and more benefits together. Moreover, they are not concern in organic product or source, the reason might be the properties contain in herbs are mostly the same benefits. Package, Net weight and brand also not affect to purchasing decision. Paper tissue has used for package of tea both inside or outside for tea infusion. Plastic bottle has used as package of tea bottle that easy to consume than tea infusion or when you want to consume tea immediately. Volume or weight is not affected to their decision Elderly people is not care much in the amount because they are more concern in taste than others factors. From survey show that they are consume only 1 time in a month where they are seriously need to consume and it is long time to buy in a time. Brand and trend are lowest factors to elderly people; it means that famous products, social products or popular products are not effect to their purchasing decision. Nowadays, several was produced and lunched by small group of villagers or they can make it by themselves.

2. To study To study effect of roasting and kneading and study effected brewing time and temperature of Asiatic pennywort tea on antioxidant activity and consumer acceptance

2.1 To study To study effect of roasting and kneading of Asiatic pennywort tea

Table 3: Liking score of Asiatic Pennywort tea from 30 consumers in 10 attributes

Sample	Overall liking[*]	Color	Green aroma	Roasted aroma	Sweet
RK	7.1 ± 1.5^a	7.4 ± 1.3^a	7.1 ± 1.1^a	6.6 ± 1.5^a	6.8 ± 1.2^a
RNK	6.9 ± 1.3^a	7.1 ± 1.0^{ab}	6.6 ± 1.5^{ab}	6.3 ± 1.7^a	6.7 ± 1.4^a
NRK	6.3 ± 1.5^b	7.1 ± 1.3^{ab}	6.3 ± 1.6^b	6.3 ± 1.1^a	6.4 ± 1.3^a
NRNK	6.2 ± 1.4^b	6.6 ± 1.4^b	6.2 ± 1.5^b	6.1 ± 1.4^a	6.2 ± 1.7^a

Sample	Bitter	Green Flavor	Roasted Flavor	Green Aftertaste	Astringent
RK	6.5 ± 1.3^{ab}	6.9 ± 1.6^a	6.7 ± 1.4^a	6.9 ± 1.6^a	7.0 ± 1.4^a
RNK	6.8 ± 1.3^a	6.8 ± 1.4^a	6.6 ± 1.3^a	6.7 ± 1.2^{ab}	6.7 ± 1.3^{ab}
NRK	6.1 ± 1.2^b	6.4 ± 1.5^a	6.2 ± 1.3^a	6.1 ± 1.5^{bc}	6.5 ± 1.6^{ab}
NRNK	6.3 ± 1.5^{ab}	6.5 ± 1.5^a	6.2 ± 1.6^a	6.0 ± 1.6^c	6.1 ± 1.9^b

All attributes were selected from characteristic of sample. There are 30 consumers that participating in the sensory test. There are significant different in overall liking, green aroma and greeny after taste in different processes of tea ($p \leq 0.05$). The significantly most preferred for all attributes is Roast & kneed process and Roast & no kneed process, it means that most of consumers are like to consumer roasted processes. Two processes are similar in roasted aroma, sweetness, greeny flavor and roasted flavor. But others all attributes are second level that is color, greeny aroma, greeny aftertaste and astringent of Roast & no kneed process. The bitterness of Roast & kneed process is the second level. Moreover, greeny aftertaste has a lowest mean score from consumers which sample No roast & kneed process and No roast & no kneed process. From result, roasted process can help to reduce greeny attributes. Focusing on greeny aroma and greeny aftertaste, both attributes has lowest mean score in the same process that is not roasted. Roasted also help in bitter taste (vellarine compound) and astringent (tannin compound) which heating can reduce the level of tannin in winged bean (Santram S, 1987). Roasted also reduce greeny aroma that occur in the tea products (Liang, Zhang, & Lu, 2005; Lv, Zhang, Lin, & Liang, 2013).

Table 4: Result of Total phenolic content, Ferric reducing antioxidant potential, and DPPH radical scavenging of Asiatic Pennywort tea from different processes.

Different process	Total phenolic content (μg/ml)	FRAP (mmol Fe^{2+}/ml)	DPPH (% reduction)
RK	30.53 ± 4.9 [a]	1.6 ± 0.1[a]	0.2 ± 0.0[b]
RNK	17.98 ± 3.9 [b]	1.7 ±0.4[a]	0.1 ± 0.0[b]
NRK	28.92 ± 5.3 [a]	1.4 ± 0.6[a]	0.3 ± 0.1[a]
NRNK	17.03 ± 4.3 [b]	1.9 ± 0.2[a]	0.2 ± 0.0[b]

Herbs are rich in phenolic compounds which are active compound and act as antioxidant properties. Asiatic Pennywort also has active compounds such as triterpenes (Rattanakom & Yasurin, 2015) polyphenols (Zainol, 2003); which contains high total phenolic contents. Total phenolic content was determined with standard garlic acid in term of μg GAE/ mg dried weight. The highest antioxidant activity represented by amount phenolic compound that is 30.53 ± 4.9 μg/mg dried weight which use Roasted & kneading process. This process is most significant different but not significant different from another processes that is Not roasted & kneading (p ≤ 0.05). Thermal process is a big influence in active compound which depend on their magnitude, duration and different heating methods. Thermal process lend to degradation of phenolic compounds. For example, roasting barley at 280 °C for 20 seconds can decrease 8% of phenol content (Sharma & Gujral, 2011). For DPPH assay is significantly different in all processes that the highest mean is Not roasted & kneading 0.3 ± 0.1 % reduction for DPPH radical scavenging (p ≤ 0.05). Using convection oven drying with spearmint can decrease antioxidant activities approximately 60% which heating go to inactivate enzyme. (Lim & Murtijaya 2007). Kneading was used to macerate the cells of leaf which can activate enzymes (mixing of chemical with enzyme) inside the leaf and can be easily being extracted during brewing (Naheed et al., 2007). For Ferric reducing antioxidant potential assay, there are not significantly different in all processes which the highest mean score is not roasted & not kneading process 1.9 ± 0.2 mmol Fe^{2+}/mg (P < 0.05). The process was selected is Roasted and kneading process because this process get significantly different in green aftertaste, good result in total phenolic content and FRAP. From this study, kneading method can improve only the amount of antioxidant. In the same way, roasted method can also improve only liking score of consumers.

2.2 To study effected brewing time and temperature of Asiatic pennywort tea

Table 5: Liking score of Asiatic Pennywort tea in different conditions from 30 consumers in 10 attributes

Attribute	2 minutes			3 minutes		
	80°C	85°C	90°C	80°C	80°C	90°C
Overall liking [ns]	7.0 ±0.9	6.7 ±1.3	6.4±1.2	6.9±1.2	6.4±1.0	6.6 ± 1.0
Color [ns]	6.9 ±1.2	6.7 ±1.4	8.8±1.3	7.0±1.1	7.0±1.1	6.8 ± 1.2
Green Aroma [ns]	6.8 ±1.0	6.7 ±1.1	6.1±1.4	7.0±1.1	6.9±1.0	6.4 ± 1.1
Roast Aroma [ns]	6.6 ±1.0	6.6±1.2	5.8±1.3	6.8±1.3	6.0±0.9	6.5 ± 0.8
Green Flavor [ns]	6.9±1.1	6.4±1.4	6.0±1.3	7.3±1.2	6.6±4.0	6.5 ± 1.2
Roast Flavor [ns]	7.1±0.6	6.4±1.3	6.1±1.0	6.8±1.2	6.6±1.0	6.4 ± 1.4
Sweetness [ns]	6.9±1.0	6.9±1.5	6.2±1.2	7.3±0.8	6.3±1.3	6.5 ± 1.1
Bitterness [ns]	7.2±0.8	6.9±1.5	6.5±1.0	7.0±0.8	6.8±1.3	6.7 ± 1.0
Green Aftertaste [ns]	7.0±0.9	6.6±1.4	6.9±0.9	7.3±0.6	6.8±1.1	7.1 ± 0.8
Astringent [ns]	7.2±0.9	6.7±1.5	6.8±1.0	7.3±0.9	7.0±1.1	7.0 ± 0.7

Attribute	4 minutes			5 minutes		
	80°C	85°C	90°C	80°C	80°C	90°C
Overall liking [ns]	6.8±1.2	6.5 ±1.1	6.8 ±1.0	6.6 ±1.4	6.7 ±1.1	6.4 ±1.1
Color [ns]	6.9±1.3	7.0 ±1.0	7.0 ±1.0	6.8 ±1.1	7.0 ±1.3	6.7 ±1.0
Green Aroma [ns]	6.6±1.3	6.6 ±1.1	6.9 ±1.1	6.6 ±1.1	6.9 ±1.2	6.7 ±1.0
Roast Aroma [ns]	6.9±1.2	6.3 ±1.0	6.7 ±0.8	6.3 ±1.2	6.6 ±1.0	6.6 ±0.8
Green Flavor [ns]	6.4±1.1	6.4±1.1	6.5±1.1	6.2±1.4	6.6±1.1	6.7±1.1
Roast Flavor [ns]	6.4±1.0	6.4±1.0	6.6±1.3	6.3±1.4	6.8±1.1	6.7±0.8
Sweetness [ns]	6.6±1.3	6.6±1.3	6.6±1.2	6.0±1.7	6.8±1.0	6.6±1.0
Bitterness [ns]	6.6±1.4	6.6±1.4	6.9±1.2	6.5±1.5	6.7±1.0	6.6±1.0
Green Aftertaste [ns]	6.6±1.2	6.6±1.2	6.8±1.0	6.5±1.5	6.8±0.9	6.6±1.2
Astringent [ns]	6.8±1.4	6.8±1.4	6.9±1.0	6.7±1.5	6.8±0.9	7.7±4.2

The result showed that there was no significant difference ($p \leq 0.05$) in all time and temperature for brewing process (see Table 5). The highest mean score of brewing from overall liking is 80°C with 2 minutes (7.0 ±0.9). From this testing can see that the liking score is decrease when they use more time for brewing the tea. Moreover, this condition also gets highest mean score in color (6.9 ±1.2), roasted flavor (7.1±0.6) and bitterness (7.2±0.8). But when the sample was brewed temperature at 80°C with 3 minutes get more attributes than using 2 minutes for brewing that is green aroma (7.0 ± 1.1), green flavor (7.3±1.2), sweetness (7.3±0.8) and green aftertaste (7.3±0.6). Astringent give highest mean score (7.7± 4.2) when brewed at 90°C with 5 minutes. Heating can help in astringent, focusing on tannin compound (give astringent feeling) which heating can reduce the level of tannin

in winged bean. [Kesornbuakao & Yasuri 2015 , Liang, Zhang, J]. From other research said that green tea was brewed with water at 50°C or 70°C, the flavor intensity of seaweed did not change. But when brewing at 95°C the intensity of seaweed flavor in the tea was lower than the intensity of tea brewed with 50°C or 70°C water. The intensity of straw-like flavor increased as the water temperature increased. [J. Lee and D. H. Chambers]

Table 6: Result of Total phenolic content, Ferric reducing antioxidant potential and DPPH radical scavenging of Asiatic Pennywort tea from brewing different condition.

Antioxidant Activity	2 minutes		
	80°C	85°C	90°C
Total phenolic content (μg/ml)	29.24 ± 3.9^{ef}	26.03 ± 9.2^{f}	32.78 ± 8.9^{ef}
DPPH (% reduction)	0.4 ± 0.5^{de}	1.1 ± 0.1^{ab}	0.3 ± 0.1^{de}
FRAP (mmol Fe2+/ml)	1.6 ± 0.7^{bcd}	1.5 ± 0.3^{bcd}	1.1 ± 0.7^{d}
	3 minutes		
	80°C	85°C	90°C
Total phenolic content (μg/ml)	37.29 ± 3.1^{cdef}	41.15 ± 10.3^{bcde}	48.87 ± 8.0^{abc}
DPPH (% reduction)	0.5 ± 0.1^{cde}	0.2 ± 0.1^{e}	1.4 ± 0.1^{a}
FRAP (mmol Fe2+/ml)	1.02 ± 0.3^{d}	1.5 ± 0.2^{bcd}	1.3 ± 0.2^{cd}
	4 minutes		
	80°C	85°C	90°C
Total phenolic content (μg/ml)	45.98 ± 9.7^{abcd}	49.52 ± 8.6^{ab}	34.4 ± 8.9^{ef}
DPPH (% reduction)	0.4 ± 0.1^{cde}	0.3 ± 0.1^{e}	0.5 ± 0.4^{cde}
FRAP (mmol Fe2+/ml)	1.29 ± 0.2^{cd}	1.8 ± 0.3^{bc}	1.6 ± 0.6^{bcd}
	5 minutes		
	80°C	85°C	90°C
Total phenolic content (μg/ml)	38.26 ± 5.3^{bcde}	57.56 ± 2.4^{a}	30.52 ± 8.9^{ef}
DPPH (% reduction)	0.8 ± 0.1^{bcd}	0.8 ± 0.1^{bc}	0.6 ± 0.2^{cde}
FRAP (mmol Fe2+/ml)	1.3 ± 0.5^{d}	2.7 ± 0.7^{a}	2.2 ± 0.5^{ab}

Herbs are rich in phenolic compounds which are active compound and act as antioxidant properties. Asiatic Pennywort also has active compounds such as triterpenes [Rattanakom & Yasurin, 2015] and polyphenols [Zainol A] which contains high total phenolic contents. There are no significant differently ($p \leq 0.05$) in antioxidant activities (Table 6). Total phenolic content was determined with standard garlic acid in term of µg/ml dried weight. The highest antioxidant activity represented by amount total phenolic compound that is 57.56±2.4 µg/ml which use 85°C with 5 minutes. This condition also gets highest in Ferric reducing antioxidant that is 2.7 ± 0.7 mmol Fe^{2+}. For DPPH assay is significantly different in all processes that the highest mean is 1.4±0.1 µg/ml which used 90°C with 3 minutes. From the result can see that time to brewing is effect to the sample by let it extract in water or soaking for long time can get more antioxidant than others in total phenolic content, ferric reducing and DPPH. Moreover, high temperature and pressure of hot water can affect to antioxidant activity in 90°C condition. However, the result of commercial tea bag compared with tea bag that used in the experiment showed that there was the same. Brewing long time and high temperature can extract more antioxidant and intensity of tea [Leila N]. For example, Brewing white tea at 98 °C for 7 min is the best condition to obtain a high content of antioxidant polyphenols and pleasant sensory properties. [S. Pérez-Burillo]. From this study, time and temperature are not necessary or not affect to liking score of consumer but it affect to antioxidant activity.

3. To optimize the Asiatic Pennywort tea product from Asiatic Pennywort with dried fruit and optimize the ratio of dried fruit

3.1 To optimize the Asiatic pennywort tea product with dried fruits

Table 7: Liking score of Asiatic Pennywort tea in different dried fruit

Attribute	Goji berry	Cranberry
Overall liking	7.53 ± 1.36	7.03 ± 1.12
Color	7.27 ± 1.39	6.83 ± 1.58
Green Aroma	7.23 ± 1.14	7.23 ± 1.41
Roast Aroma	6.78 ± 1.25	6.57 ± 1.55
Fruit Aroma	6.03 ± 1.0	6.33 ± 1.65
Green Flavor	6.37 ± 1.73	6.27 ± 1.51
Roast Flavor	7.03 ± 1.25	6.80 ± 1.58
Fruit Flavor	6.98 ± 1.23	6.87 ± 1.41
Sweetness	6.70 ± 1.34	6.43 ± 1.48
Bitterness [*]	6.57 ± 1.38	6.00 ± 1.88
Green Aftertaste	6.63 ± 1.38	6.27 ± 1.95
Astringent	6.83 ± 1.66	6.53 ± 20.03

Table 8 : Result of Total phenolic content, Ferric reducing antioxidant potential and DPPH radical scavenging of Asiatic Pennywort tea from different dried fruit infusion.

Antioxidant Activity	Goji berry	Cranberry
Total phenolic content (μg/ml)	59.89 ± 8.2	60.78 ± 13.6
DPPH (% reduction)	0.67 ± 0.00	0.69 ± 0.00
FRAP (mmol Fe2+/ml)	1.56 ± 0.6	1.48 ± 0.24

There was only bitterness of tea that was significant different ($p \leq 0.05$) (Table 7). According to the result that has significantly difference, the most preference in bitterness attribute is Goji berry tea (6.57 ± 1.38) that quite more different from Cranberry (6.00 ± 1.88). The consumers said that it had feels sweeter, less bitterness, and less green aroma. They said that it can be consumed much easier than pure Asiatic Pennywort tea. From the previous researches, goji berry has many benefits that are classified as high antioxidant and fiber food. Moreover, goji berry has benefits like a cross

between cranberry and cherry. Additionally, it helps promote healthy skin because it loads with beta-carotene and it acts like a natural skin cancer treatment. (Dr. Axe, 2014) Both of dried fruit was mixed with Asiatic Pennywort tea which can increase amount of antioxidant content than pure Asiatic Pennywort tea. It is neuroprotective effect due to antioxidant level. (Ponnusamy, 2010) For antioxidant activity between 2 dried fruits. There are no significantly different in TPC, DPPH and FRAP. So, goji berry was selected to mix with asiastic pennyworth tea because it get different liking score in bitter from consumers.

3.2 to optimize the ratio of herbal tea product from asiatic pennywort and goji berry

Table 9 : Result of attributes of liking score from vary ratio between Asiatic Pennywort and Goji berry

Attributes	(Tea : Golji berry) 1 : 1	(Tea : Golji berry) 1 : 1.5	(Tea : Golji berry) 1 : 2
Overall liking	6.1 ± 1.2 [b]	6.5 ± 1.1 [b]	7.8 ± 0.9 [a]
Color	5.9 ± 1.2 [b]	6.8 ± 1.5 [a]	7.0 ± 1.1 [a]
Green aroma	6.1 ± 1.1 [b]	7.0 ± 1.1 [a]	7.1 ± 1.3 [a]
Fruit Flavor	5.2 ± 1.3 [b]	4.8 ± 2.1 [b]	6.9 ± 0.9 [a]
Sweetness	5.5 ± 1.8 [b]	6.5 ± 1.4 [a]	7.1 ± 1.4 [a]
Astringent	6.3 ± 0.9 [b]	6.7 ± 1.5 [ab]	7.1 ± 1.0 [a]

Table 10 : Result of Total phenolic content, Ferric reducing antioxidant potential and DPPH radical scavenging from vary ratio between Asiatic Pennywort tea and Goji berry

Antioxidant Activity	(Tea : Golji berry) 1 : 1	(Tea : Golji berry) 1 : 1.5	(Tea : Golji berry) 1 : 2
Total phenolic content (μg/ml)	46.94 ± 2.43 [b]	68.50 ± 3.40 [ab]	78.59 ± 5.87 [a]
DPPH (% reduction)	0.6 ± 0.1 [b]	0.6 ± 0.2 [b]	0.8 ± 0.1 [a]
FRAP (mmol Fe2+/ml)	1.86 ± 0.14 [b]	2.89 ± 0.91 [b]	4.80 ± 0.43 [a]

The differences in ratio bwtween goji berry and Asiatic Pennywort tea were determined; the ratio is 1:1, 1:1.5, and 1:2. The result on table 9 showed that the most preference ratio is tea 1:2. There are significantly different in all attributes ($p \leq 0.05$). Ratio 1:2 highest liking score in all attributes. This ratio also gets highest antioxidant activity in total phenolic compound (78.59 ± 50.87 μg/ml), DPPH

% reduction (0.8 ± 0.1) and FRAP (4.80 ± 0.43 mmol Fe2+/ml). The result of this study showed that adding more goji berry can increase amount antioxidant activity. Therefore, it is effective herbal tea from Asiatic Pennywort leaves. Goji berry has vitamin A that can help to reduce the risk of neurodegenerative decline. (Dr.Axe, 2014) While Asiatic Pennywort tea has Acetylcholinesterase inhibitors (AChEIs) which helps enhance memory and mental disorder. (Anchalee Chuthaputti, et al, 2017) Once goji berry and Asiatic Pennywort are combined, the amount of antioxidant is multiplied to three times of original Asiatic Pennywort tea.

4. To study preparation of Asiatic pennywort tea between tea leaves and ethanol extract-loaded gelatin nanoparticles

Table 11 : Result of Asiatic Pennywort Nanoparticle tea in Total phenolic content, Ferric reducing antioxidant potential and DPPH radical scavenging

Antioxidant activity	Total phenolic content (μg/ml)	FRAP (mmol Fe2+/ml)	DPPH (% reduction)
Asiatic Pennywort tea Nanoparticle with Goji berry	441.33 ± 334.54	7.34 ± 0.79	2.17 ± 0.07

Table 12 : Result of mixed Asiatic Pennywort Nanoparticle tea with Goji berry in Total phenolic content, Ferric reducing antioxidant potential and DPPH radical scavenging

Antioxidant activity	Total phenolic content (μg/ml)	FRAP (mmol Fe2+/ml)	DPPH (% reduction)
Asiatic Pennywort tea Nanoparticle with Goji berry	577.317 ± 207.98	7.66 ± 0.61	3.31 ± 0.10

Table 12 shows that the adding goji berry in Asiatic Pennywort tea nanoparticle also enhance amount of antioxidant activity that use ratio 1 : 2 (tea : dried fruit) with in 2 grams of tea bag. The total phenolic content from nanoparticle gets higher amount than normal tea leaves for 7 times, FRAP from nanoparticle get twice amount when compare to normal tea leaves and DPPH also get higher amount than tea leave for 4 times.

5. To study acceptance of elderly people with the Asiatic Pennywort tea nanoparticle goji berry with repeated exposure method

5.1to study acceptance of Asiatic pennywort tea nanoparticle with goji berry

Table 13: Consumer behavior and demographic information from questionnaire from 82 panelists

Gender		Male (35%)		Female (65%)	
Age (years old)					
< 50 (79%)		56-60 (18%)		61 – 65 (3%)	
Status					
Single (49%)	Married (40%)	Couple (9%)		Separated (1%)	Divorced (1%)
House Member					
4-5 people (45%)		2-3 people (31%)	Alone (14%)		More than 5 people (10%
Nationality		Thai (100%)			
Level of education					
Bachelor degree (43%)	Lower than high school (24 %)	High school (14%)		Master degree or higher (10)	Diploma (9%)
Income per month					
10001-20000 ฿ (33%)	20001-30000 ฿ (19%)	30001-40000 ฿ , Less than 10000 ฿ (16%)		40001-50000 ฿ More than 50000 ฿(8%)	
Medical Problem in details					
No problem (65%)	Hypertension (12%)		Other (11%)		Dyslipidemia (7%)
Obesity (3%)	Diabetes, Nephropathy (1%)		Heart disease, Postural hypotension (0%)		

There are 65 percent of female and 35 percent of male were participant in questionnaire. Most of them have are below 50 years old 79 percent, 56 – 60 years old 18 percent and 61-65 years old 3 percent. 49 percent of consumers is single, 40 percent is married. All of them are Thai. For house members, there are 4-5 people in their family 45 percent, 2-3 people 31 percent, stay alone 14 percent and more than 5 people in their family for 10 percent. Highest answer for Level of education is bachelor degree 43 percent. 24 percent of them graduate lower than high school has 24 percent. Graduate high school has 14 percent. Graduate master degree or higher has 10 percent and graduate in diploma for 9 percent. Income of consumer is 10,000 – 20,000 baht that is highest 33 percent. Second income has 19 percent that is 20,001 – 30,000 baht. There are 16 percent for both rank income which is 30,001 – 40,000 baht and less than 10,000 baht. Income per month get more than 50,000 baht gets same percentage as 40,001 – 50,000 baht that are 8 percent. There are 65 percent from consumers who no medical problem. Hypertension is the first disease that gets highest for 12 % and other problems such labored breathing in asthma, stomach trouble and osteoarthritis for 11 % . Dyslipidemia has 7 % , Obesity has 3 %, Diabetes and Nephropathy 1 % for each. Heart diseases   and   Postural   hypotension   have   0   %

Table 14: Consumer liking score from 82 consumers in final product testing

Do you consume herbal tea?	100 % (Yes)				
How much they consume herbal tea?	Like most 6 %	Like 56 %	Fair 34 %	Dislike 4 %	Dislike most 0 %
Which herbs of herbal tea they consume?					
Ginger tea 17%	Safflower tea 16%	Chrysanthemum tea 14 %		Lemon glass tea 13 %	Pandan tea 12 %
Rosella tea Mulberry leaf tea 8 %	Lou Han Gua 5 %	Asiatic Pennywort tea 3 %		Reishi tea 2 %	Indian Gooseberry tea Other 1 %
Which package of herbal tea that that consume?					
Tea bag (43%)	Bottom tea (24%)	Tea leaves (19%)		Tea powder (14%)	
How often do you consume the herbal tea?	2-3 times in a week 34%		1 time in a month 21%	2-3 times in a month 16%	
	4-5 times in a week 10 %, 1 time in a week 10%		Other 6%	4-5 times in a week 10%	
When they consume herbal tea?	Afternoon 39%		Morning 32%	not specific the time 13%	
	Evening 9%		Before sleep 6%	After wake up1%	
Where do they buy the herbal tea products?					
Hypermarket 55%			Supermarket 30%		
Fresh Market 10%		Other 4%		Internet or delivery 1%	
How much they purchase the herbal tea product per time?					
51-100 ฿ (34%)	Less than 50 ฿ (22%)		101-150 ฿ (20%)	Can not remember(11%)	
201-250 ฿ (6%)		151-200 ฿ (5%)		More than 250 (2%)	
Reason why they like to consume herbal tea?					
Medical benefits (28%)	Freshness 21%	Help to relax 19%		Easy to consume 17%	Aroma 15%
Have you ever drunk herbal tea with flavored from fruits or plants?					
Yes (90%)			No (10%)		
Which flavored of tea that you ever consumer?					
Lemon, Jasmine 24%		Rose 13%		Mint, Berry, Peach 8%	
Passion Fruit, Chamomile 5%		Cranberry 4%		Other 1%	

There are 100 percent like to drink tea and 56 percent are like to consume tea, 34 is fair, 6 percent like most and 4 percent dislike to consume herbal tea. Most of them had ever consume herbal tea, the highest herbs is ginger tea 17 percent, safflower tea 16 percent and chrysanthemum tea 14 percent. There are 3 lowest of herbal tea that they ever consume are Indian gooseberry tea 1 percent, reishi tea 2 percent and Asiatic pennywort 3 percent. They like to consume tea in tea bag for 43 percent is the highest percent, second is tea in the bottom for 24 percent, third is tea leave 19

percent and lowest percent is tea powder for 14 percent. They consume 2-3 time in a week for 34 percent, 21 percent for a time in a month, and 2-3 in a month for 21 percent. Most answer from them that when they consume tea is afternoon 39 percent, second answer is consume in the morning 32 percent and not specific the time for 13 percent. Hypermarket is the most answer was selected for buying herbal tea 55 percent such as BigC or Lotus supermarket; second place for purchasing is supermarket 30 percent such as Foodland, Tops Supermarket and fresh market has 10 percent. Other purchasing means get free from other people for 4 percent. They purchase 51 – 100 baht in a time for herbal tea 34 percent. 22 percent is purchase less than 50 baht in a time 22 percent and purchase between 101 – 150 baht has 20 percent. 11 percent of them cannot remember the price. They like to consume herbal tea because its contain more medical benefits 28 percent, make them fresh during the day 21 percent, help to relax or feels better 19 percent. 17 percent of consumer is easy to consume herb 17 percent and 15 percent is herbal aroma. 90 percent of them have ever consumed herbal tea with flavored from fruits or plants. Jasmine and lemon is the most flavored tea that they ever consume 24 percent. Rose is the second flavor 13 percent. There are 3 flavor have 8 percent that is mint, berry and peach. Passion fruit and chamomile has 5 percent. Cranberry has 4 percent.

Part II : Product testing

Table 15 : Consumer acceptance liking score with mean and standard deviation

Attributes	Mean ± SD
Overall Aroma	6.4 ± 1.4
Overall taste	6.4 ±1.5
Overall Flavor	6.4 ± 1.6
Overall linking	6.6 ± 1.7
Do consumer accept the Asiatic pennyworth Tea with Goji berry Flavor?	
Accept (76%)	Reject (24%)
From consumers who accept the product, Will you buy this product?	
Yes (63.4%)	No (12.2%)
What is a suitable price for buying Bua Bok Tea with Goji berry Flavor for 10 packs in a box?			
Less than 200 ฿ (77%)	201-300 ฿ (22%)	301-400 ฿ (1%)	401-500 ฿ More than 500 ฿ 0%

Asiatic pennywort nanoparticle tea was served, tested and asked about liking score by use 9 point hedonic scale Overall liking from this product is 6.6 ± 1.7. Most of consumers are accept this

asiatic pennywort nanoparticle tea 76 percent and will buy if they launch in the market for 68 percent. They give suitable price is less than 200 baht for 10 packs in a box for 77 percent and 201-300 baht for 22 percent.

5.2 Study the changes in consumer acceptance with repeated exposure method

Table 16 : Consumer acceptance liking score with percent differential during repeated exposure

Attribute	Percent Differential		
	Positive	Unchanging	Negative
Overall aroma	59.1	36.4	4.5
Sweetness	54.5	27.3	18.2
Overall taste	63.6	27.3	9.1
Green flavor	45.5	45.5	9.1
Overall flavor	45.5	50	4.5
Astringent	40.9	45.5	13.6
Overall liking	54.5	45.5	-

From the results of the repeated testing, the panelists clearly showed that the attributes of overall taste get the most positive effect that is 63.6 percent. For unchanging result is overall flavor for 50 percent. Moreover, there are no negative percent in overall liking. However, the highest negative percent is sweetness that means repeated tasting might not help panelists feel better after test the sample.

Table 17: Comparing the percentage of liking score between first-test and last-test.

Attribute	Begin		After	
	Lower than 5	more than 5	Lower than 5	More than 5
Overall Aroma	0	100	0	100
Sweet	0	100	0	100
Overall taste	4.5	95.5	0	100
Green flavor	0	100	0	100
Overall flavor	0	100	0	100
Astringent	13.6	86.4	0	100
Overall liking	0	100	0	100

There are 5 attributes that panelists give liking score more than 5 at the first test and last test including overall aroma, sweet, green flavor, overall flavor and overall liking. There are 2 attributes have change into better liking score that are overall taste and astringent. Liking score at first test, panelists give the liking score lower than 5 for 4.5% for overall taste and 13.6 % for astringent but this 2 attributes get 0% from panelists in last test.

1. Overall Aroma

Figure 1: Positive result of panelists after repeated exposure in overall aroma
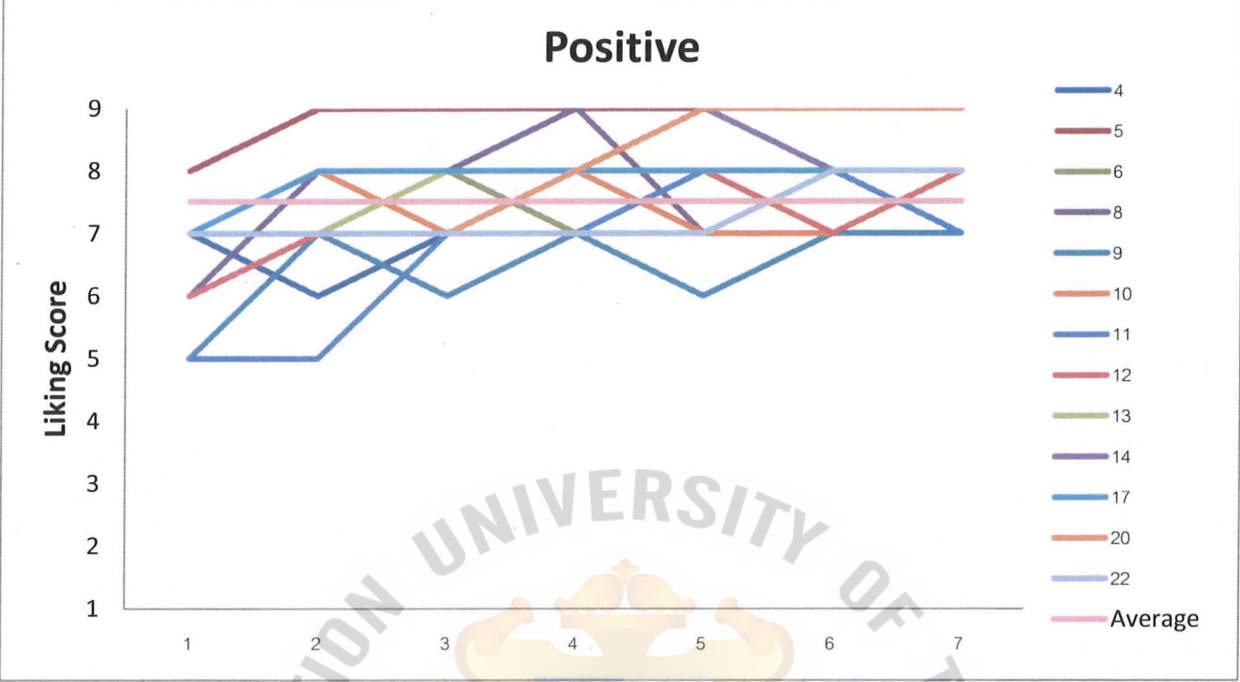
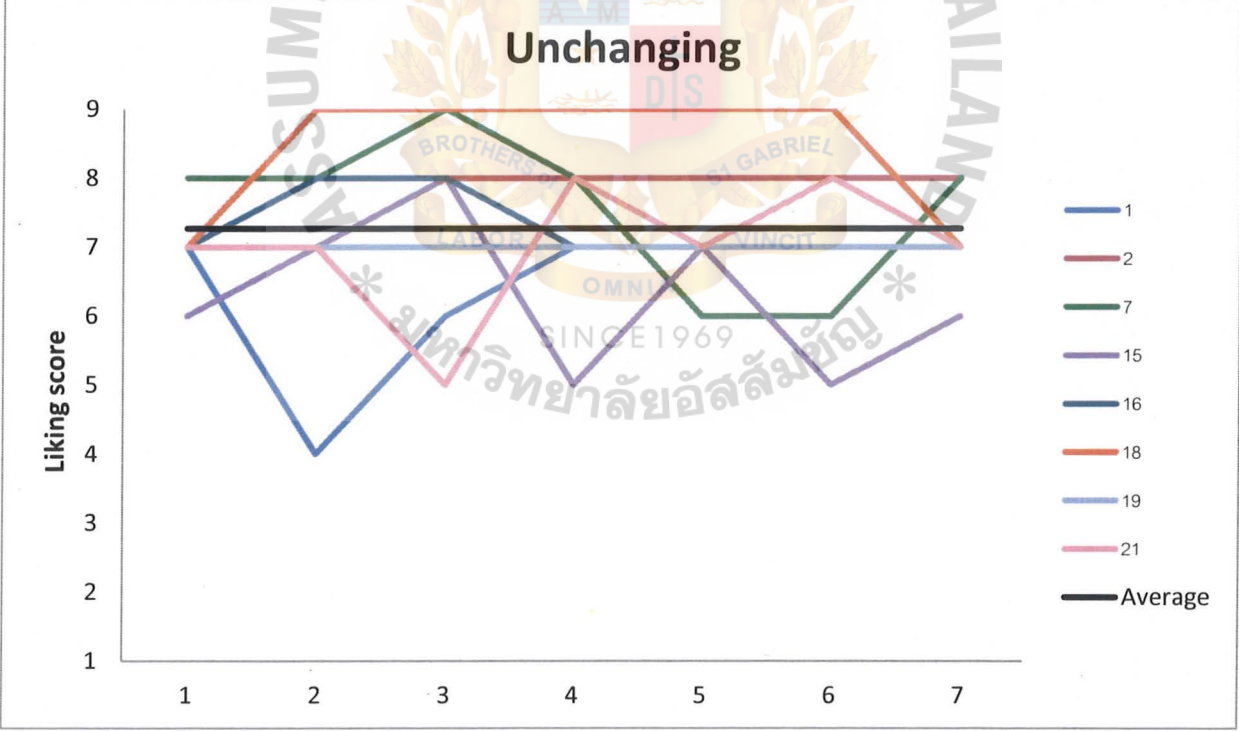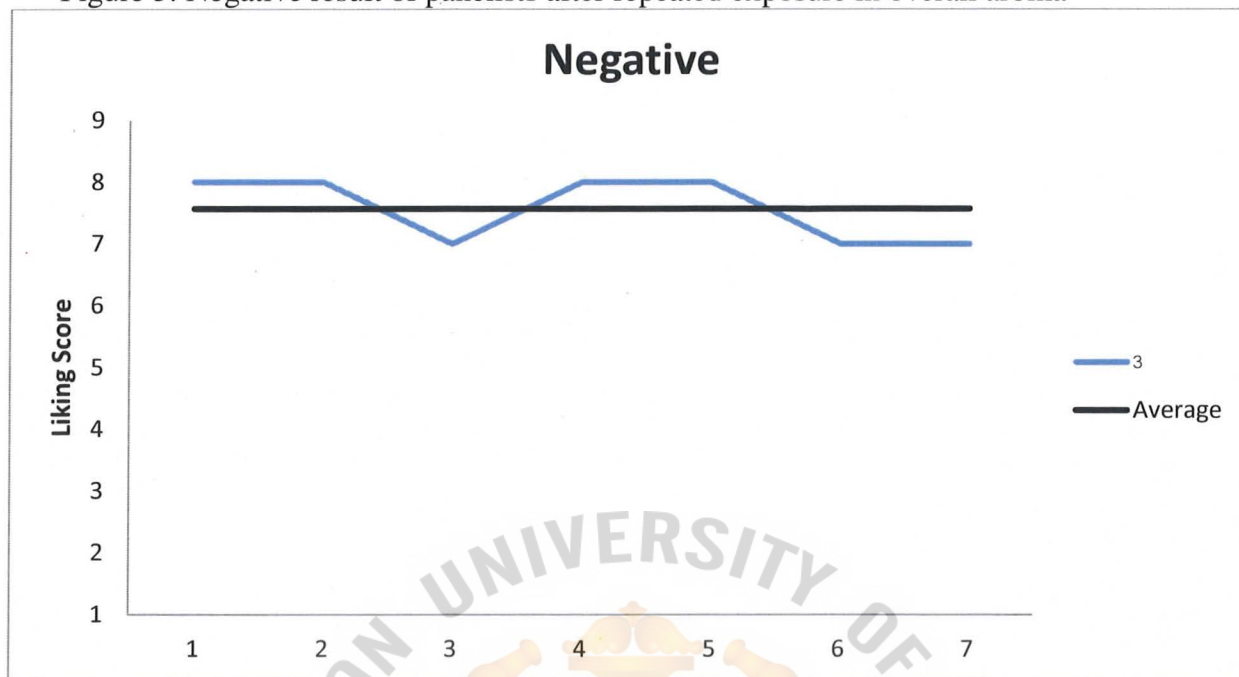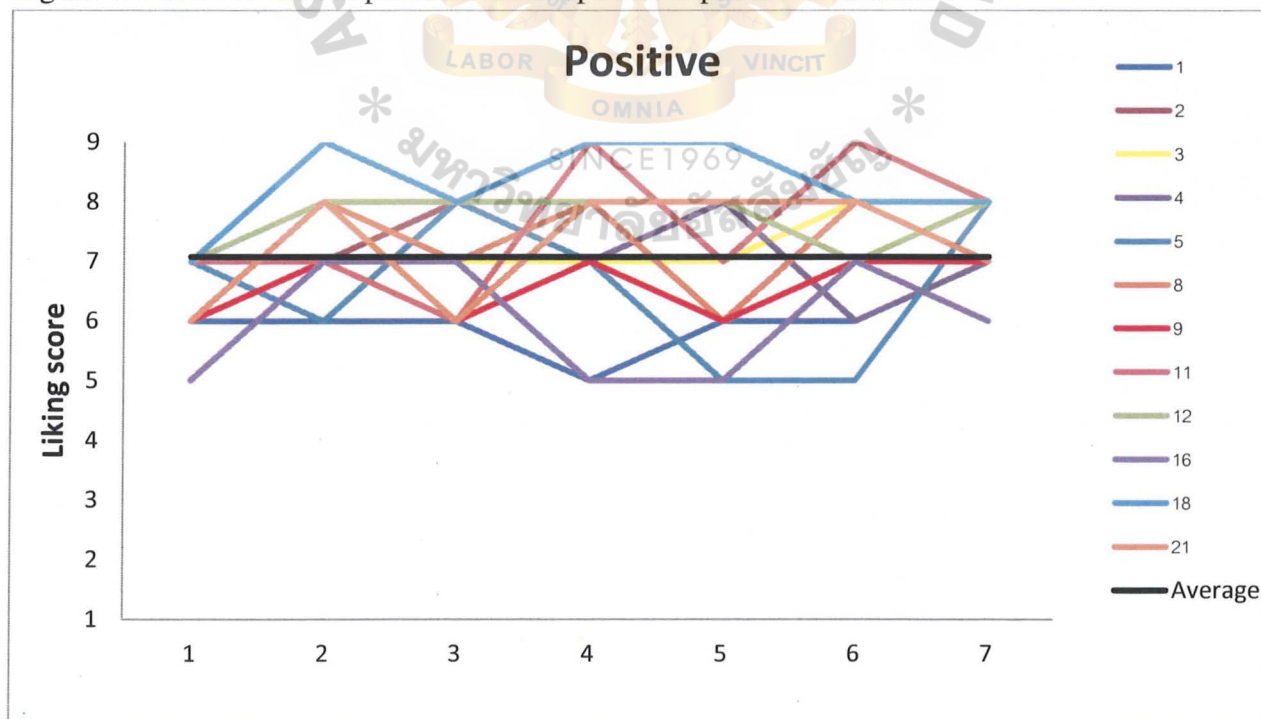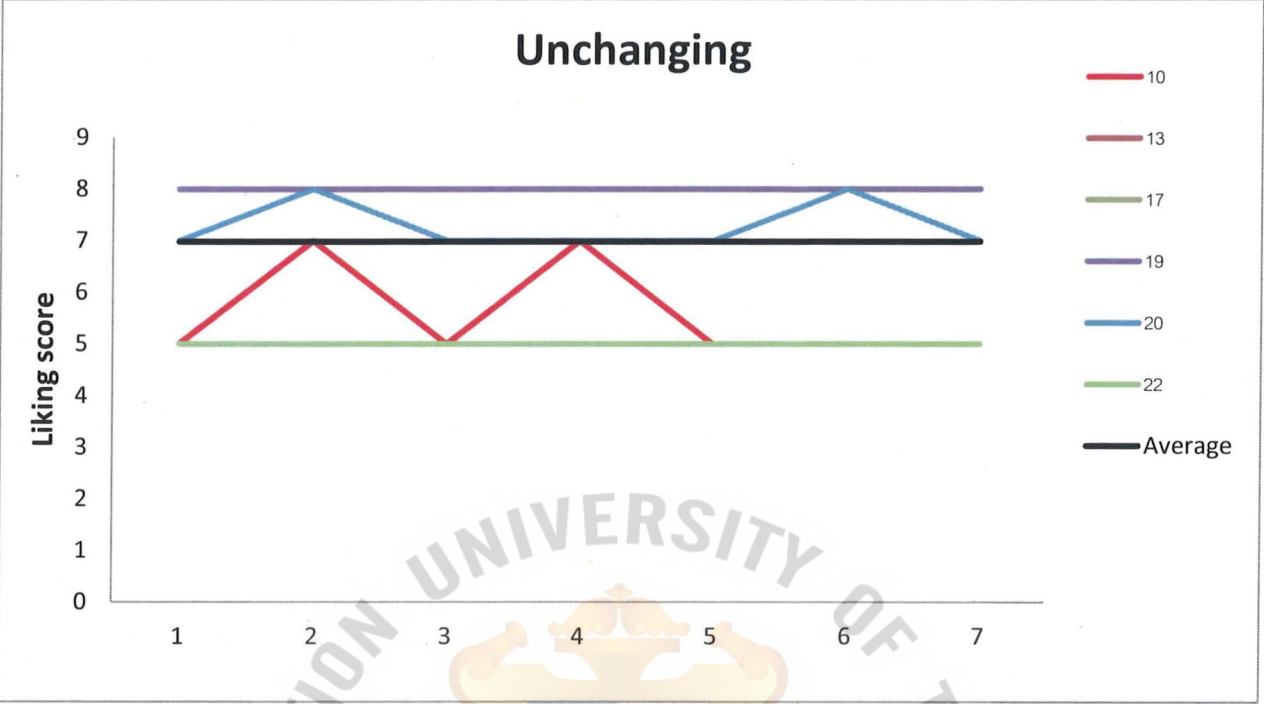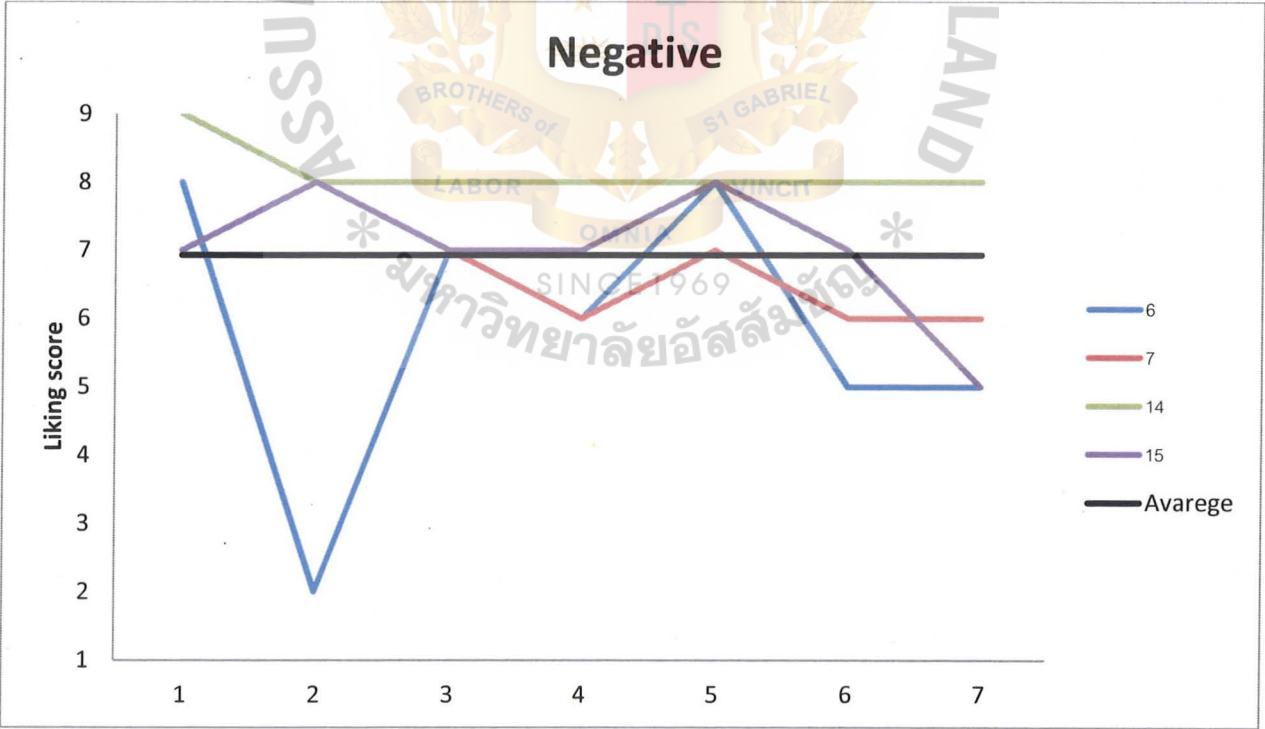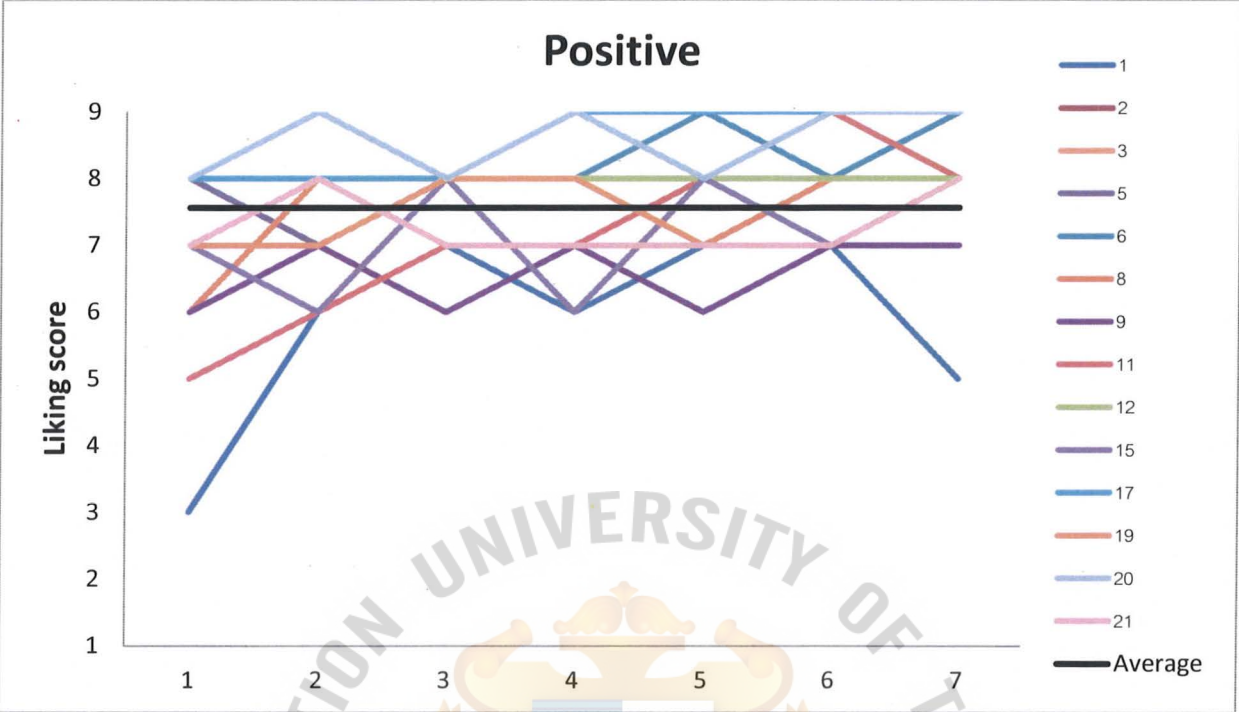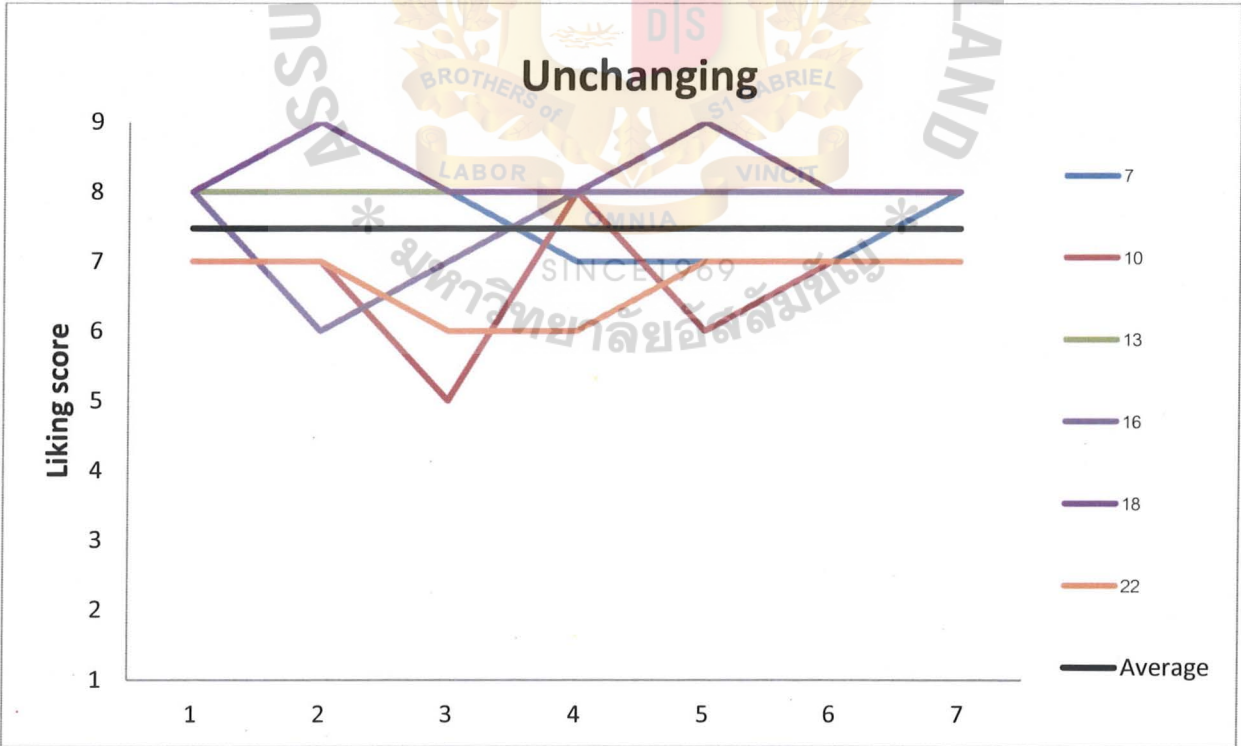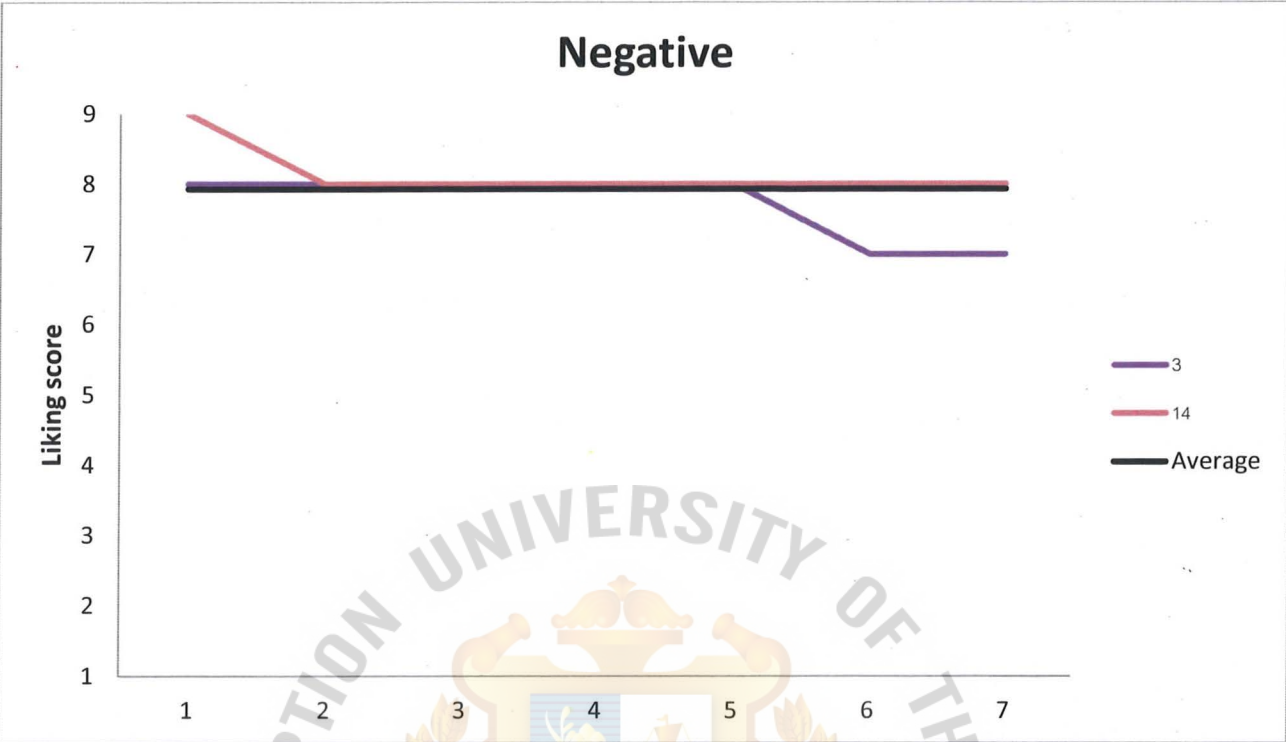Figure 2: Unchanging result of panelists after repeated exposure in overall aroma

Figure 3: Negative result of panelists after repeated exposure in overall aroma

In overall aroma testing, there are 13 panelists give positive result after repeating for 7 times and score average at 7.5 from 9. For unchanging result has 8 panelists feel the same that average is 7.3. There is only a panelist in the negative result.

2. Sweetness

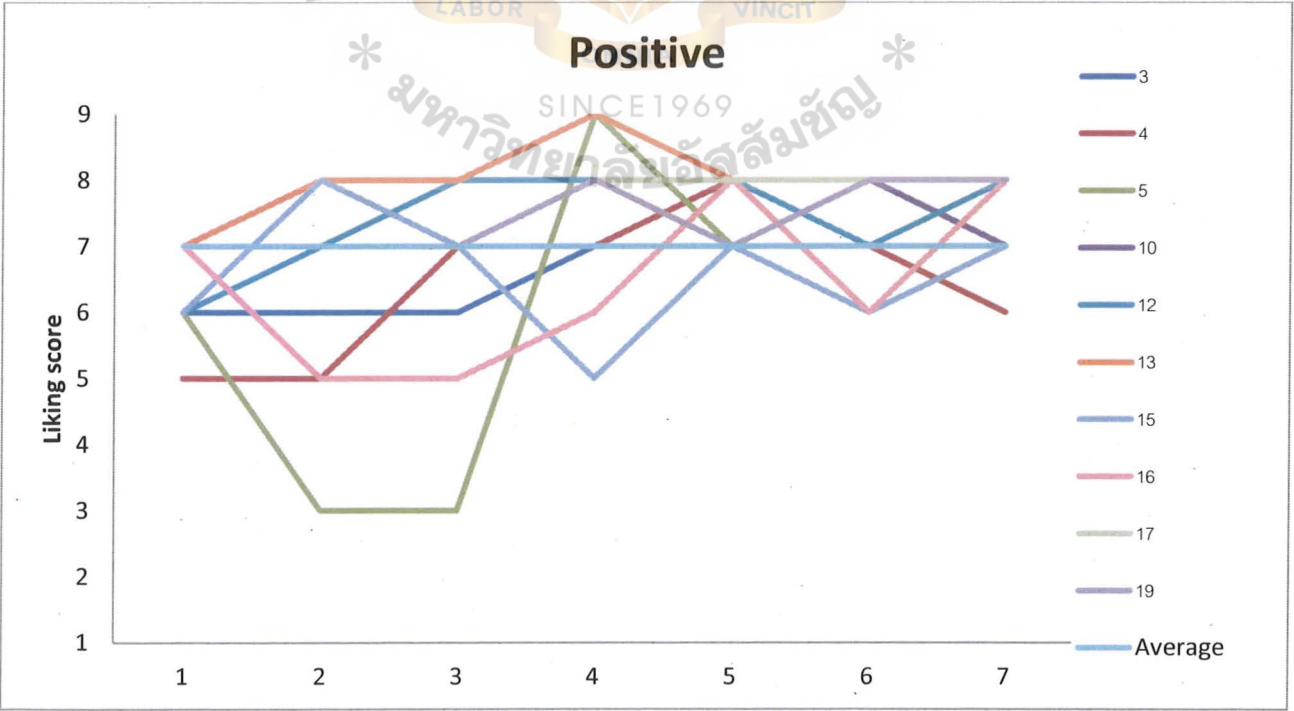Figure 4: Positive result of panelists after repeated exposure in sweetness

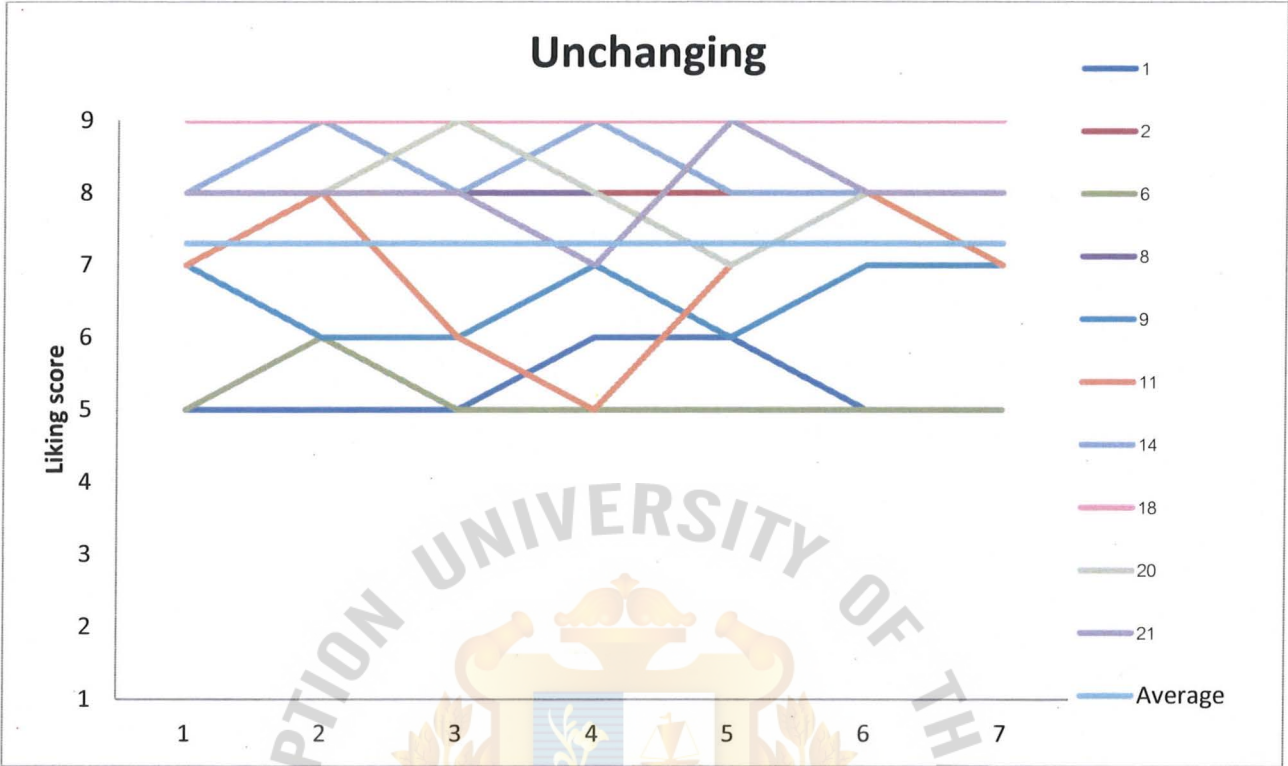Figure 5: Unchanging result of panelists after repeated exposure in sweetness

Figure 6: Negative result of panelists after repeated exposure in sweetness

Positive result for sweetness, 12 panelists feel better after repeat consume the sample for 7 times that get average at 7.1 for liking score. There are 6 panelists feel unchanged from the first time which 7.0 liking score by average. The negative average from repeated testing is 6.9 for 4 panelists.

3. Overall taste

Figure 7: Positive result of panelists after repeated exposure in overall taste

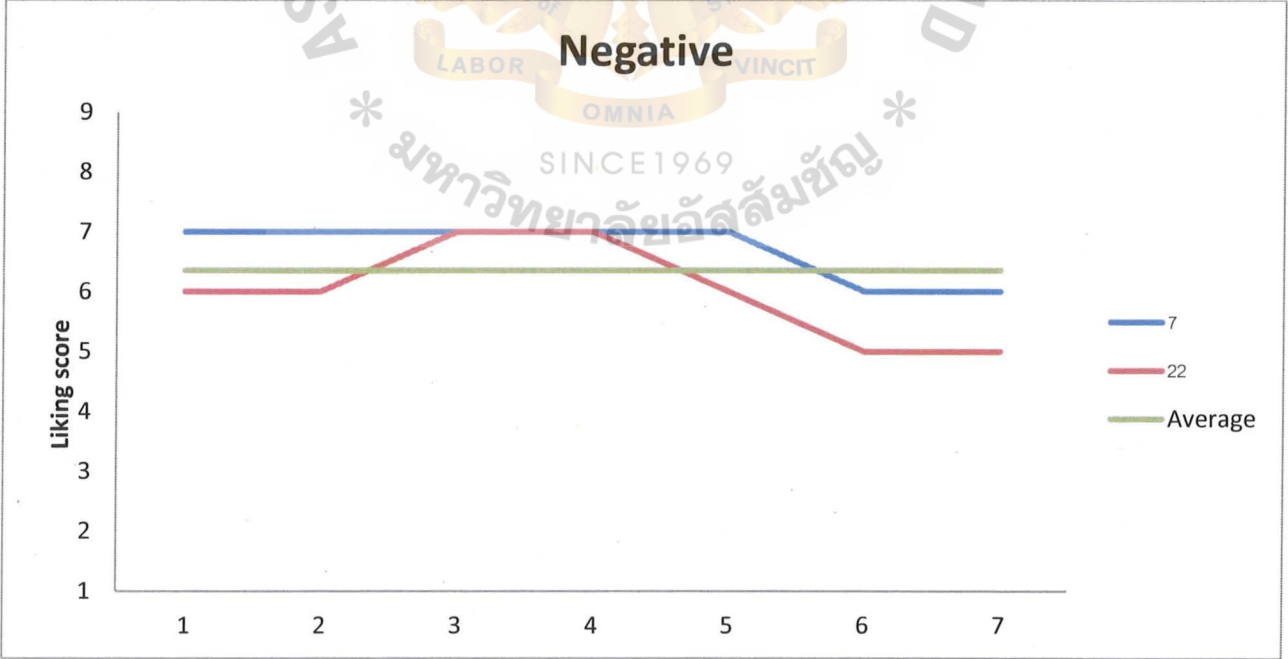Figure 8: Unchanging result of panelists after repeated exposure in overall taste

Figure 9: Negative result of panelists after repeated exposure in overall taste

Overall product taste get positive result that has average at 7.6 from 14 panelists.6 panelists still unchanged after repeated, average at 7.5. There are 2 panelists feels negative in overall taste average at 7.9.

4. Green Flavor

Figure 10: Positive result of panelists after repeated exposure in green flavor

Figure 11: Unchanging result of panelists after repeated exposure in green flavor

Figure 12: Negative result of panelists after repeated exposure in green flavor

There are 10 panelists are positive result after repeating 7 times at average 7. Unchanging in liking score has 10 panelists and 2 panelists still feel negative in green flavor.

5. Overall Flavor

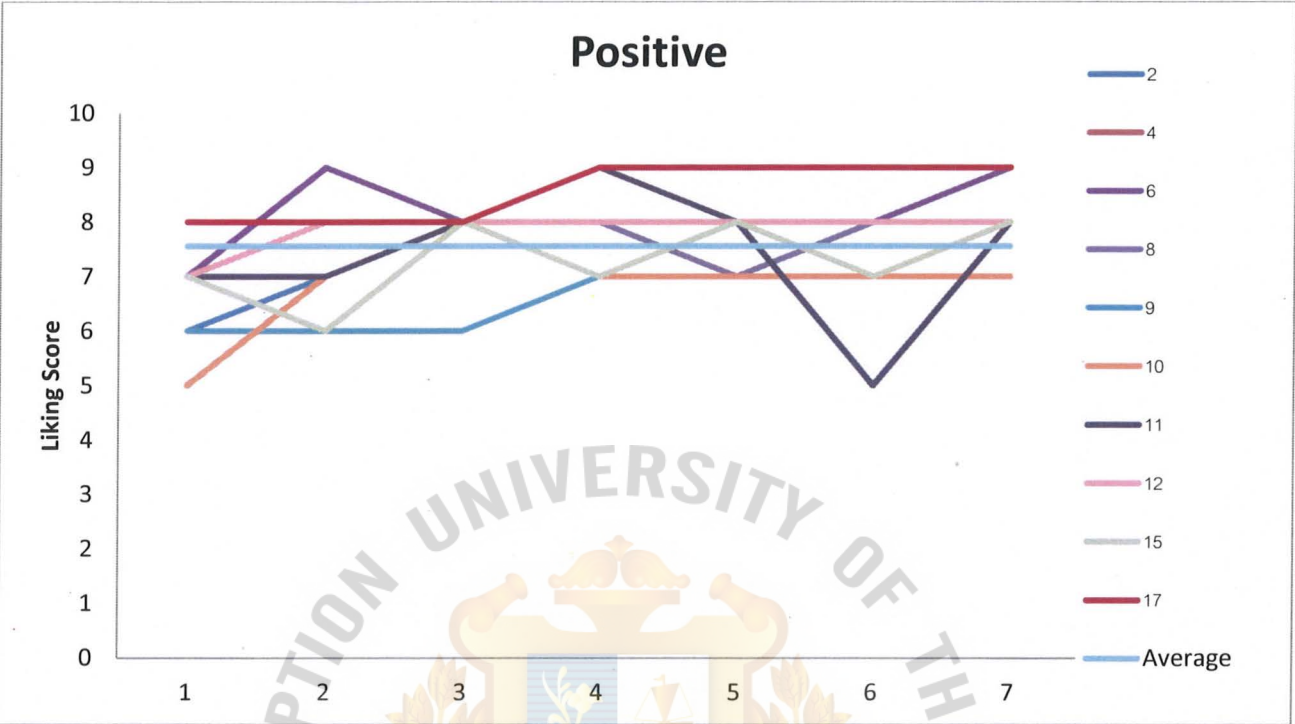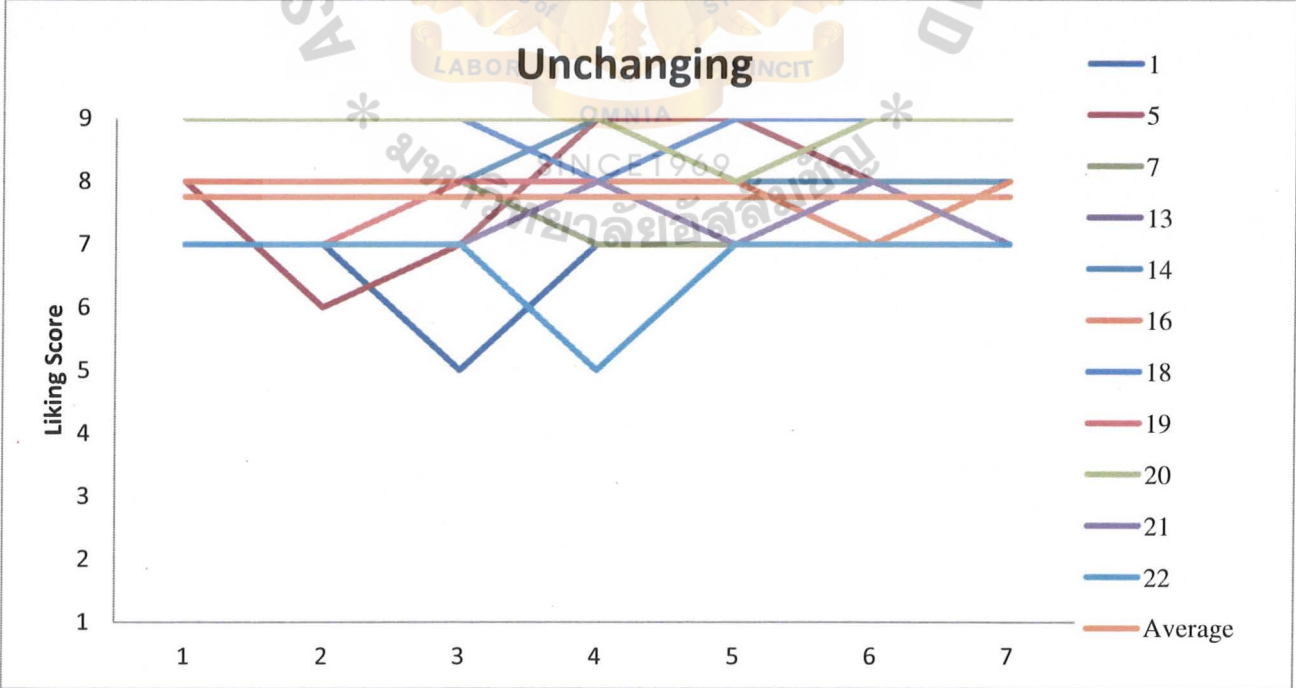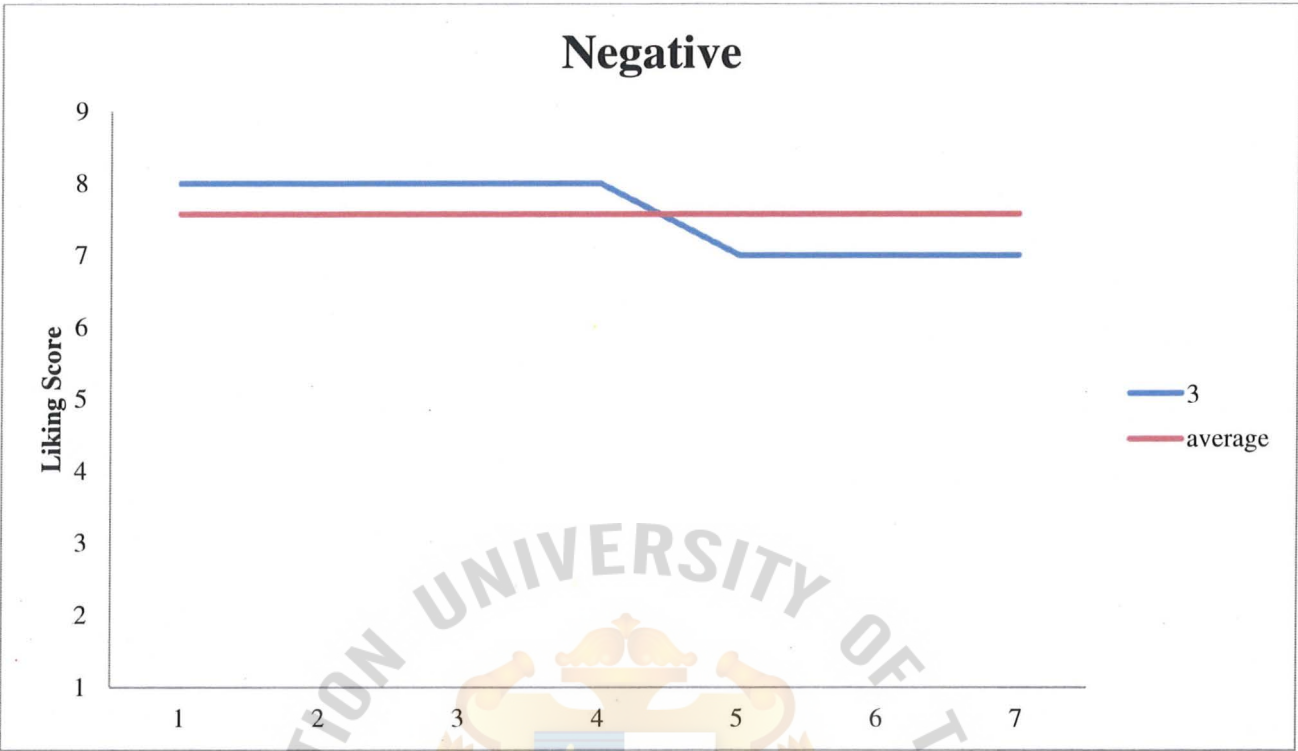Figure 13: Positive result of panelists after repeated exposure in overall flavor

Figure 14: Unchanging result of panelists after repeated exposure in overall flavor

Figure 15: Negative result of panelists after repeated exposure in overall flavor

There is a panelist still negative after repeated sample in overall flavor but 10 panelists are positive result that average is 7.6. Unchanging after repeat has 11 panelists.

6. Astringent

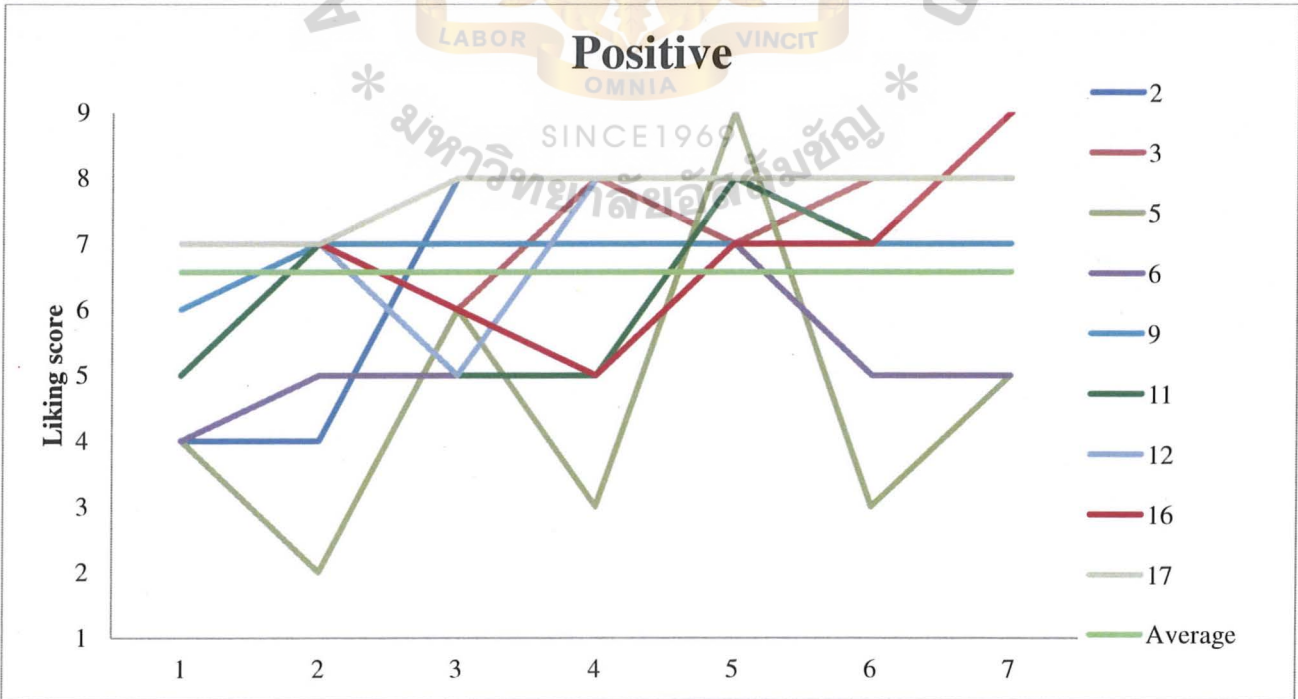Figure 16: Positive result of panelists after repeated exposure in astringent

Figure 17: Unchanging result of panelists after repeated exposure in astringent
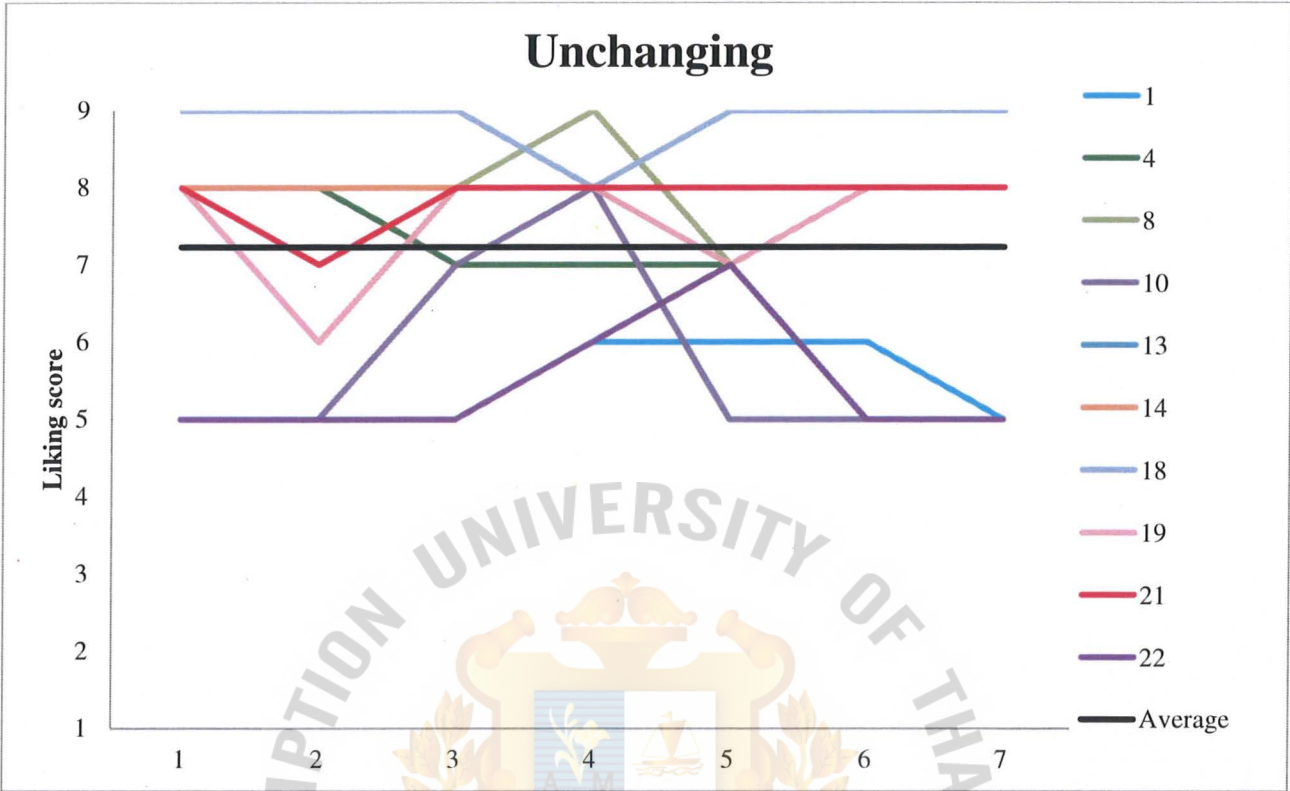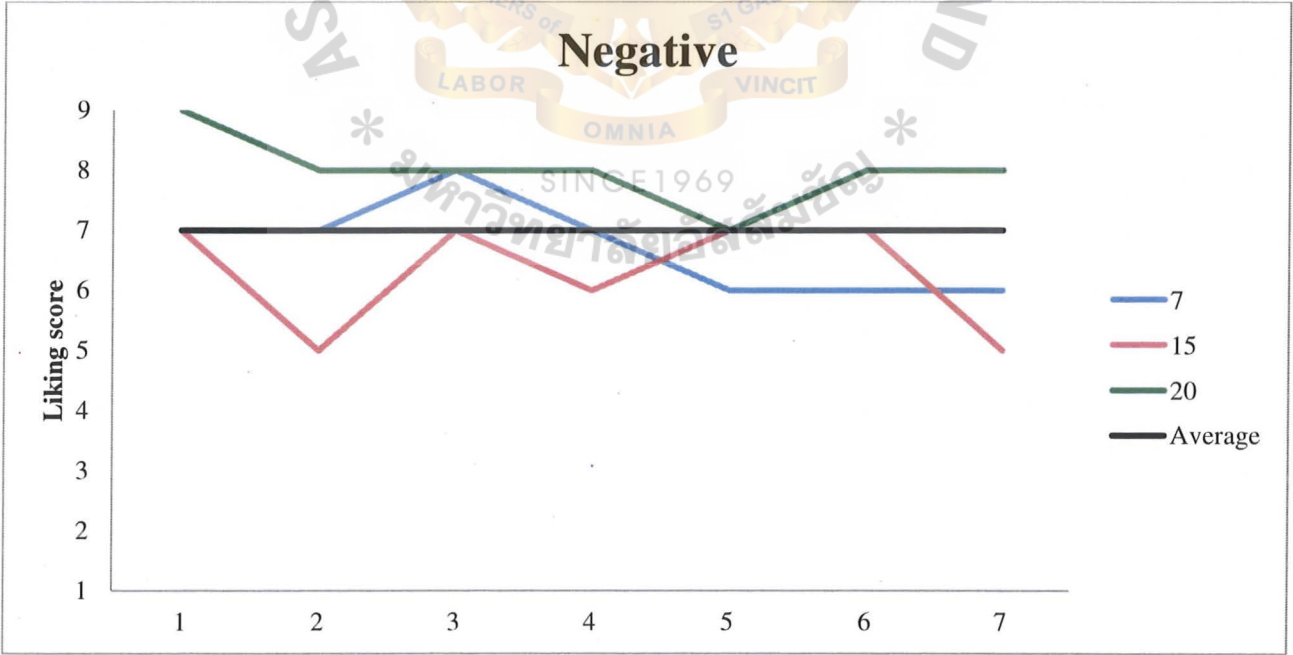

Figure 18: Negative result of panelists after repeated exposure in astringent

There are 9 panelists in astringent get positive result after repeating, the average is 6.6. 3 panelists are still negative in astringent and 10 panelists are unchanging after repeat 7 times.

7. Overall liking

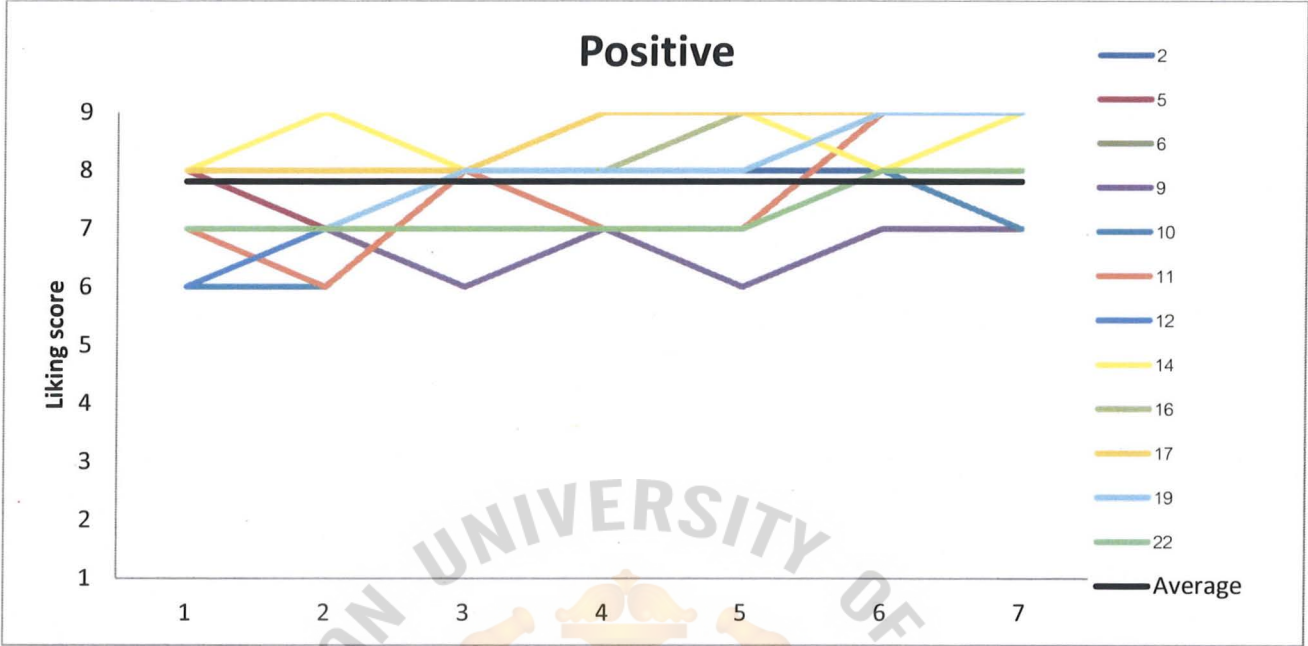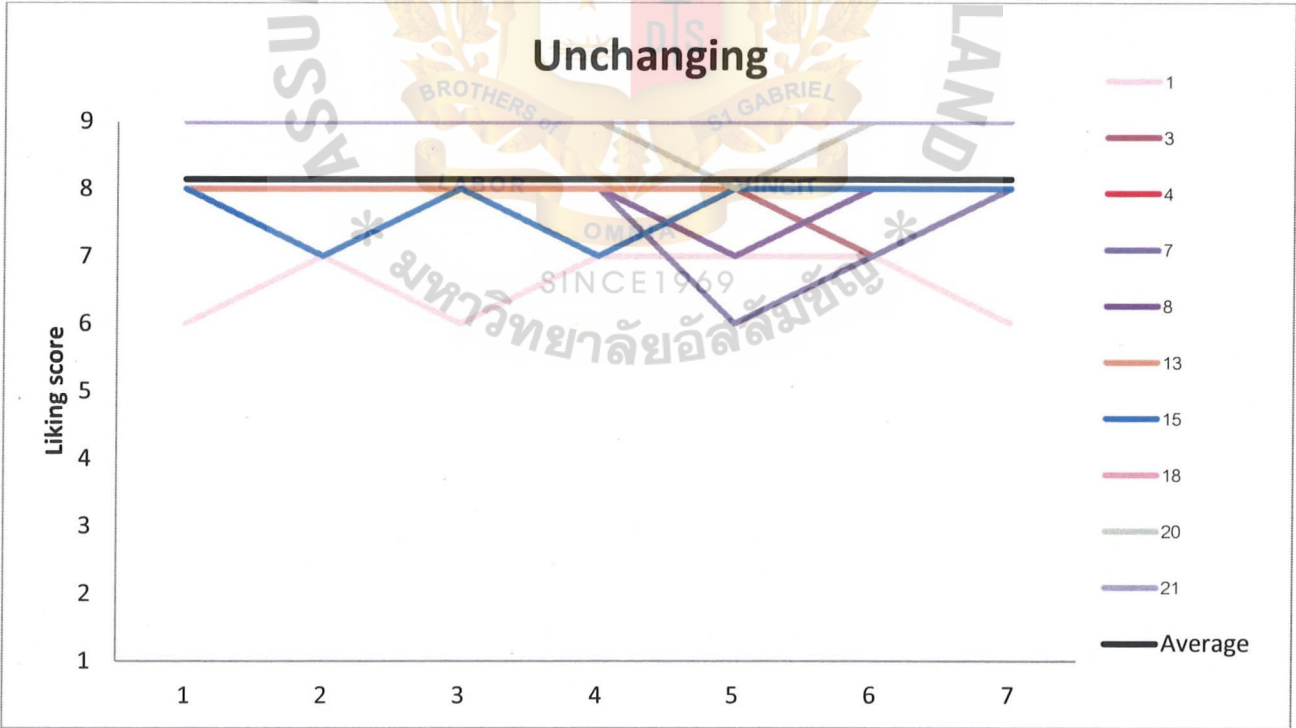Figure 19: Positive result of panelists after repeated exposure in overall liking

Figure 20: Unchanging result of panelists after repeated exposure in overall liking

There is no negative result in overall liking and 10 panelists still not change or feel like more than first time after repeating but there are 12 panelists are more like last time than first time which has average of liking at 7.8

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CONCLUSION

From this project, to study attitude, behavior and opinion of elderly people towards tea products, the most factors to purchasing for elderly people are safety, certification from FDA and nutrition of the products, but brand and trend are not affect to purchasing decision of elderly people. Asiatic pennywort has a lot of benefits to inside and outside body. Asiatic pennywort tea was produced to more options for some groups that don't like it taste, to easier consume but still have same benefits or more. To optimize preparation, procedure and process of Asiatic Pennywort tea, roasted and kneading can enhance the aroma and reduce green flavor itself and still have antioxidant activity. The best brewing asiatic pennywort tea is 85°C for 5 minutes because this conditions can get more antioxidant out from tea leave than other conditions and the good ratio when mixed with goji berry is 1 : 2 because goji berry contain sweet taste that help the consumer easier to consume than consume only tea. Moreover, goji berry can enhance antioxidant activity in Asiatic pennywort tea. After that, Asiatic Pennywort tea was created to be nanoparticle to more concentrate and more antioxidant activity. The process was used is ethanol extraction and gelatin nanoparticle because both of them can consume and can easy to buy in the markets. This nanoparticle tea can get more antioxidant activity than normal tea leave for 7 times in total phenolic content, 2 times for ferric reducing antioxidant power(FRAP) and 4 times for DPPH . This product has consumer acceptance for 76 percent, will buy if they are launched 68 percent. The overall liking has mean score at 6.6 ± 1.7 which most of people are no medical problems and no negative result in overall liking in this product after finish the repeated exposure.

ACKNOWLEDGE

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QUESTIONNAIRES AND BALLOT

Objective 1: To study attitude, behavior and opinion of elderly people towards tea product

Study the attitude and consumer's behavior of the elderly people in herbal tea product.

แบบสอบถามเกี่ยวกับทัศนคติและพฤติกรรมการบริโภคของผู้สูงอายุในกลุ่มผลิตภัณฑ์ชาสมุนไพร

Instruction: The purpose of this questionnaire is to obtain the information of elderly consuming behavior. Please kindly complete the question below based on your opinion by using ✓ on the ☐ answer(s)

คำแนะนำ : แบบสอบถามนี้จัดทำขึ้นเพื่อใช้ศึกษาพฤติกรรมการบริโภคของผู้สูงอายุ กรุณาตอบแบบสอบถามด้านล่างตามความคิดเห็นของคุณ โดยใช้ เครื่องหมาย ✓ ลงในช่อง ☐ หน้าคำตอบ

Part I : Consumer's behavior (พฤติกรรมผู้บริโภค)

1. Have you ever eat any herbs before? คุณเคยกินสมุนไพรมาก่อนไหม

   ☐ Yes เคย   ☐ No ไม่เคย

2. Which catalog of herbs that you normally eat? สมุนไพรหมวดไหนที่คุณมักจะกินโดยปกติ

   ☐ Thai herb สมุนไพรไทย   ☐ Chinese herb สมุนไพรจีน   ☐ Korean herb สมุนไพรเกาหลี

   ☐ Other, please specify (อื่นๆโปรดระบุ) _____

3. How to you consume them? คุณบริโภคสมุนไพรเหล่านั้นอย่างไร

   ☐ Eat as foods in meals กินเป็นอาหารในมื้ออาหาร ☐ Consumes as a beverage บริโภคแบบเครื่องดื่ม

   ☐ Medicines บริโภคในรูปแบบยา   ☐ Other, please specify (อื่นๆโปรดระบุ) _____

4. Have you ever consumed herbal tea?

   ☐ Yes เคย   ☐ No ไม่เคย

5. Which herbs of herbal teas that you ever consumed? ชาสมุนไพรประเภทไหนที่คุณเคยบริโภคมาก่อน

   ☐ Lemon grass tea ชาตะไคร้   ☐ Ginger tea ชาขิง   ☐ Indian gooseberry tea ชามะขามป้อม

   ☐ Safflower tea ชาดอกคำฝอย   ☐ Rosella tea ชากระเจี๊ยบ ☐ Pandan tea ชาใบเตย

   ☐ Mulberry leaf tea ชาใบหม่อน   ☐ Asiatic Pennywort tea ชาใบบัวบก

   ☐ Chrysanthemum tea ชาเก๊กฮวย   ☐ Reishi tea ชาเห็ดหลินจือ   ☐ Lou Han Gua ชาหล่อฮังก้วย

   ☐ Other, please specify (อื่นๆโปรดระบุ) _____

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6. Which package of herbal tea that you consume? ชาสมุนไพรในรูปแบบใดที่คุณบริโภค

☐ Bottom tea ชาผงสำเร็จรูป ☐ Tea bag ชาชงแบบถุง ☐ Tea leaves ชาชงแบบใบ

☐ Tea powder ชาชงแบบผง ☐ Other, please specify (อื่นๆโปรดระบุ) _____

7. How often do you consume the herbal tea? (คุณกินชาสมุนไพรบ่อยแค่ไหน)

☐ Everyday ☐ 4 – 5 times in a week ☐ 2 - 3 times in a week

☐ 1 time in a week ☐ 2 – 3 times in a month ☐ 1 time in a month

☐ Other, please specify (อื่นๆโปรดระบุ) _____

8. When do you consume herbal tea? คุณจะดื่มชาสมุนไพรตอนไหน?

☐ After wake up immediately หลังตื่นนอนทันที ☐ Morning ตอนเช้า

☐ Afternoon ตอนกลางวัน ☐ Evening ตอนเย็น

☐ Before sleep ก่อนนอน ☐ Occasionally not specific the time

9. Where do you buy the herbal tea products? คุณซื้อผลิตภัณฑ์ชาสมุนไพรที่ใด?

☐ Fresh market (ตลาด)

☐ Hypermarket (ไฮเปอร์มาร์เก็ต) : Big C, Makro, Tesco Lotus (บิ๊กซี, แม็คโคร, เทสโก้ โลตัส)

☐ Supermarket (ซุปเปอร์มาร์เก็ต) : Gourmet Market (กัวเมทมาร์เก็ต), Tops supermarket (ท้อปมาร์เก็ต)

☐ Internet or delivery (ทางอินเตอร์เน็ตหรือจัดส่ง)

☐ Other, please specify (อื่นๆโปรดระบุ) _____

10. How many bahts do you purchase the herbal tea in each time?
คุณใช้เงินกี่บาทในการซื้อชาสมุนไพรในแต่ละครั้ง?

☐ Less than 15 bahts (บาท) ☐ 16 – 30 bahts (บาท)

☐ 31 - 45 bahts (บาท) ☐ 45 - 60 bahts (บาท)

☐ 61 - 75 bahts (บาท) ☐ More than 3,500 bahts (บาท)

Figure 25: Graph result from questionnaire "Which herbs of herbal teas that you ever consumed?"
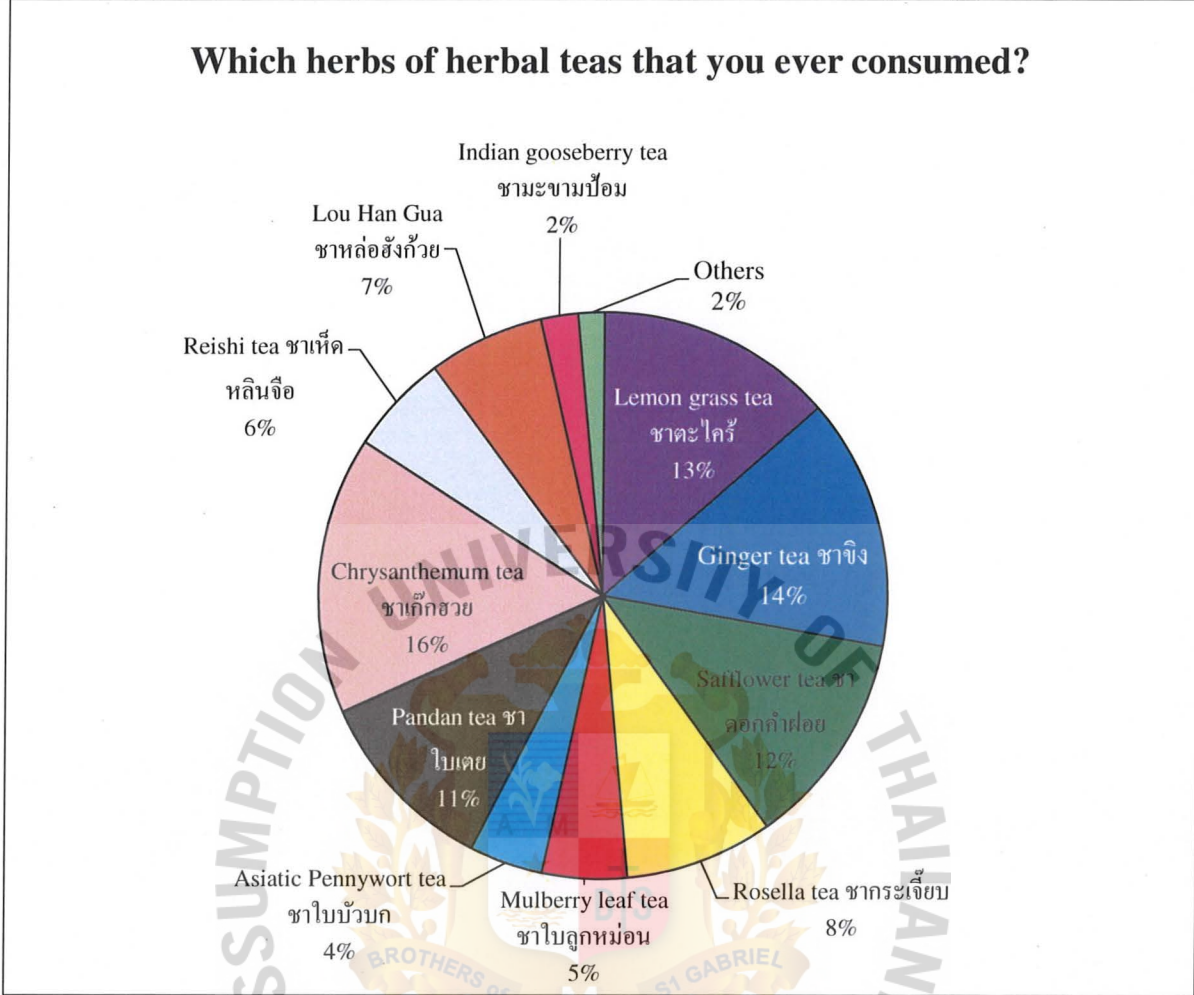

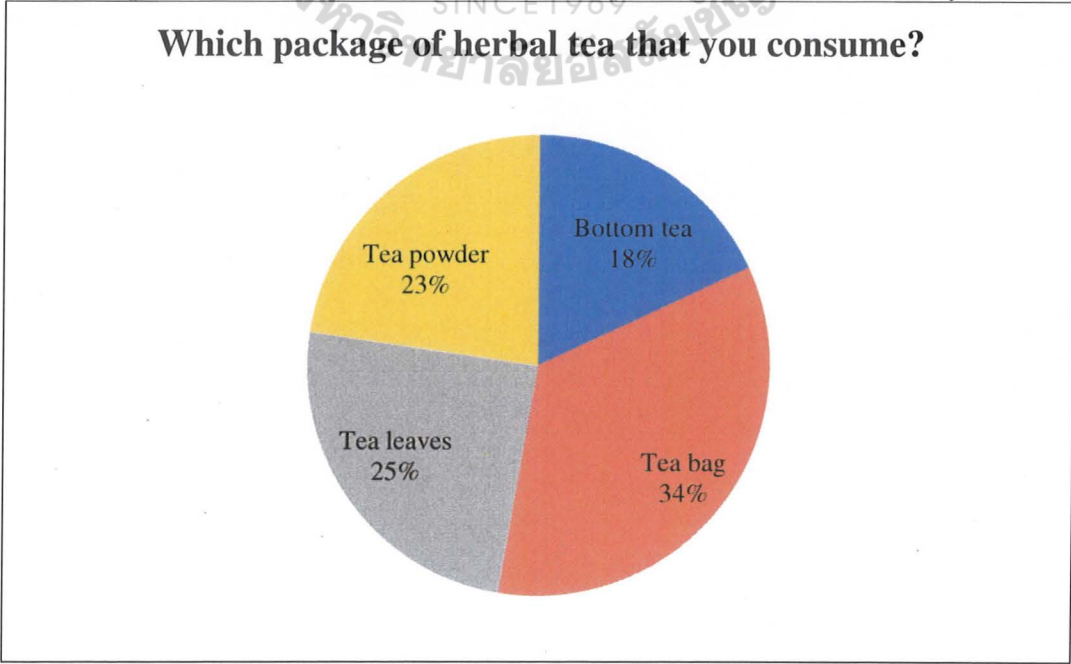Figure 26: Graph result from questionnaire "Which package of herbal tea that you consume?"

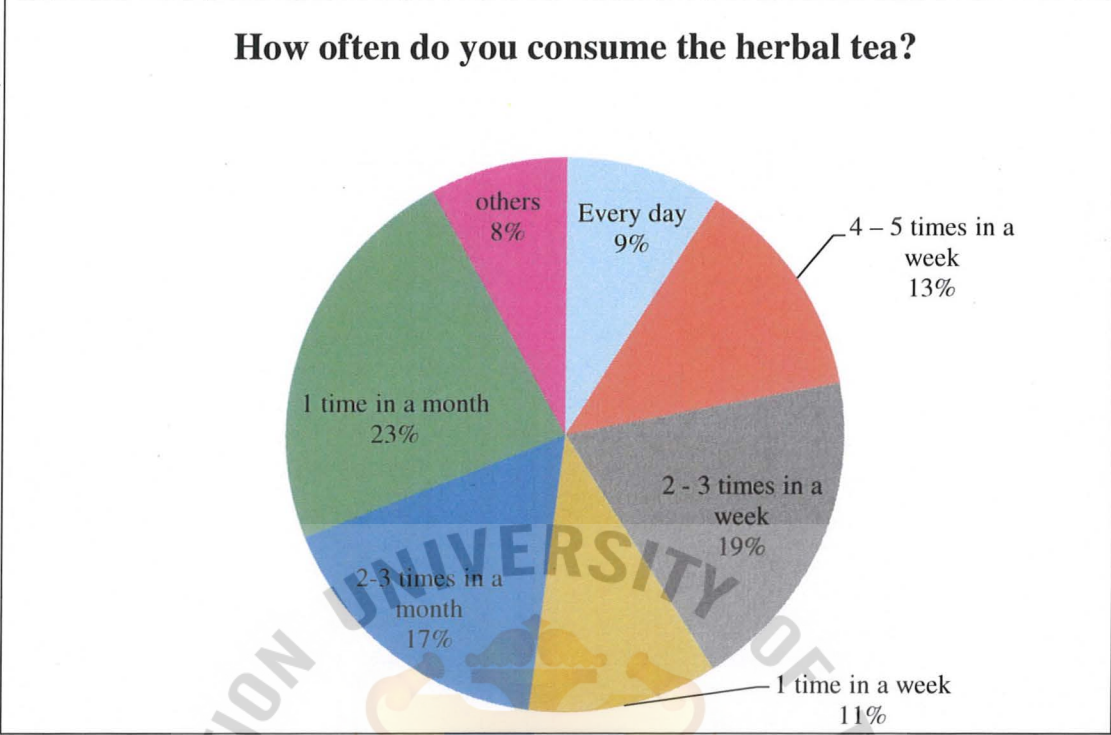Figure 27: Graph result from questionnaire "How often do you consume the herbal tea?"

How often do you consume the herbal tea?

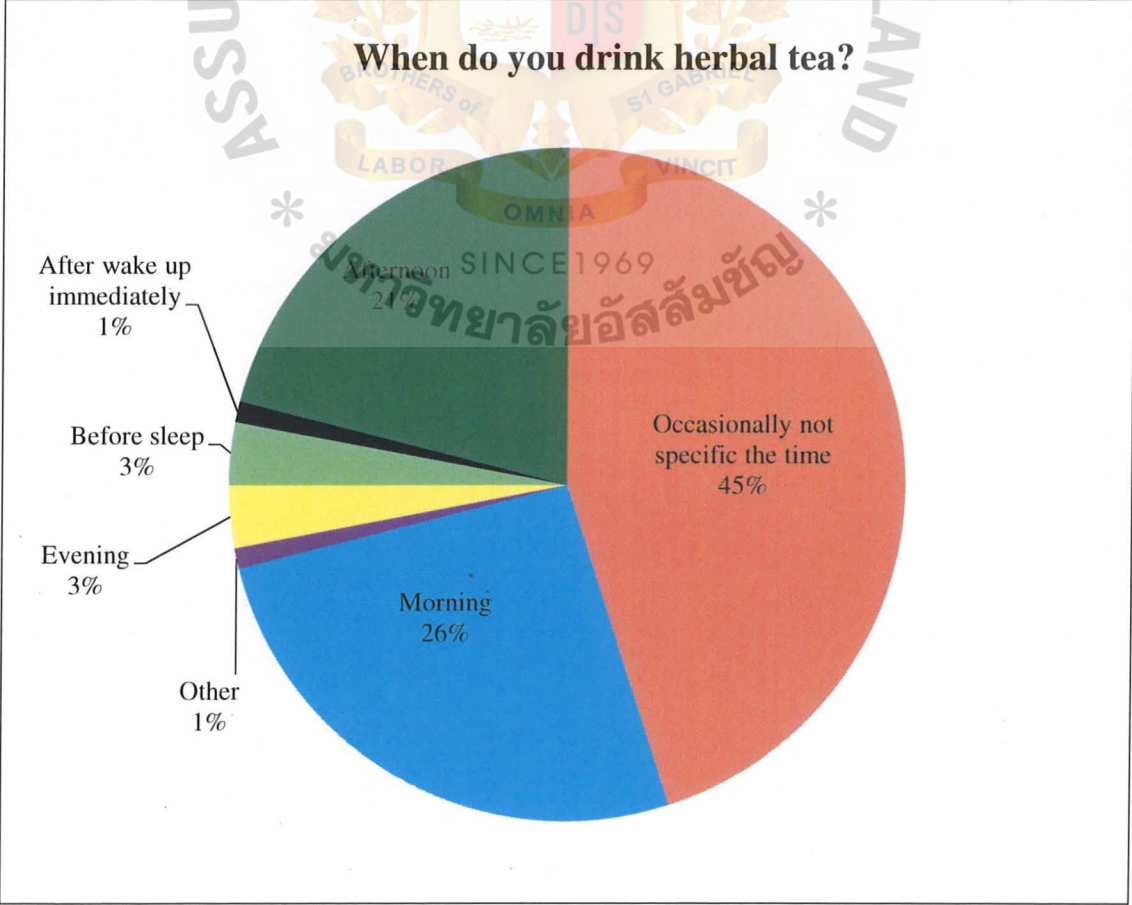Figure 28: Graph result from questionnaire "When do you drink herbal tea?"

When do you drink herbal tea?

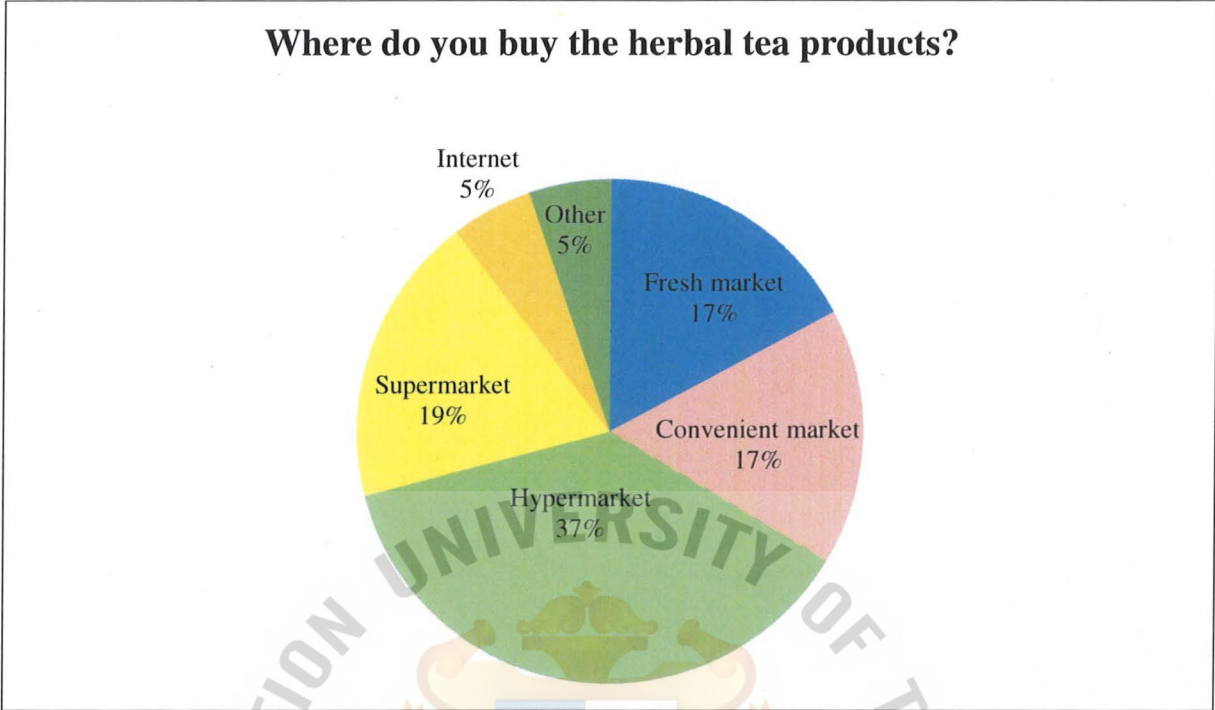Figure 29: Graph result from questionnaire "Where do you buy the herbal tea products?"

Where do you buy the herbal tea products?

Internet 5%
Other 5%
Fresh market 17%
Convenient market 17%
Supermarket 19%
Hypermarket 37%

Figure 30: Graph result from questionnaire "How many bahts do you purchase the herbal tea in each time?"

How many bahts do you purchase the herbal tea in each time?

Get free 1%
Less than 15 bahts 8%
16 – 30 bahts 21%
More than 75 bahts 41%
31 - 45 bahts 6%
45 - 60 bahts 19%
61 - 75 bahts 4%
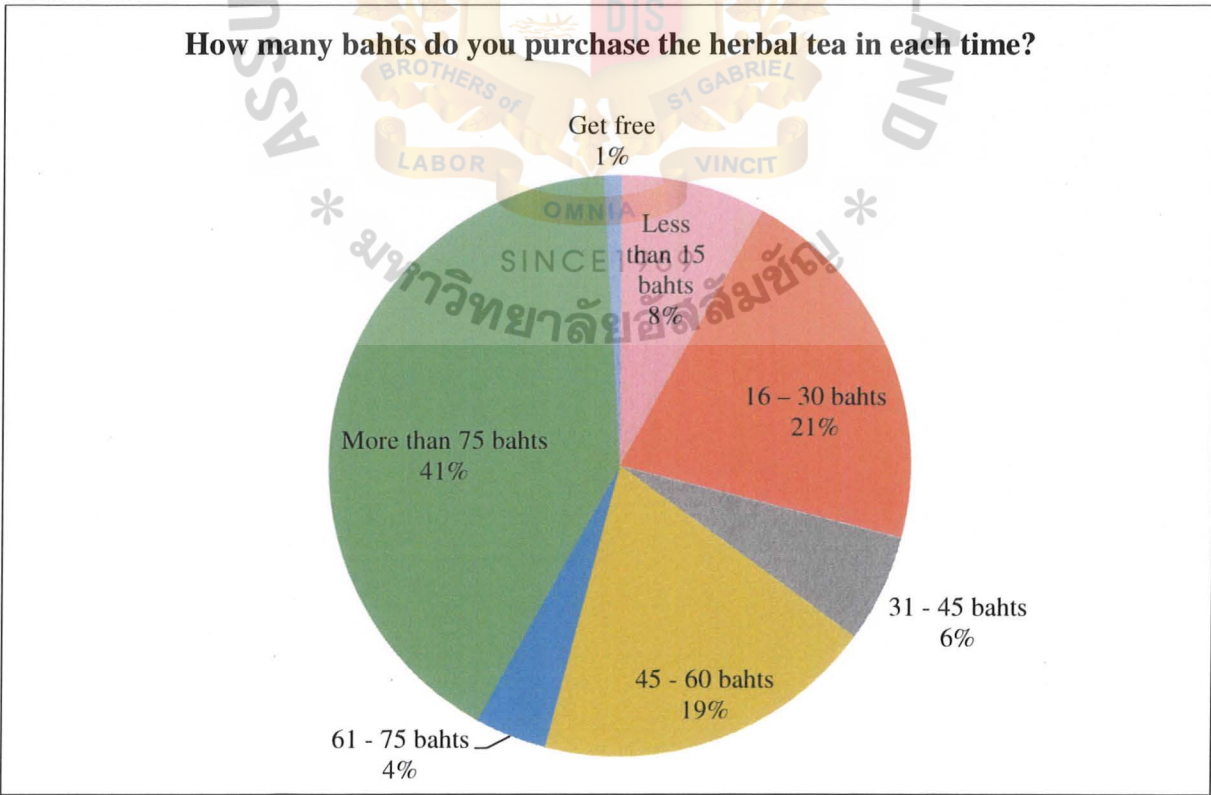
Figure 31: Graph result from questionnaire "Why do you consume herbal tea?"
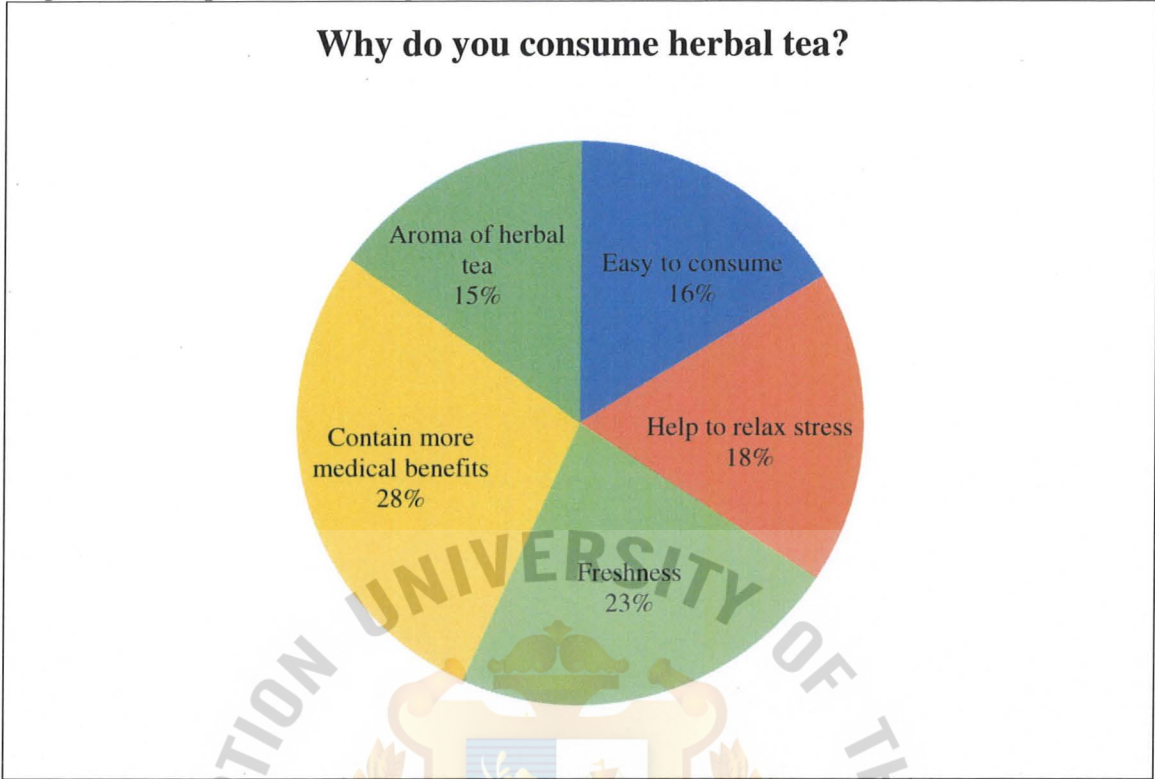

Why do you consume herbal tea?

Figure 32: Graph result from questionnaire "Do you agree that all nutritive value in the product will be presented as it is claimed on the package?"
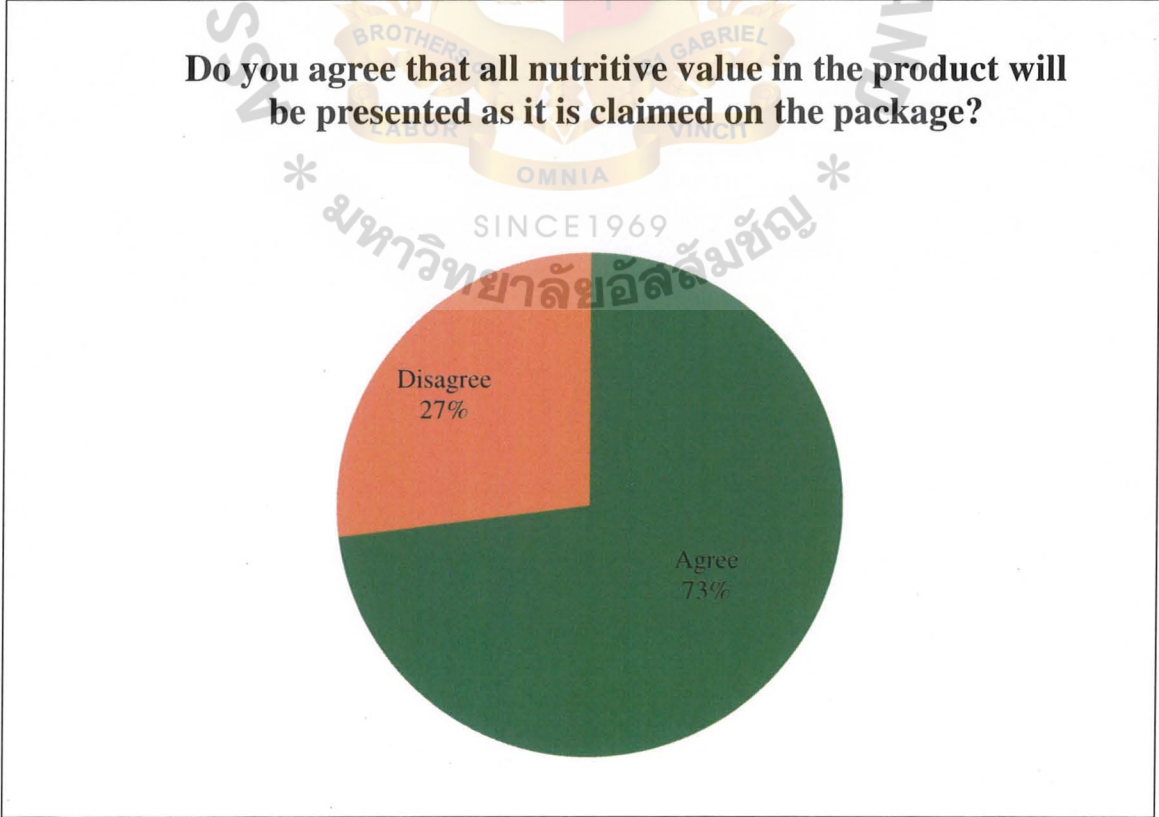

Do you agree that all nutritive value in the product will be presented as it is claimed on the package?

Figure 33: Graph result from questionnaire "How many percent that your body will absorb the nutrients from products?"
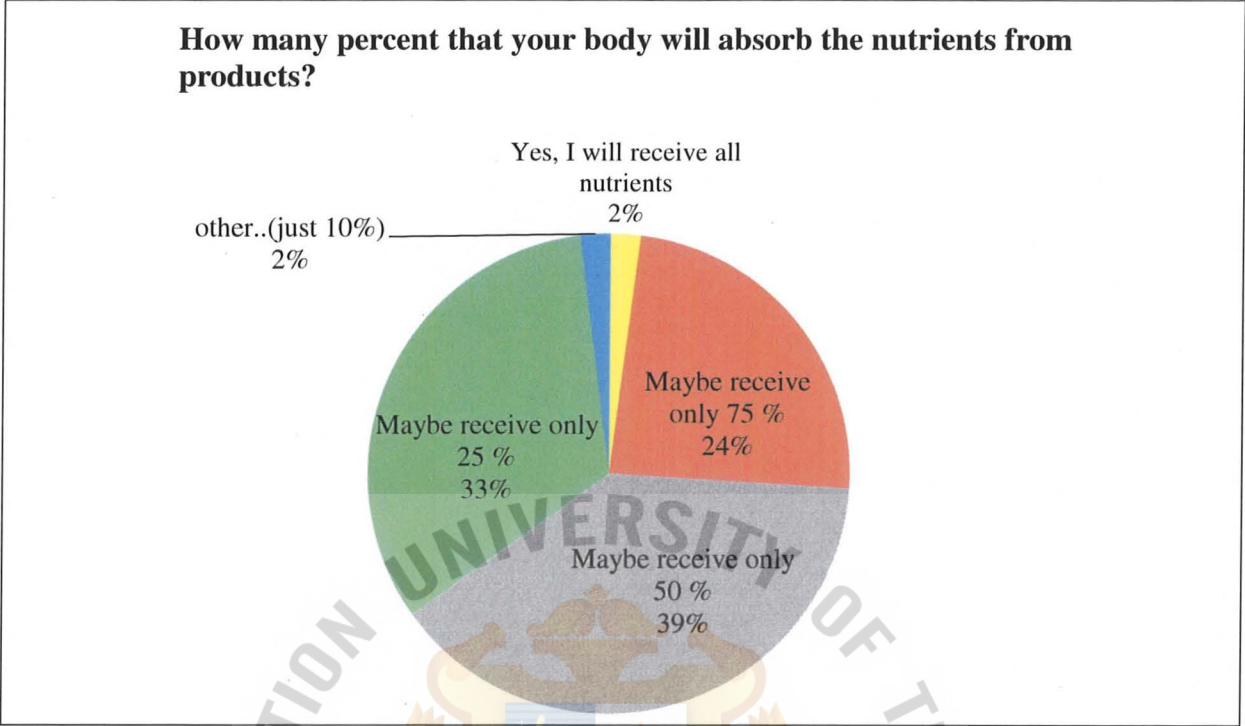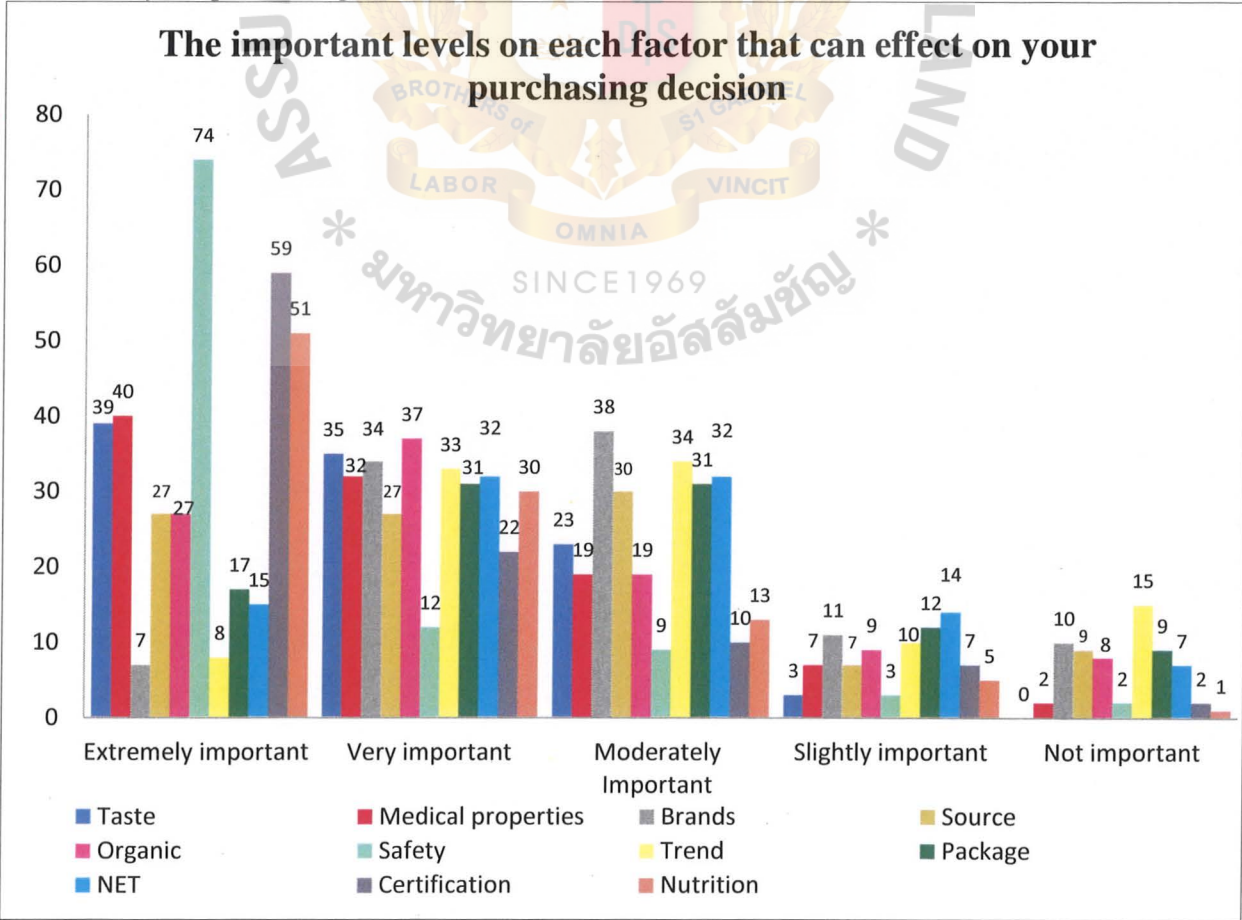

Figure 34: Graph result from questionnaire about the important levels on each factor that can effect on your purchasing decision

Demographic

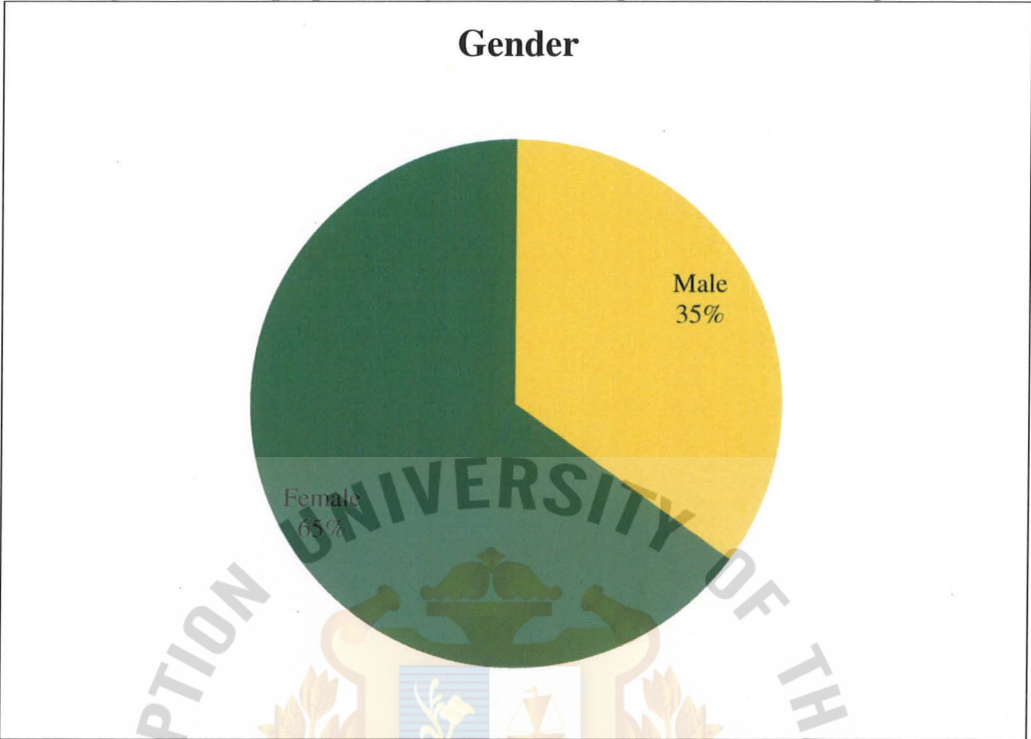Figure 35: Graph percentage result from questionnaire about gender

Gender

Male
35%

Female
65%

Figure 36: Graph result of questionnaire from objective 1 about age

Age

66 – 70 years old
1%

More than 70
years old
3%

61 – 65 years old
17%

50 – 55 years old
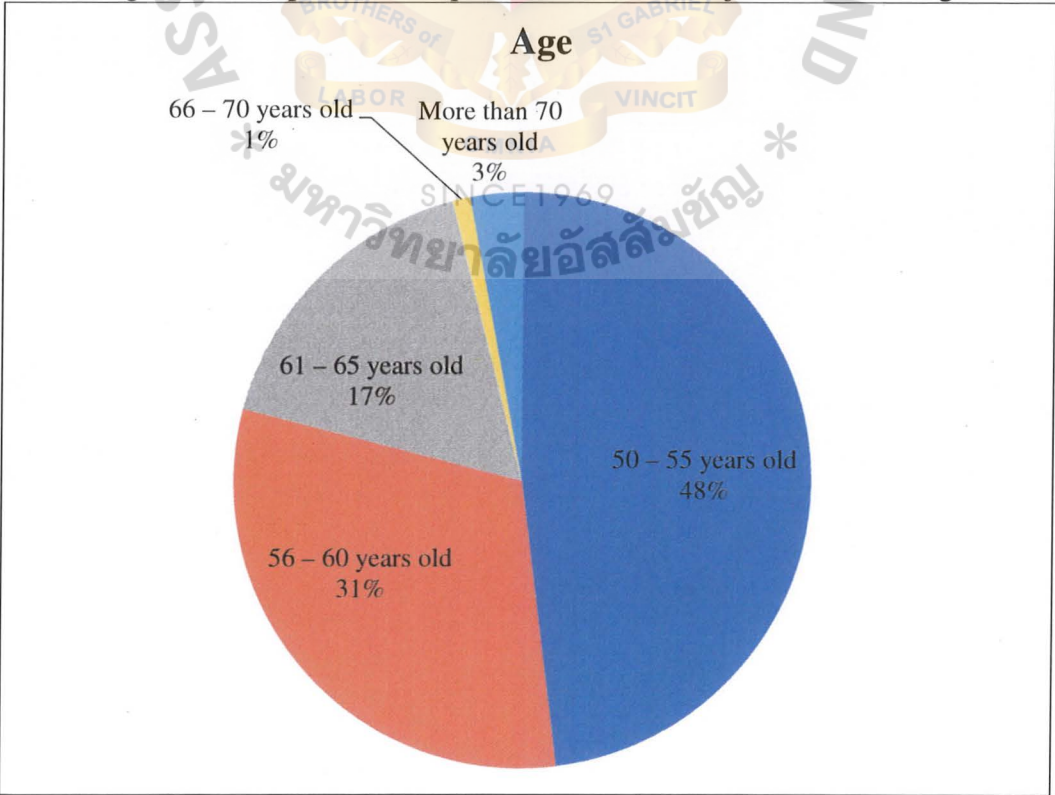48%

56 – 60 years old
31%

Figure 37: Graph result of questionnaire from objective 1 about status
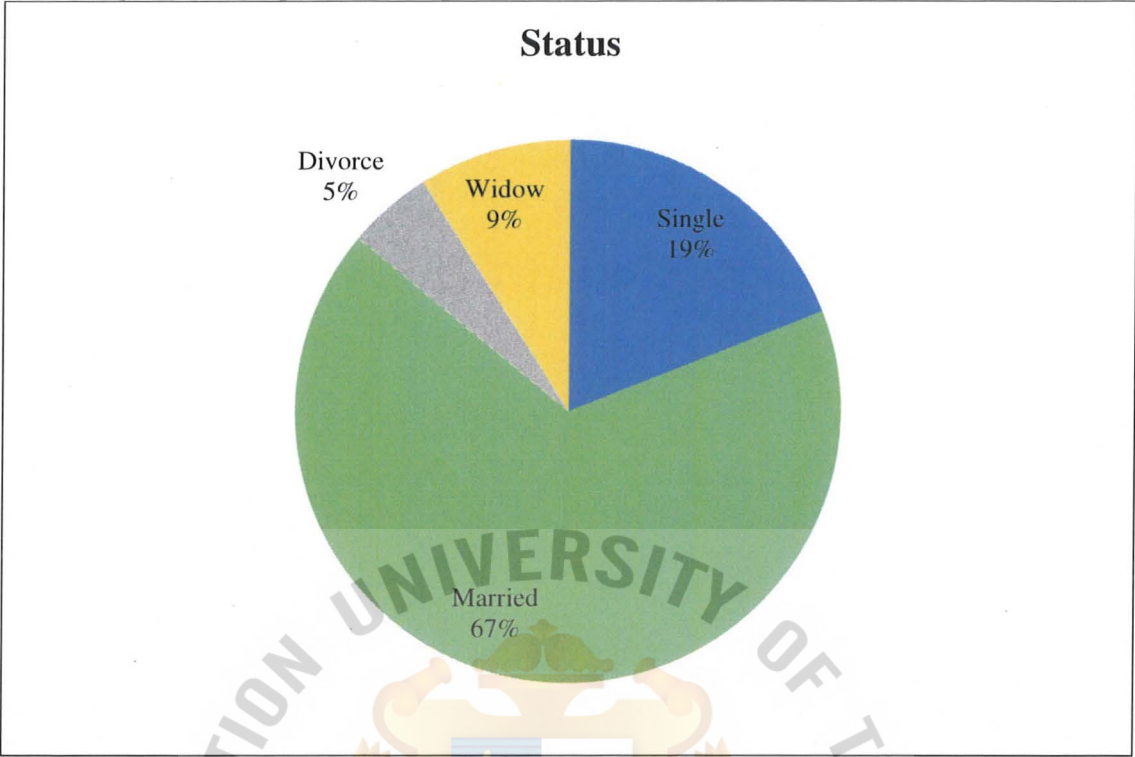
Status

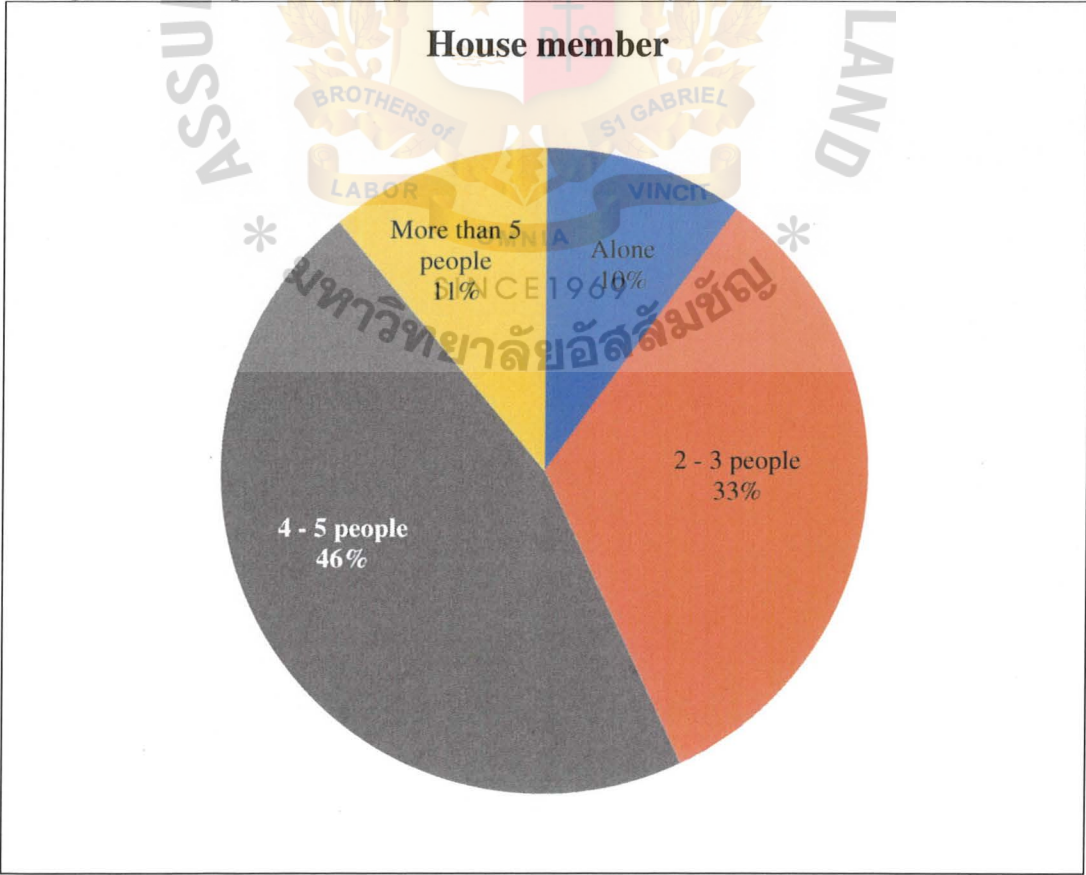Figure 38: Graph result of questionnaire from objective 1 about house member

House member

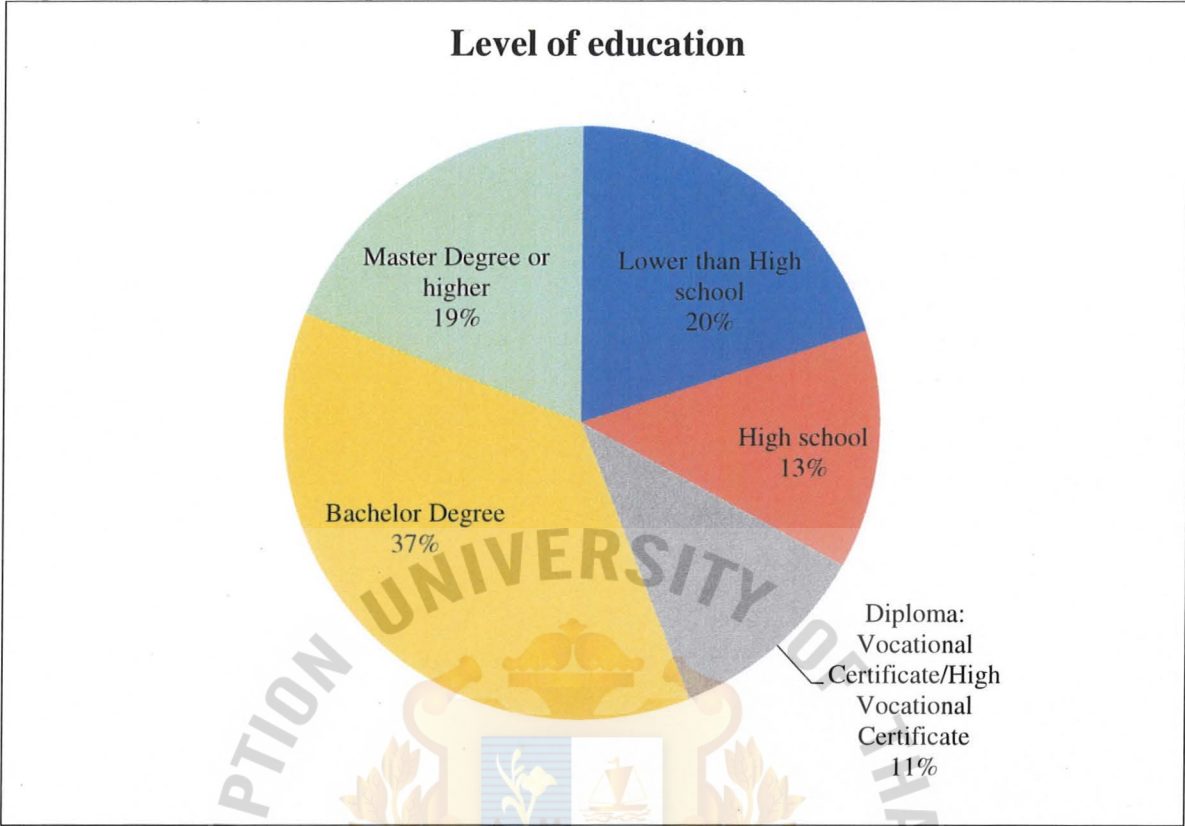Figure 39: Graph result of questionnaire from objective 1 about level of education

Level of education

Master Degree or higher 19%

Lower than High school 20%

High school 13%

Bachelor Degree 37%

Diploma: Vocational Certificate/High Vocational Certificate 11%

Figure 40: Graph result of questionnaire from objective 1 about Income/month

Income/month

Less than 10,000 ฿ 13%

More than 50,000 ฿ 25%

10,001 - 20,000 ฿ 19%

40,001 - 50,000 ฿ 13%

20,001 – 30,000 ฿ 21%

30,001 - 40,000 ฿ 9%
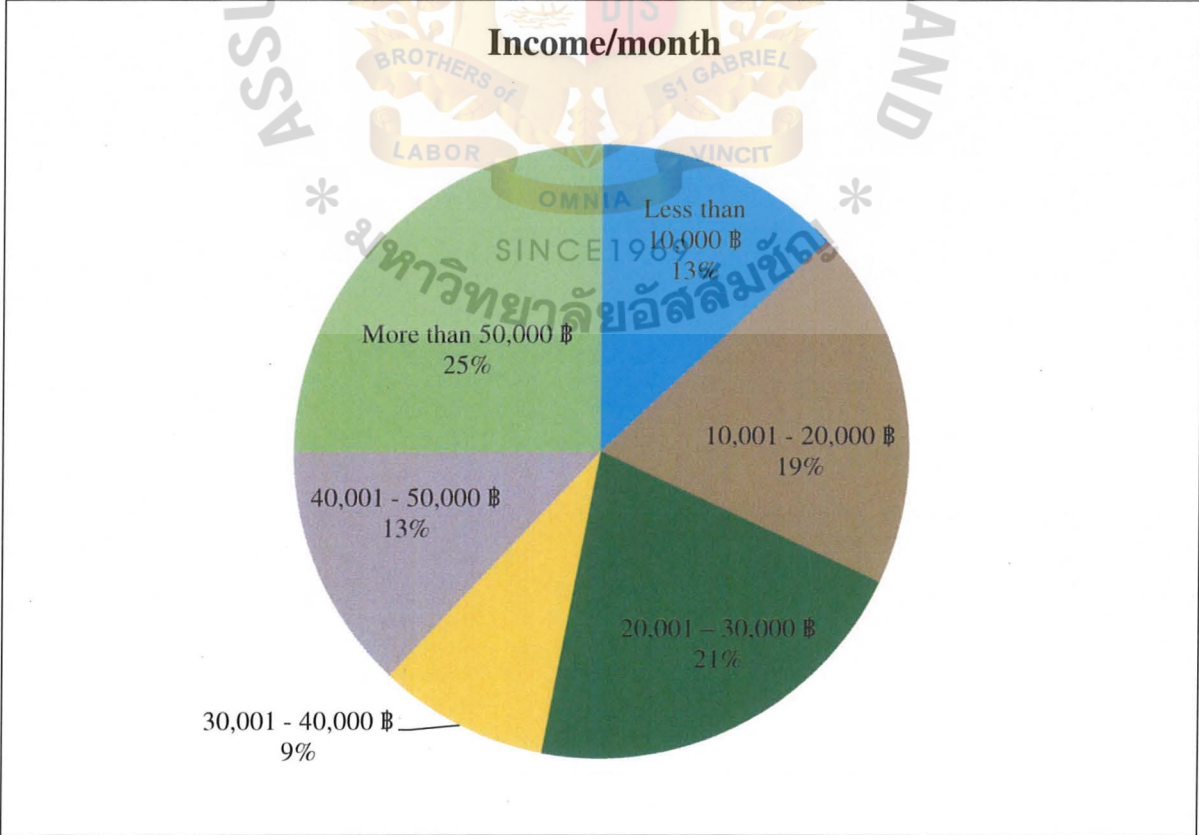
Figure 41: Graph result of questionnaire from objective 1 about Chronic health conditions

Chronic health conditions

other 3%

Heart disease 2%

Nephropathy 2%

Diabetes mellitus 10%

Hypertension 22%

No Chronic health conditions 39%

Dyslipidemia 15%

Obesity and overweight 6%

Postural hypotension
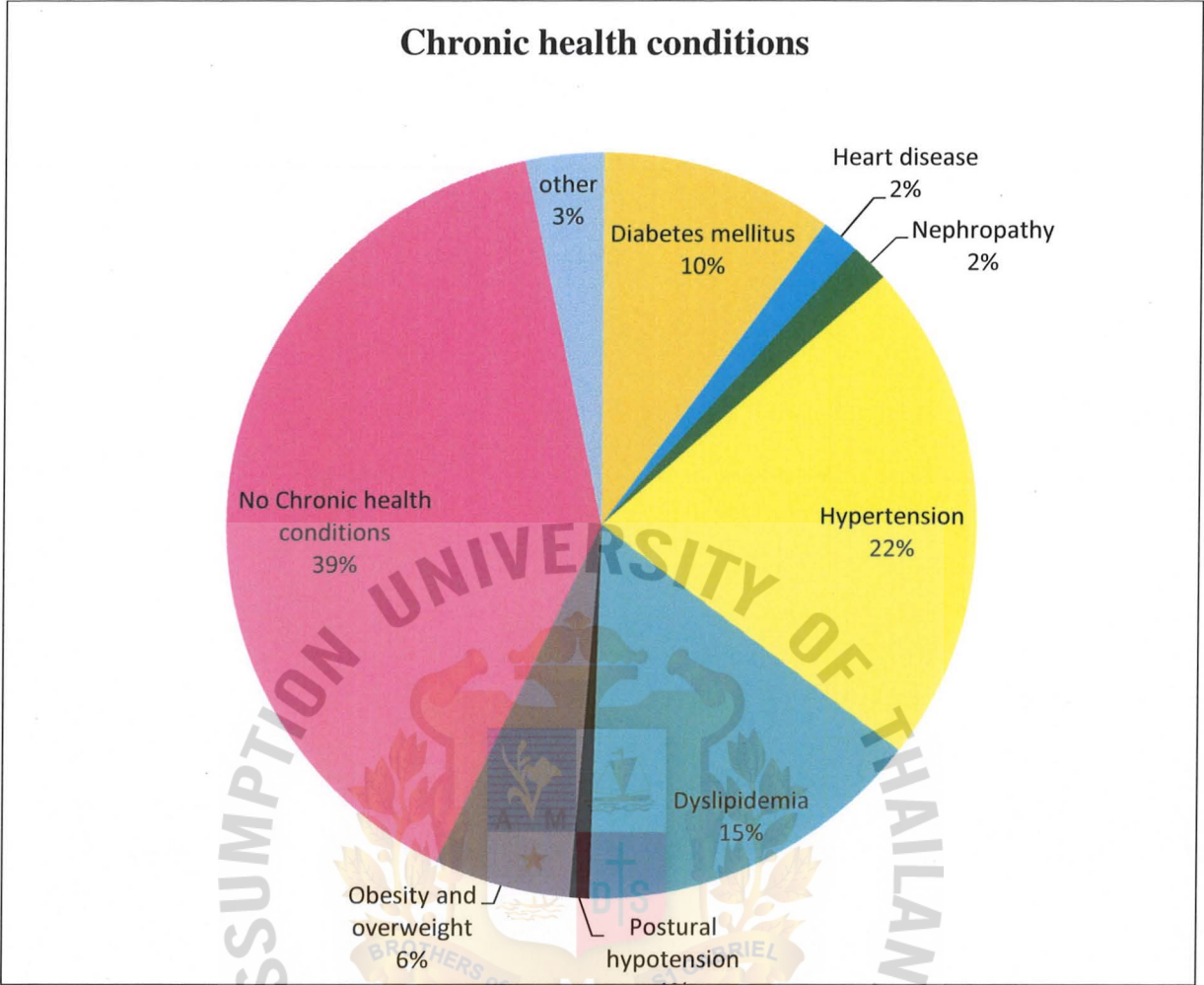
Objective 5 : To study acceptance of elderly people with the Asiatic Pennywort tea nanoparticle with Goji berry

<u>Bua Bok Tea with Goji berry flavor</u>

This survey will use to study about consuming behaviors, attitudes, and need toward the developed product with a goal to determine consumers' acceptance of the developed product. The important information from yours participation will be further used to complete my project. Please kindly complete the questions below and carefully give mark on the answer(s) based on your opinion. Your personal data will be kept confidential. Thank you for your kind participation.

Instruction: The purpose of this questionnaire is to obtain the information of elderly consuming behavior. Please kindly complete the question below based on your opinion by using ✓ on the ☐ answer(s)

เรื่องการสำรวจพฤติกรรมการบริโภคและสำรวจการยอมรับของผู้บริโภคต่อผลิตภัณฑ์สมุนไพรจากบัวบก แบบสอบถามฉบับนี้เป็นส่วนหนึ่งของงานวิจัยเพื่อประกอบการวิจัยของข้าพเจ้า ขอความกรุณาจากท่านทดสอบผลิตภัณฑ์และตอบแบบสอบถาม ข้อมูลทั้งหมดที่ท่านตอบมาจะเป็นประโยชน์อย่างยิ่งสำหรับงานวิจัยครั้งนี้

คำแนะนำ : แบบสอบถามนี้จัดทำขึ้นเพื่อใช้ศึกษาพฤติกรรมการบริโภคของผู้สูงอายุ กรุณาตอบแบบสอบถามด้านล่างตามความคิดเห็นของคุณ โดยใช้เครื่องหมาย ✓ ลงในช่อง ☐ หน้าคำตอบ

Part I : Consumer's behavior (พฤติกรรมผู้บริโภค)

1. Do you consume herbal tea? คุณบริโภคชาสมุนไพรไหม

   ☐ Yes (ดื่ม)   ☐ No (ไม่ดื่ม)

2. How much do you consume herbal tea? คุณชอบดื่มชาสมุนไพรมากน้อยเท่าไร?

   ☐ Dislike most ไม่ชอบมาก   ☐ Dislike ไม่ชอบ   ☐ Fair เฉยๆ   ☐ Like ชอบ   ☐ Like most ชอบมาก

3. Which herbs of herbal teas that you ever consumed? (check all that apply)

   ชาสมุนไพรประเภทไหนที่คุณเคยบริโภคมาก่อน

   ☐ Lemon grass tea ชาตะไคร้ ☐ Ginger tea ชาขิง   ☐ Safflower tea ชาดอกคำฝอย

   ☐ Rosella tea ชากระเจี๊ยบ   ☐ Mulberry leaf tea ชาใบหม่อน ☐ Asiatic Pennywort tea ชาใบบัวบก

   ☐ Pandan tea ชาใบเตย   ☐ Chrysanthemum tea ชาเก๊กฮวย ☐ Reishi tea ชาเห็ดหลินจือ

   ☐ Lou Han Gua ชาหล่อฮังก้วย ☐ Indian gooseberry tea ชามะขามป้อม

   ☐ Other, please specify (อื่นๆโปรดระบุ) _____

2. If a new product, Bua Bok Tea with Chinese Wolfberry flavor, is launched to market, will you buy that product? ถ้าผลิตภัณฑ์นี้วางขายในตลาด คุณจะซื้อหรือไม่?

☐ Yes ซื้อ ☐ No, Why? ไม่ เพราะ_____

3. What price do you think is the most suitable for 10 bags per box? คุณคิดว่าผลิตภัณฑ์ชาบัวบกผสมเก๋ากี้นี้ควรมีราคาเท่าใดใน 1 กล่อง?

☐ less than 200 baht (ต่ำกว่า 200 บาท) ☐ 201 - 301 baht (บาท)

☐ 301 – 400 baht (บาท) ☐ 401 – 500 baht (บาท)

☐ more than 500 baht (มากกว่า 500 บาท)

Part III: General Information (ข้อมูลทั่วไป)

2. Gender (เพศ)

☐ Male (ชาย) ☐ Female (หญิง)

2. Age (อายุ)

☐ 50 – 55 years old (50 – 55 ปี) ☐ 56 – 60 years old (56 – 60 ปี)

☐ 61 – 65 years old (61 – 65 ปี) ☐ 66 – 70 years old (66 – 70 ปี)

☐ More than 70 years old (มากกว่า 70 ปี)

10. Status (สถานภาพ)

☐ Single (โสด) ☐ Married (สมรส) ☐ Couple (มีคู่)

☐ Divorce (หย่าร้าง) ☐ Widow (หม้าย) ☐ Separated (แยกกันอยู่)

11. House members (สมาชิกภายในบ้าน)

☐ Alone (คนเดียว) ☐ 2 – 3 people (2 – 3 คน)

☐ 4 – 5 people (4 – 5 คน) ☐ More than 5 people (มากกว่า 5 คน)

12. Nationality (สัญชาติ)

☐ Thai (ไทย) ☐ Others, please specific (สัญชาติอื่น โปรดระบุ)

Graph result from final product testing

Figure 42: Graph result of questionnaire from final product about "Do consumers like to drink tea?"
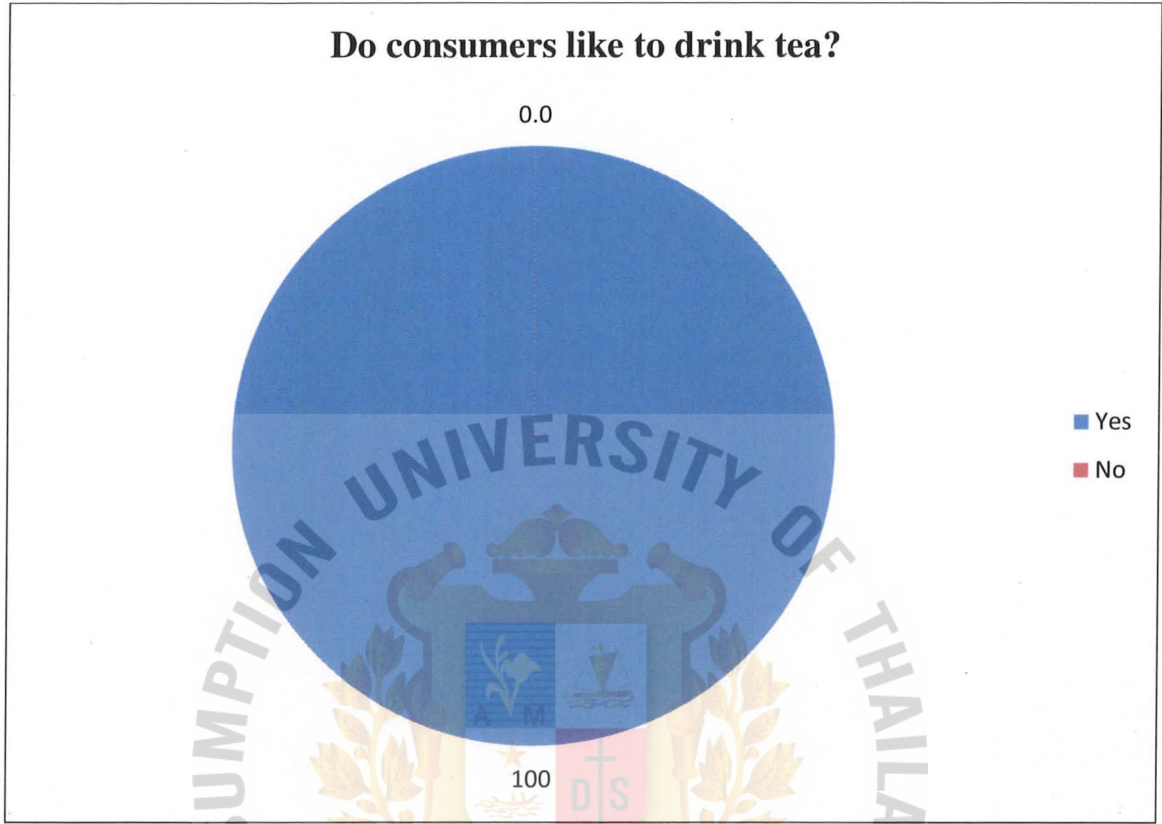

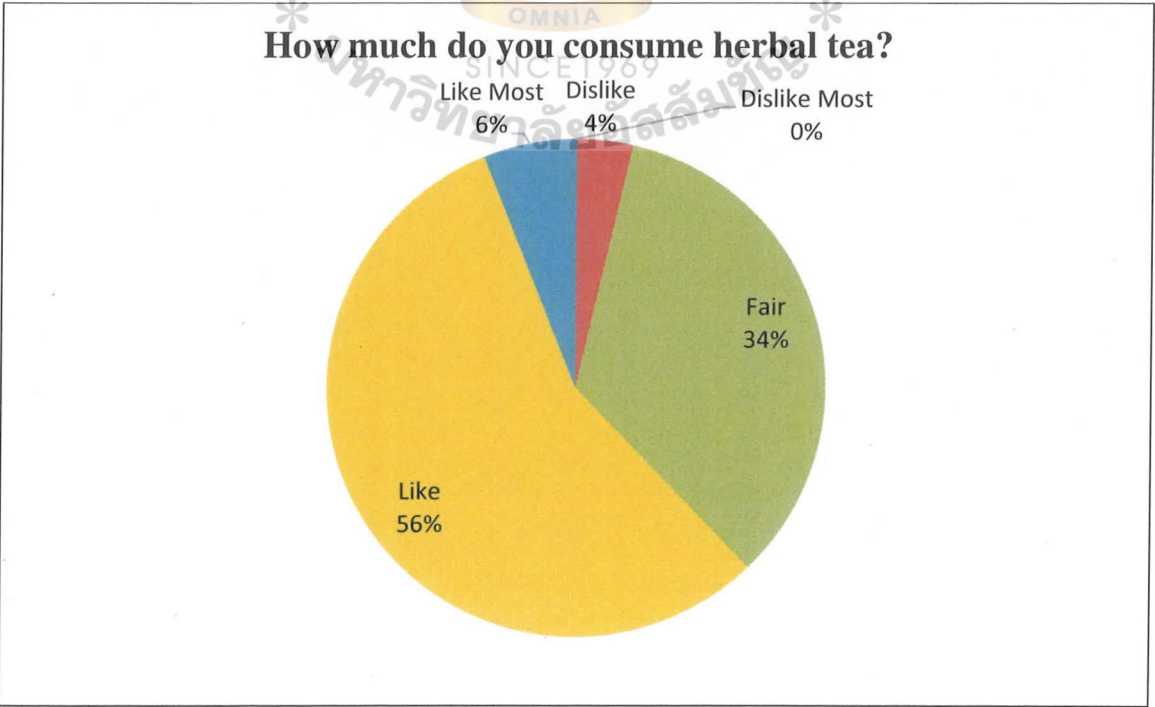Figure 43: Graph result of questionnaire from final product about "How much do you consume herbal tea?"

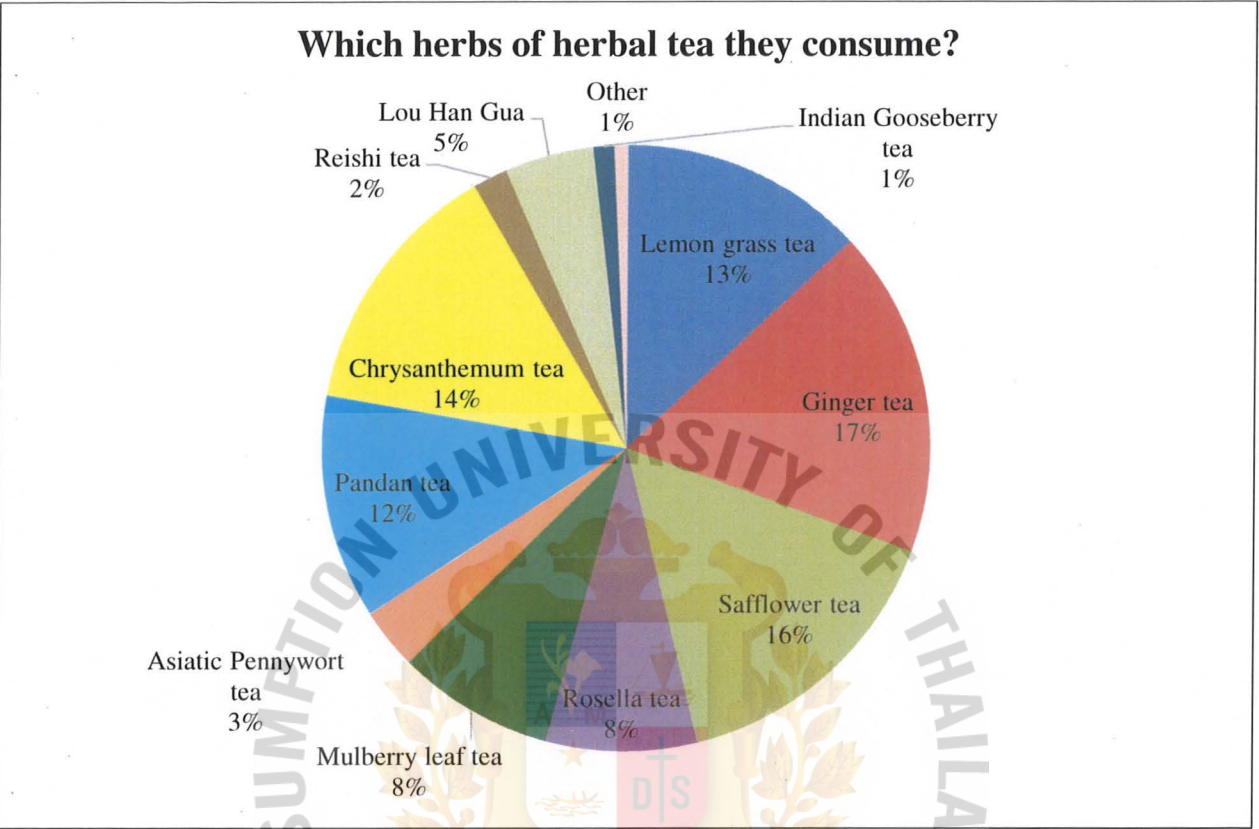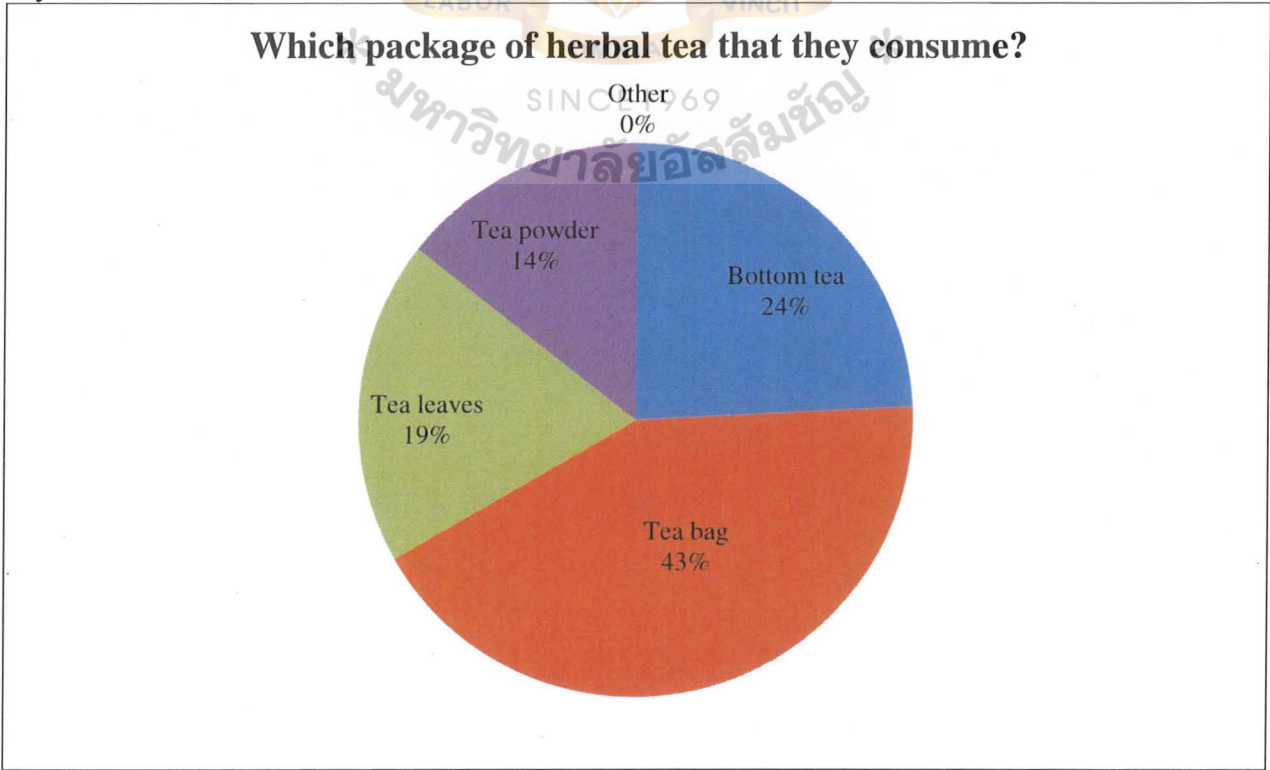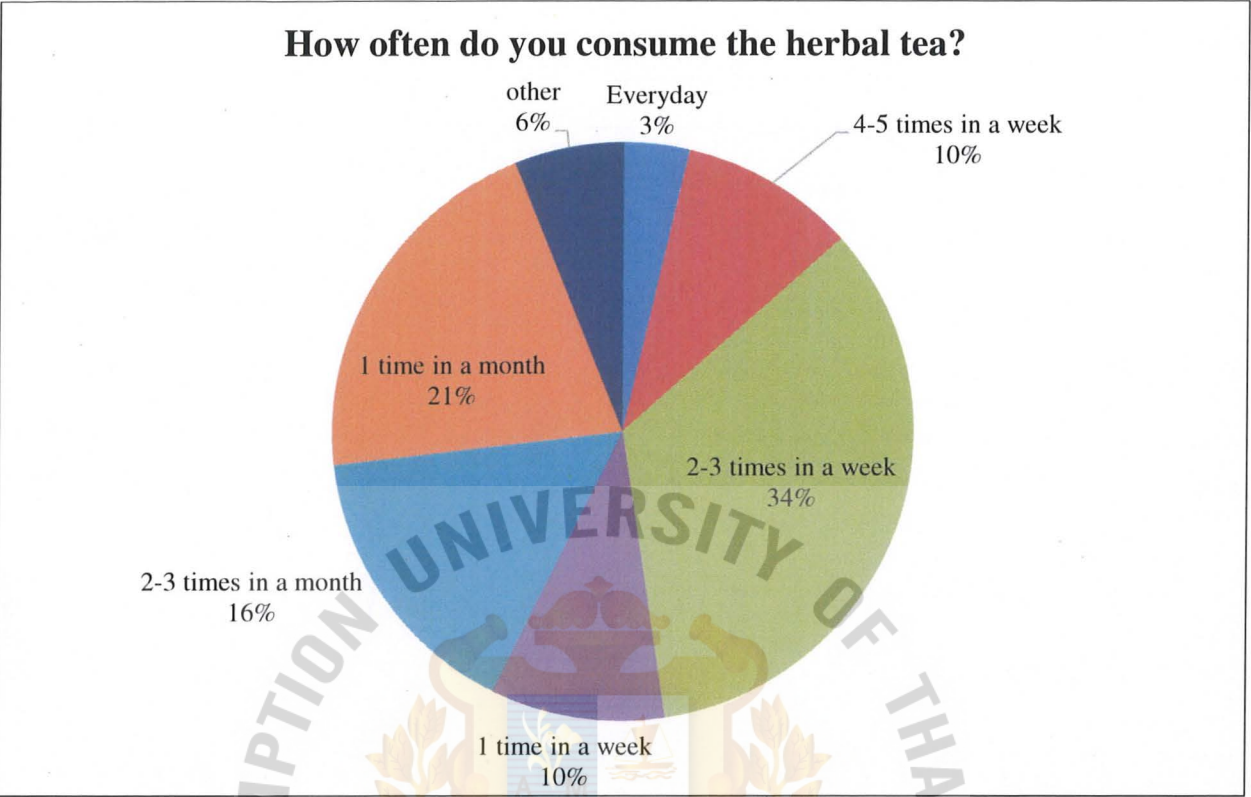Figure 44: Graph result of questionnaire from final product about "Which herbs of herbal tea they consume?"

Which herbs of herbal tea they consume?

- Other 1%
- Lou Han Gua 5%
- Reishi tea 2%
- Indian Gooseberry tea 1%
- Lemon grass tea 13%
- Ginger tea 17%
- Chrysanthemum tea 14%
- Pandan tea 12%
- Safflower tea 16%
- Asiatic Pennywort tea 3%
- Rosella tea 8%
- Mulberry leaf tea 8%

Figure 45: Graph result of questionnaire from final product about "Which package of herbal tea that they consume?"

Which package of herbal tea that they consume?

- Other 0%
- Tea powder 14%
- Bottom tea 24%
- Tea leaves 19%
- Tea bag 43%

Figure 46: Graph result of questionnaire from final product about "How often do you consume the herbal tea?"

How often do you consume the herbal tea?

- other 6%
- Everyday 3%
- 4-5 times in a week 10%
- 2-3 times in a week 34%
- 1 time in a week 10%
- 2-3 times in a month 16%
- 1 time in a month 21%

Figure 47: Graph result of questionnaire from final product about "When they consume herbal tea?"

When they consume herbal tea?

- After wake up 1%
- Morning 32%
- Afternoon 39%
- Evening 9%
- Before sleep 6%
- Occasionally not specific the time 13%
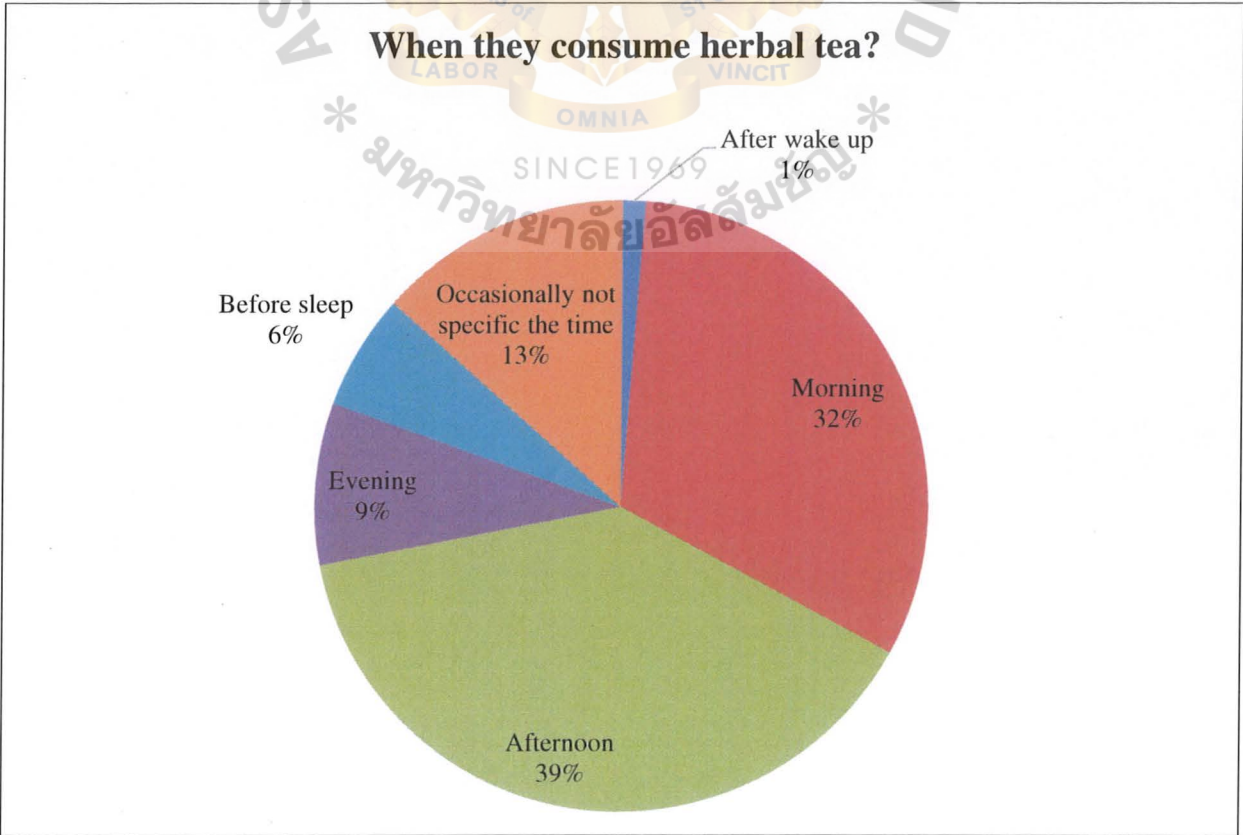
Figure 48: Graph result of questionnaire from final product about "Where do they buy the herbal tea products?"
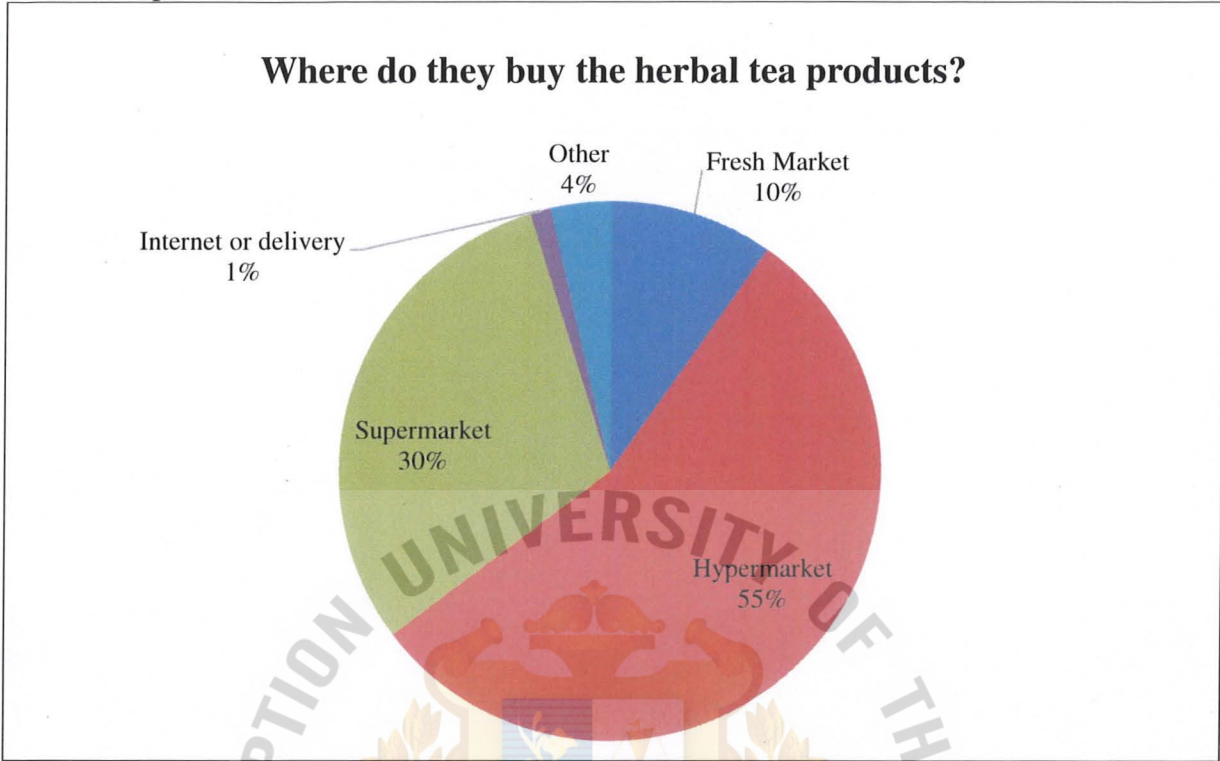
Where do they buy the herbal tea products?

Figure 49: Graph result of questionnaire from final product about "How much they purchase the herbal tea product per time?"
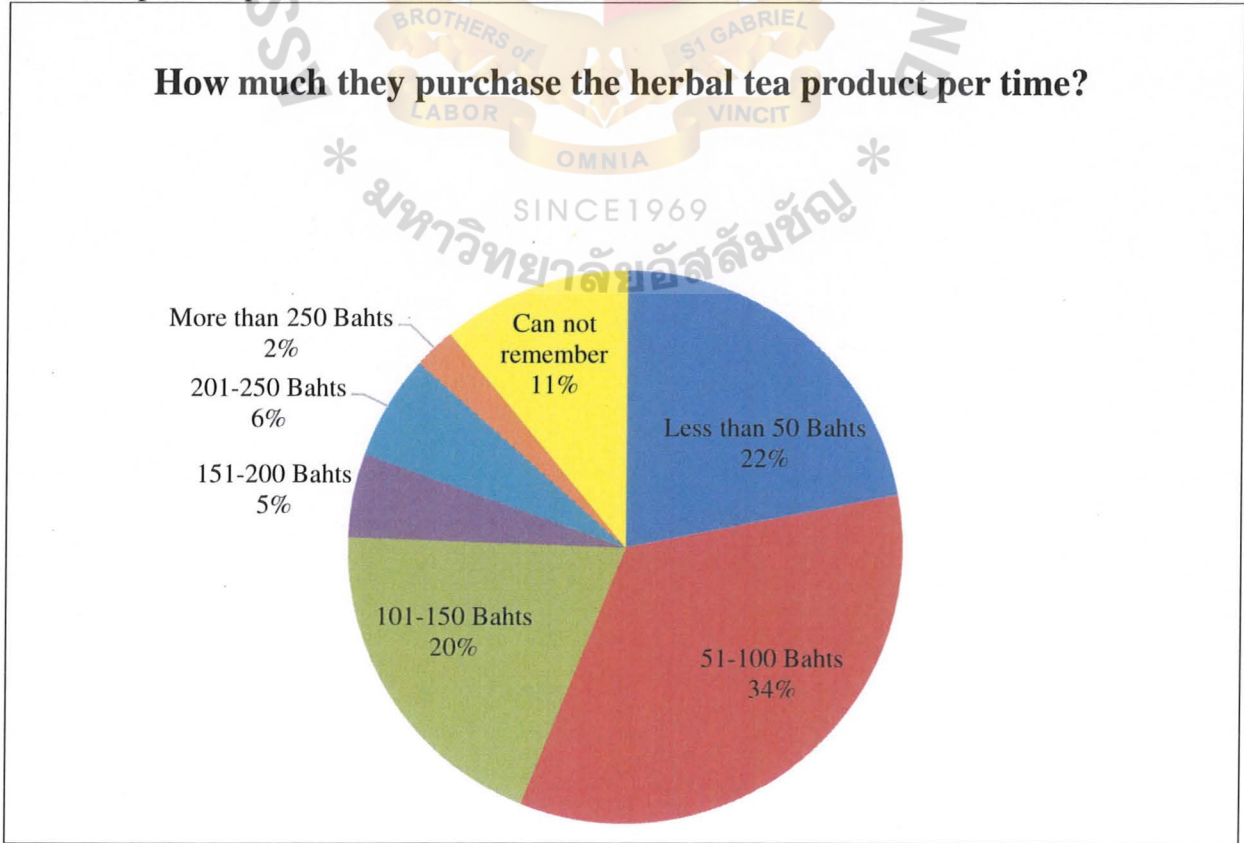
How much they purchase the herbal tea product per time?

Figure 50: Graph result of questionnaire from final product about "Reason why they like to consume herbal tea"
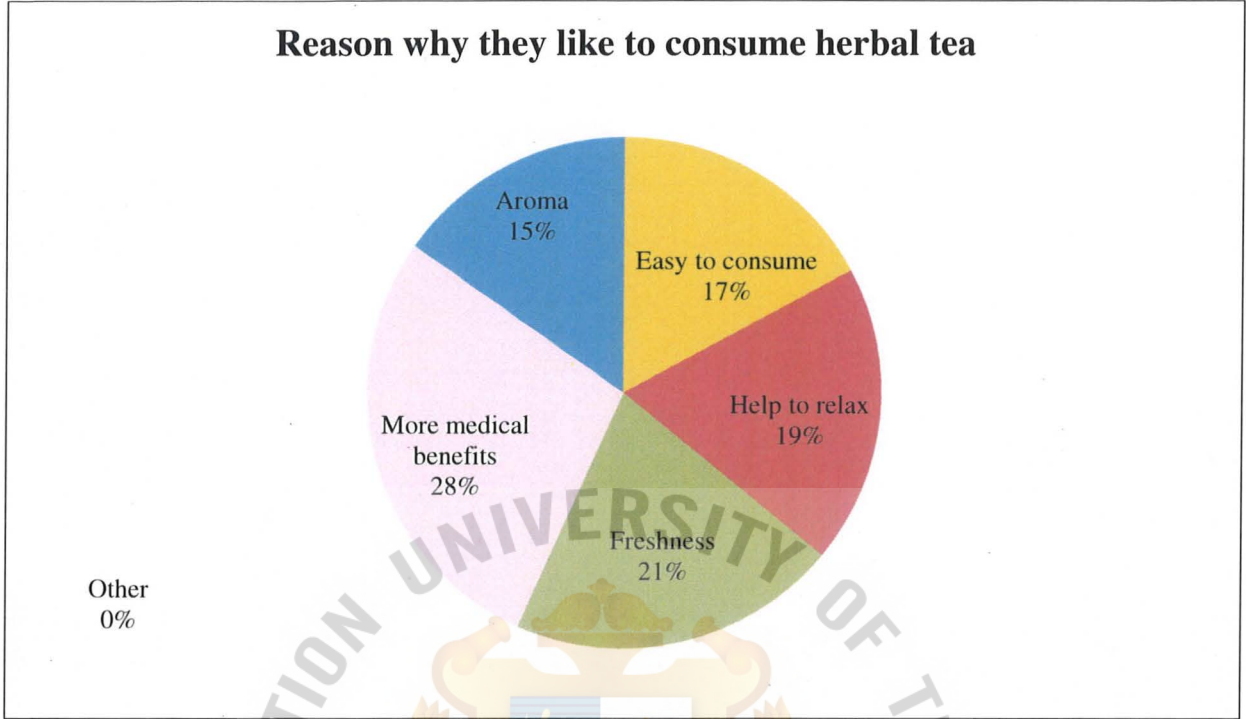

Reason why they like to consume herbal tea

- Aroma 15%
- Easy to consume 17%
- Help to relax 19%
- Freshness 21%
- More medical benefits 28%
- Other 0%

Figure 51: Graph result of questionnaire from final product about "Have you ever drunk herbal tea with flavored from fruits or plants?"
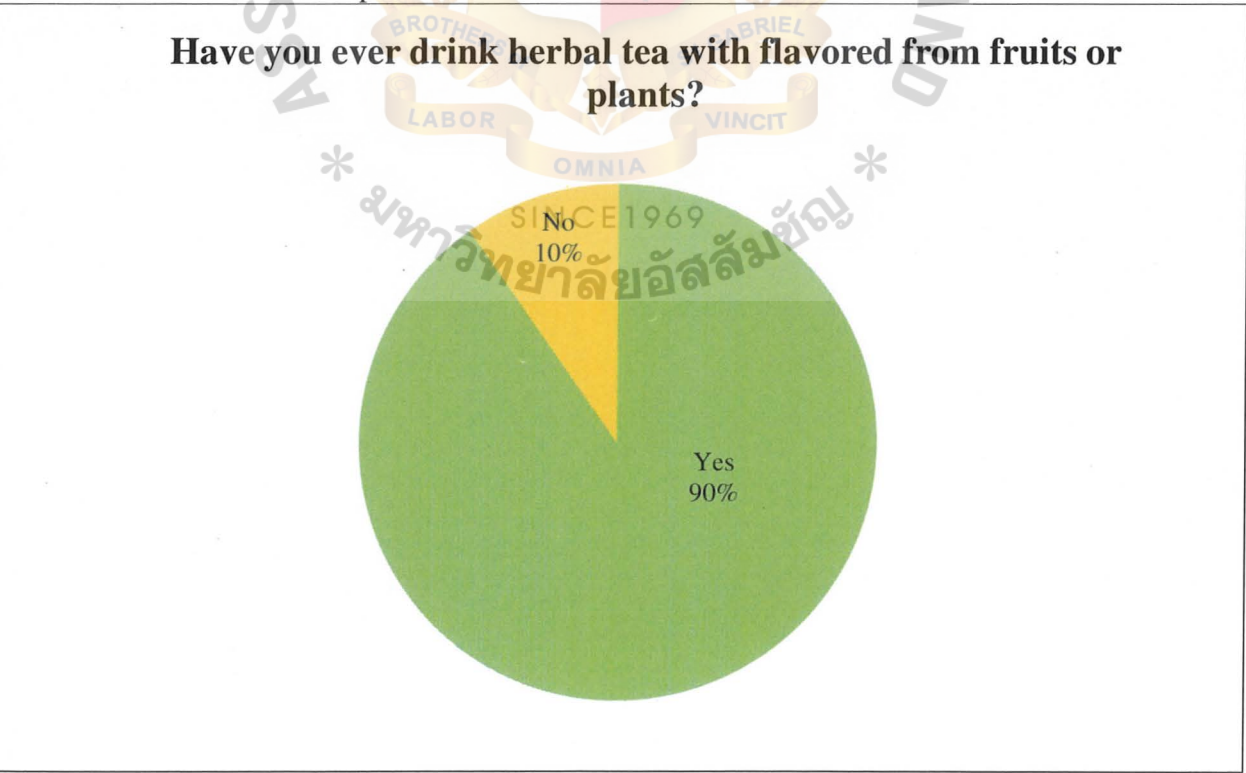

Have you ever drink herbal tea with flavored from fruits or plants?

- No 10%
- Yes 90%

Figure 52: Graph result of questionnaire from final product about "Which flavored of tea that you ever consumer?"

Which flavored of tea that you ever consumer?

Other 1%
Mint 8%
Lemon 24%
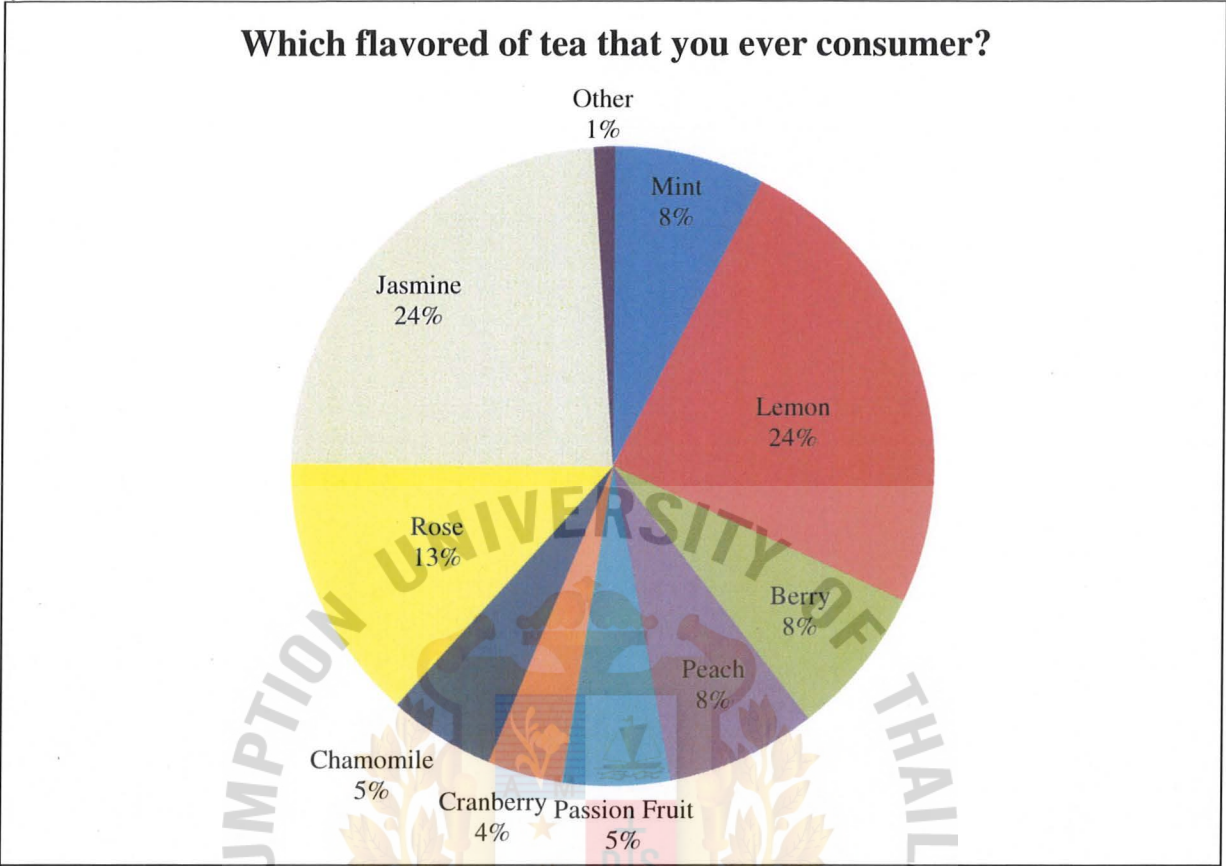Jasmine 24%
Rose 13%
Berry 8%
Peach 8%
Chamomile 5%
Cranberry 4%
Passion Fruit 5%

Figure 53: Graph result of questionnaire from final product about "Do consumer accept the Bua Bok Tea with Goji berry Flavor?"

Do consumer accept the Bua Bok Tea with Goji berry Flavor?

Reject 24%
Accept 76%
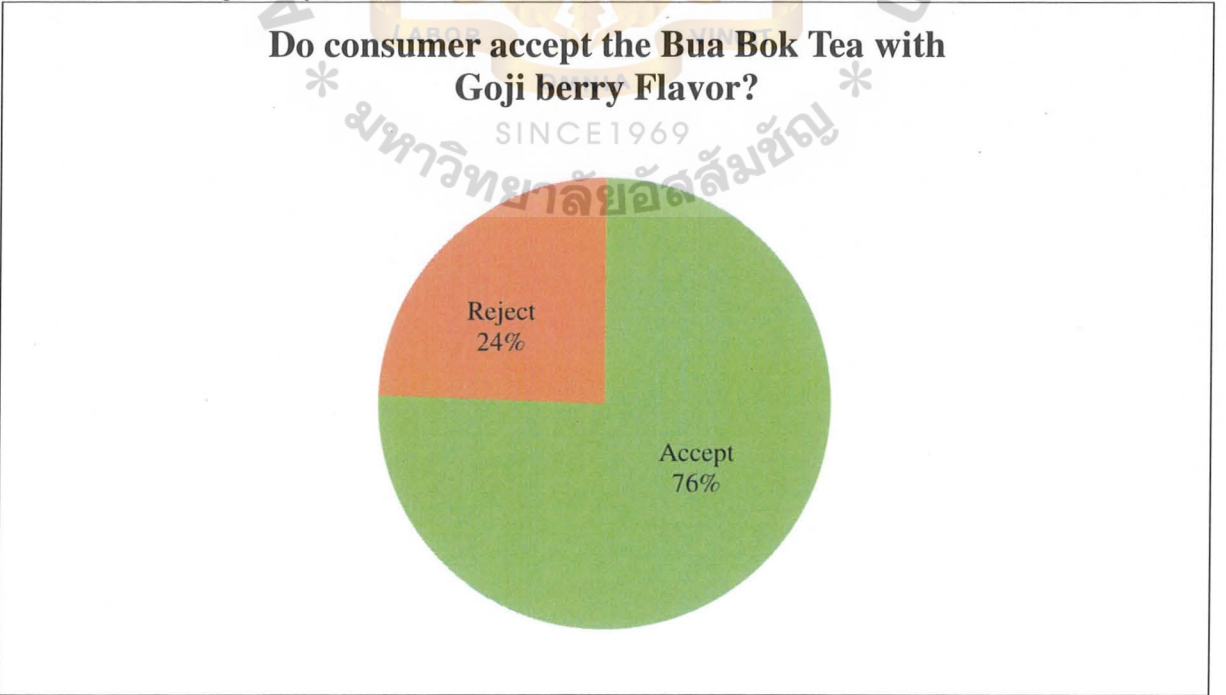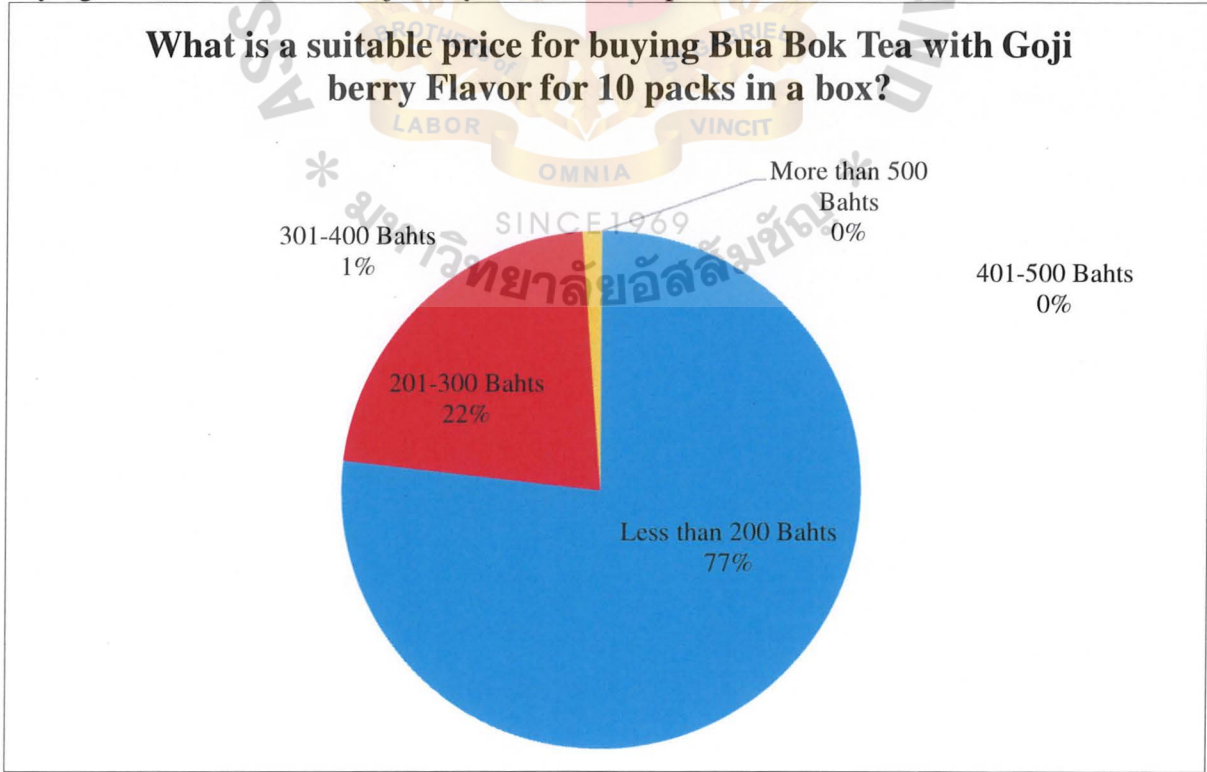
Figure 54: Graph result of questionnaire from final product about "From consumer who accept this product, will you buy this product?"

From consumer who accept this product, will you buy this product?

No
16%

Yes
84%

Figure 55: Graph result of questionnaire from final product about "What is a suitable price for buying Bua Bok Tea with Goji berry Flavor for 10 packs in a box?"

What is a suitable price for buying Bua Bok Tea with Goji berry Flavor for 10 packs in a box?

More than 500 Bahts
0%

301-400 Bahts
1%

401-500 Bahts
0%

201-300 Bahts
22%

Less than 200 Bahts
77%

Part III : General information

Figure 56: Graph result of questionnaire from final product about gender

Gender

Male 35%

Female 65%
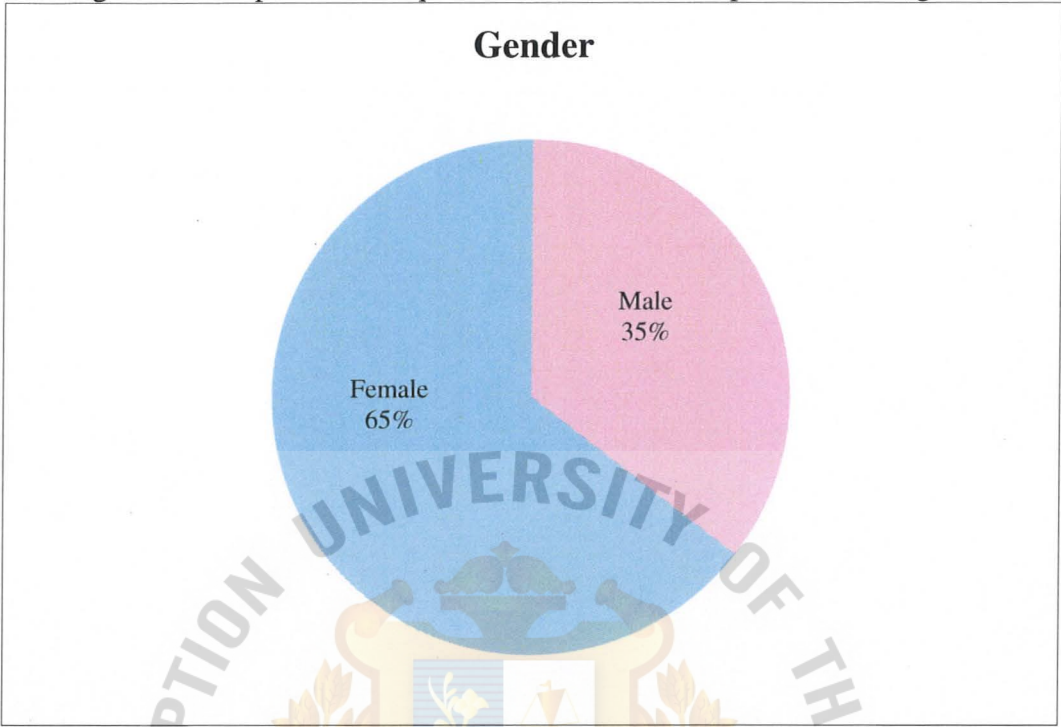
Figure 57: Graph result of questionnaire from final product about age

Age

61-65 Years Old 3%

56-60 Years Old 18%

Lower 50 79%

66-70 Years Old 0%

More than 70 years old 0%
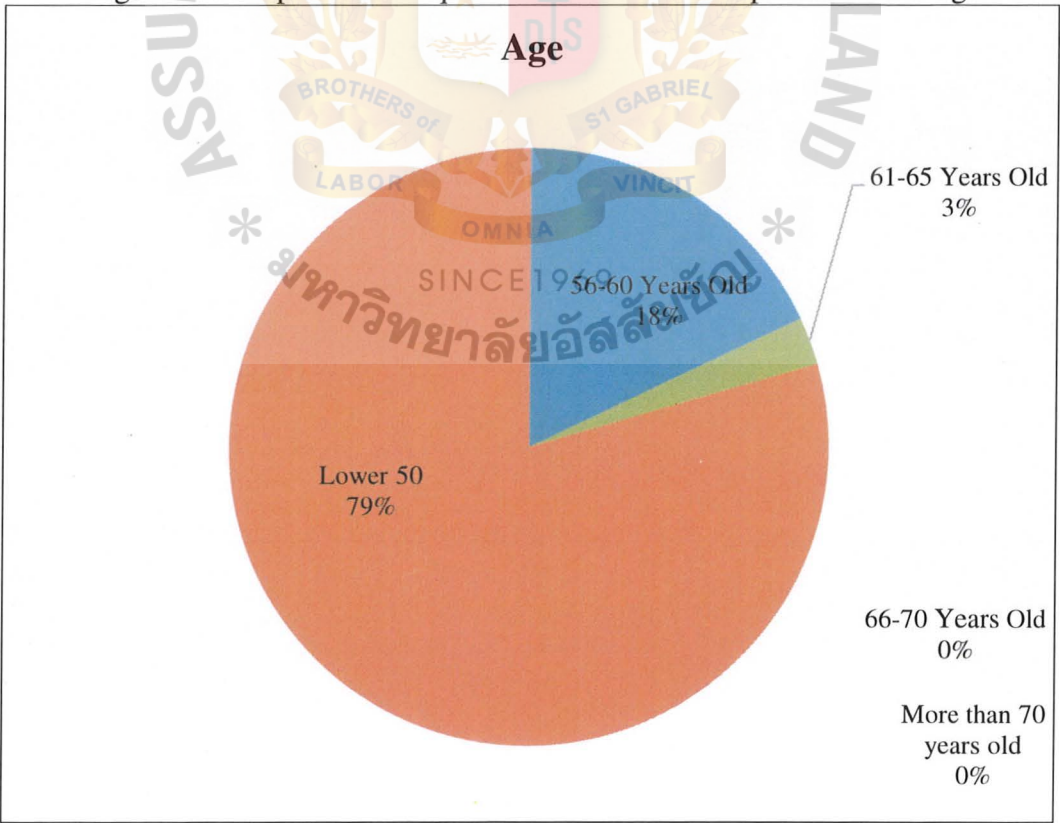
Figure 58: Graph result of questionnaire from final product about status

Status

Divorce 1%
Seperated 1%
Couple 9%
Single 49%
Married 40%
Widow 0%
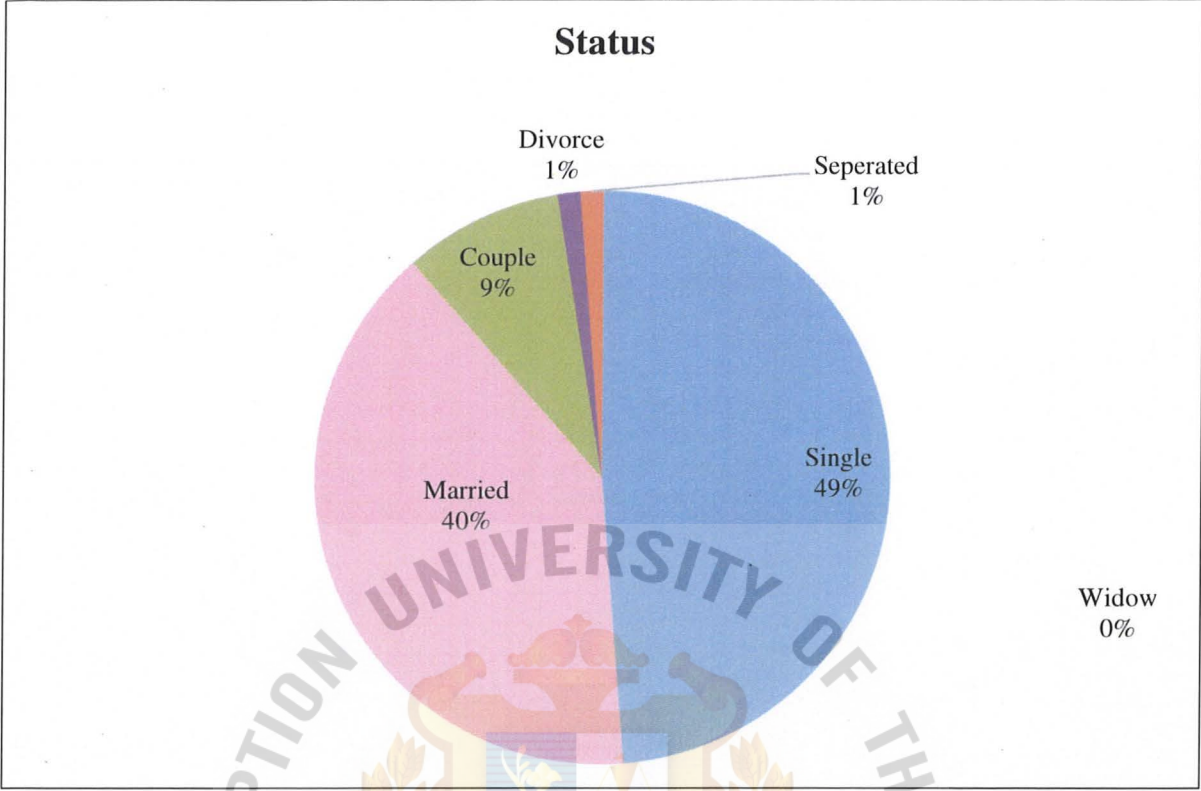
Figure 59: Graph result of questionnaire from final product about House member

House member

More than 5 people 10%
Alone 14%
2-3 people 31%
4-5 people 45%
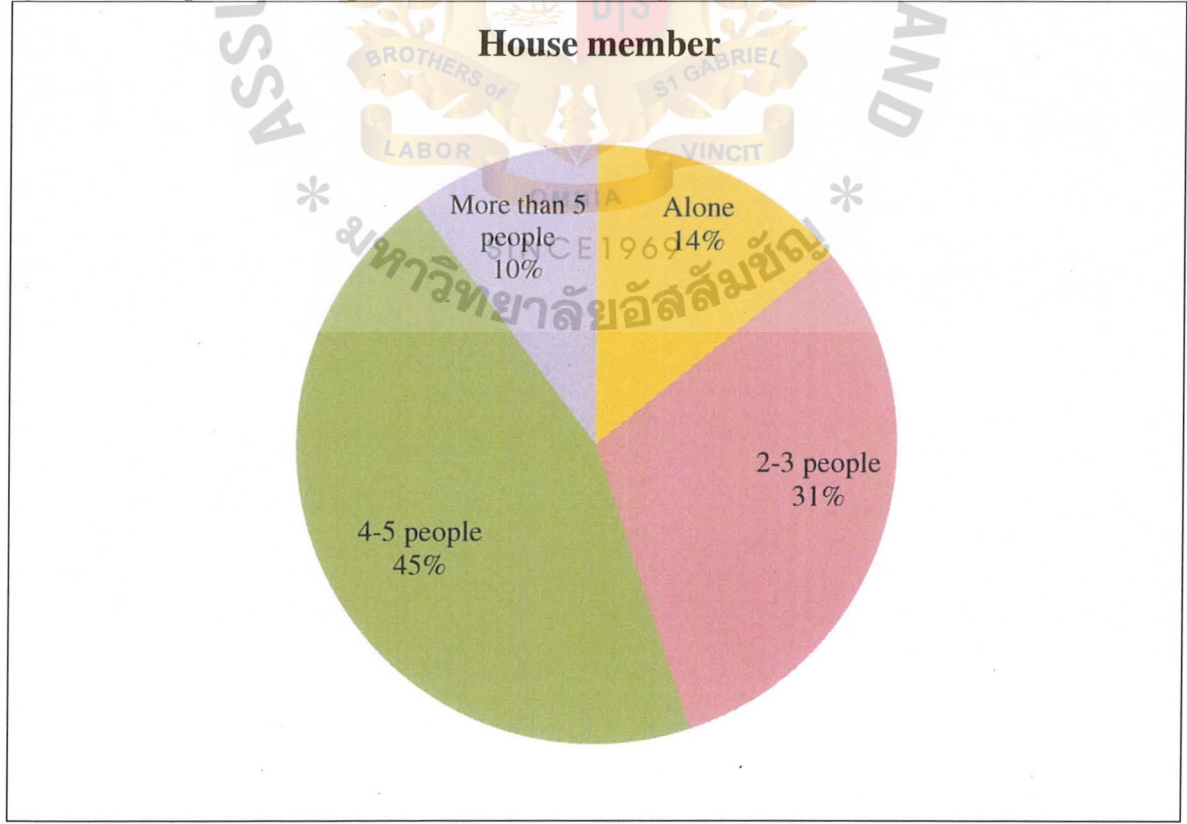
Figure 60: Graph result of questionnaire from final product about nationality

Nationality

■ Thai

■ Other

100.0
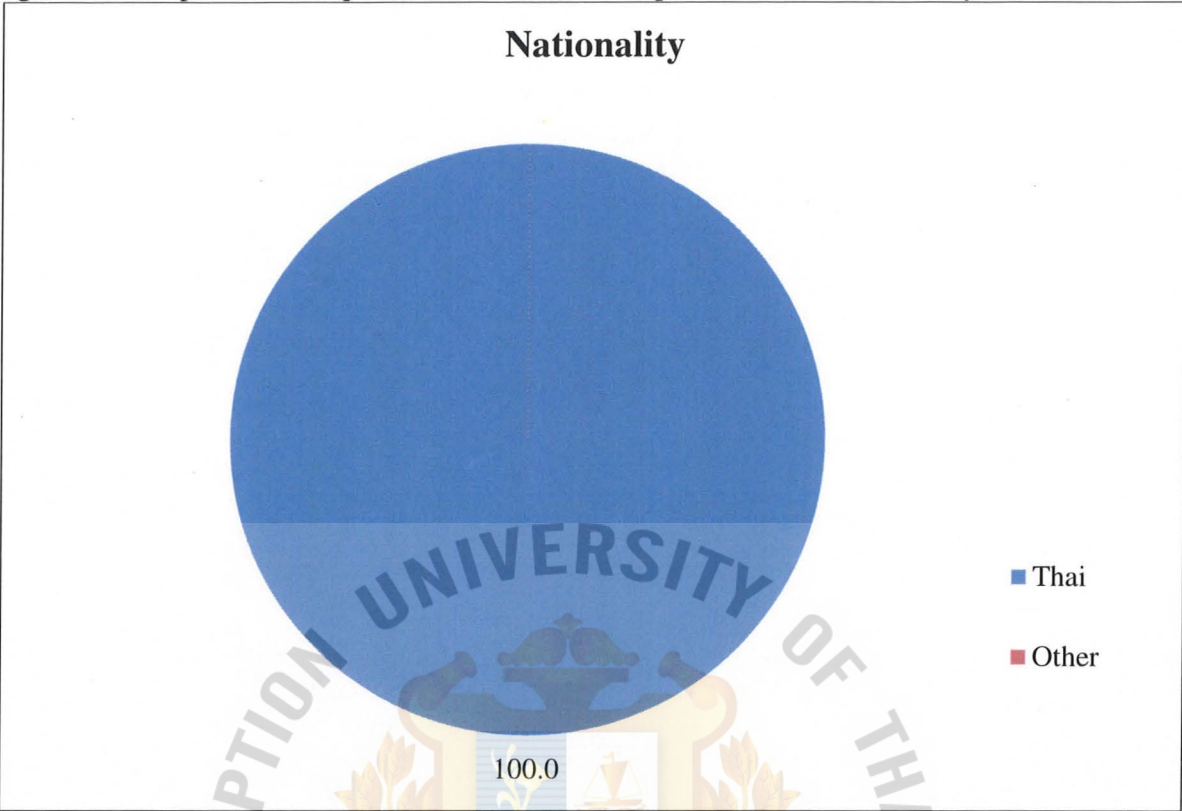
Figure 61: Graph result of questionnaire from final product about Level of education

Level of education

Master degree or higher 10%

Lower than high school 23%

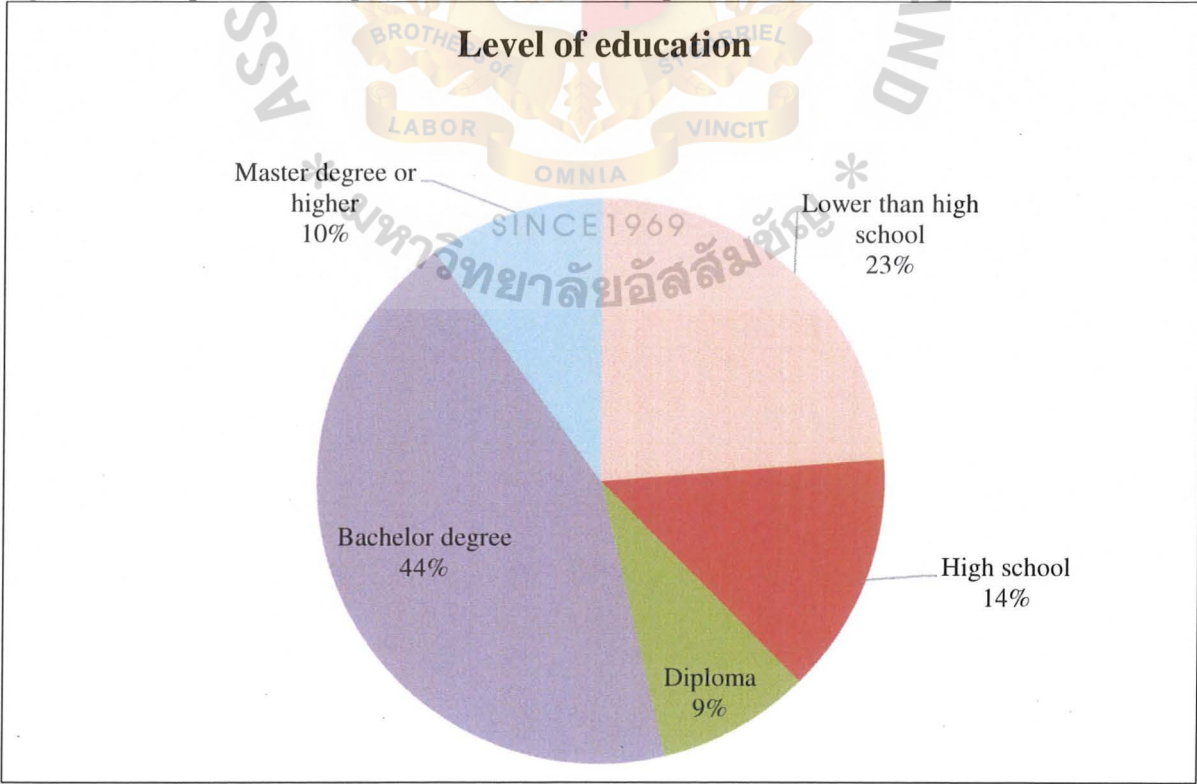Bachelor degree 44%

High school 14%

Diploma 9%

Figure 62: Graph result of questionnaire from final product about income
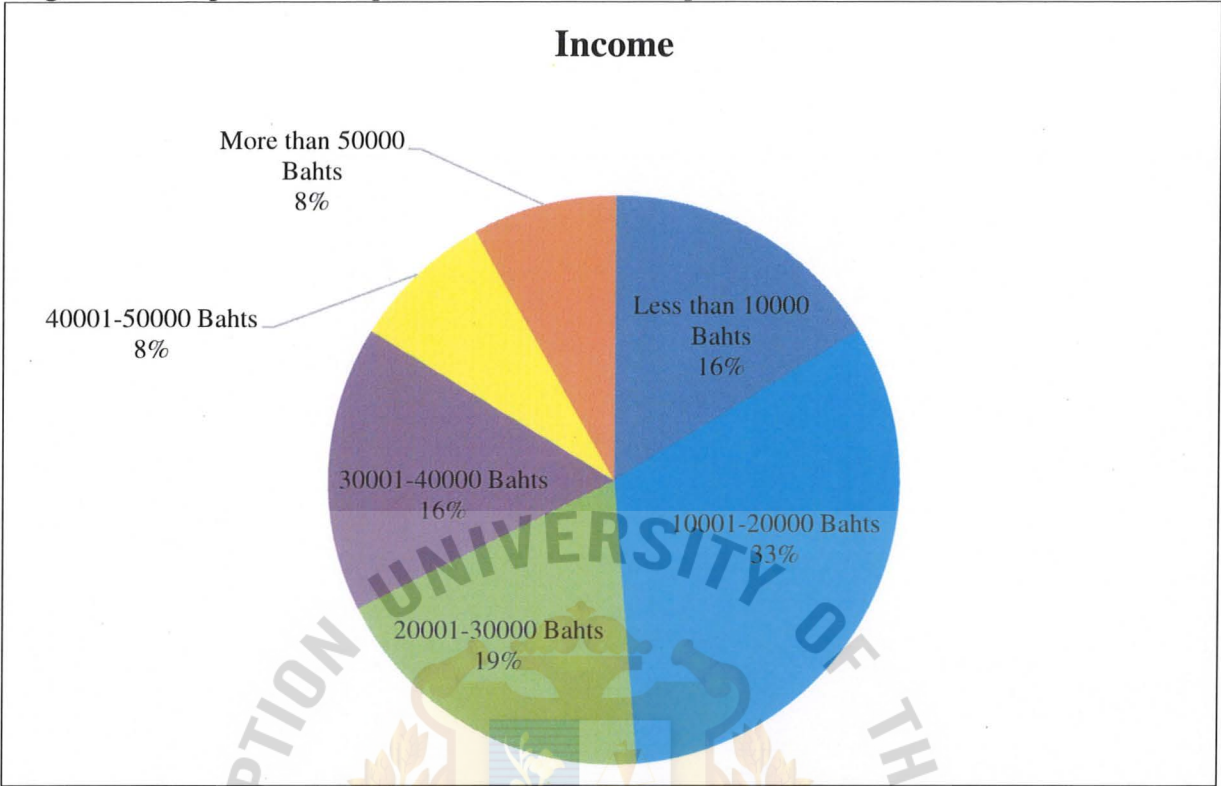

Income

Figure 63: Graph result of questionnaire from final product about Medical Problem in details

Medical Problem in details