

Development Mixed Fruit Juice from Red Dragon
Fruit Juice and Pineapple Juice

By
Ms Phan Khanh Trang

A Special project submitted to the Faculty of Biotechnology
Assumption University which in the part fulfillment of the
requirements for the degree of Bachelor of Science in Biotechnology

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Senior Project

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Title : Development Mixed Fruit Juice from Red
Dragon Fruit Juice and Pineapple Juice

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Level of Study : Bachelor of Science

Faculty : Biotechnology

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Advisor



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Abstract

Development Mixed Fruit Juice from Red Dragon Fruit Juice and Pineapple Juice was aimed to create a new variety of fruit juice to satisfy a desire of consumer. The study was started from making mixed fruit juice from Red Dragon Fruit with orange juice and pineapple juice. From the preference test, it was found that the test panelists preferred the fruit juice from Red Dragon Fruit and pineapple juice. The pineapple juice was selected in the product development. Two mixed fruit juice was made by comparing the ratio of Red Dragon juice to pineapple juice as 1:1 and 1:2 and the preference test was done with 15 untrained test panelists. Ratio of 1:2 was satisfied more than ratio 1:1 in overall liking, color and after taste as 6.3, 6.9 and 6.7, respectively, but was low in sweetness with score of 5.15. Therefore 3 different Brix degrees, 11, 12, and 13 with 14 as control, were studied in the mixed fruit juice. The mixed fruit juice with 12°Bx was chosen with the highest scores of 7.33, 7.27, 6.67, 7.67 and 7.2 in sweetness, saltiness, sourness, overall flavor and overall liking, respectively.

The consumer acceptance test with 100 consumers showed that 74% of the consumer had intention to purchase the product. 57% of them was willing to buy the product at 10 – 15 Baht per packed of 200 gram juice. The estimated benefit gained would reach 40 -60% from the production cost.

Acknowledgement

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Introduction

People consume fruit juice in many forms. Until the 19th century the fruit juice still means the fermentation or conversion to wine or cider. The commercial juice began from 1869 when the Welch Company of Vineland, New Jersey produced the unfermented grape fruit and this production introduced the principle of fruit juice pasteurization. The fruit juice industry started to develop slowly in the 1920s but accelerated in the 1930s. The nutritional value in fruit juice especially vitamin C was recognized during the Great Depression period and was further stimulated by technology development. The consumption of fruit juice continued to expand and during the 1950s, it became established. However the industry development was slower in Europe and UK, from which the fruit juice was packaged in the bottles or cans and often sweetened. The consumption increased after mid-1970s, when fruit juice was consumed for a healthy life style. This impetus was reinforced by the application of UHT and aseptic packaging. These types of packaging give the concentrate juice a high quality, long life according to the perceptions of a healthful product (P.R Ashurst, 1995)

Nowadays, fruit juice becomes one of the staple foods around the world. Citrus juices are most widely consumed for over 50% of juice in international commerce. Popular juices are not limited to apple, orange, grapefruit, pineapple, tomato, mango, carrot, grape, cranberry and pomegranate, etc. It has become increasingly popular to combine a variety of fruits into single juice drinks. Prepackaged single fruit juices have lost market share to prepackaged fruit juice combinations. Juice bars have also become common across most of the western world and offer similar juices. Most of these juice bars offer freshly made fruit juices and claim that confers greater health benefit. Juice is also commonly found in many

cooking recipes around the world. The most popular are lime and lemon juice which help to add a slightly sourer or bitter taste to dishes.

The development of varieties fruit juice depends on the consumer's desire and satisfaction. To understand and satisfy the consumer's demand, it is necessary to develop the new variety of fruit juice in terms of sensory evaluation.



Objectives

1. To study the consumer preference on a new variety of fruit juice
2. To determine the best formulation for making mixed fruit juice made from Red Dragon fruit juice and pineapple juice
3. To study the consumer satisfaction on mixed fruit juice made from Red Dragon fruit juice and pineapple juice



Literature Review

1. Fruit juice

Number fruit juices are produced on a commercial basic. They are primarily defined by the post-extraction processing

A. Single-strength direct juice

This is the simplest technical that the fruit juice was undergoes no concentration. Single strength juice can be produced on a very small scale or immediate consumption or packed without heat treatment for consumption within a few hours. This technique is also produced on a full commercial scale for much wider distribution. Preservation is necessary by pasteurization or by in-container or UHT sterilization. The single strength direct juice is primarily a consumer product with the high costs of transport and storage caused it tends to restrict its role in international commerce. Recently, the aseptic packaging of UHT sterilized single strength juice in bulk containers, which may be stored for long time without refrigeration, has led to an increase in commercial usage.

B. Concentrated juice

Concentrated juice is the important part of international commerce production of fruit juice. Juice is concentrated by thermal evaporation and may be preserved by heat treatment or freezing. Frozen concentrated juice is also available as a consumer product. Juice from concentrates is prepared by dilution of concentrated juice with water. Dried fruit juice is prepared from concentrated juice, spray drying is most common but some is freeze-dried.

2. Dragon fruit

Pitaya is the fruit of several cactus species, most importantly of the genus *Hylocereus* (sweet pitayas). These fruits are also known as pitaya, dragon fruit, huǒ lóng guǒ, lóng zhū guǒ, strawberry pear, nanettikafruit, or thanh long. Native to Mexico and Central and South America, and cultivated in Southeast Asian countries such as Taiwan, Vietnam, the Philippines, Sri Lanka and Malaysia. They are also found in Okinawa, Israel, northern Australia and southern China. The Pitaya fruit is a tropical fruit that can grow in soil or on tree bark like the orchid. Cut the fruit in half to reveals the opaque white or red to purple flesh dotted with small seeds which look like black sesame seeds. This fruit is a bit like kiwi and weigh up to 3 pounds. (Wikipedia, 2008)

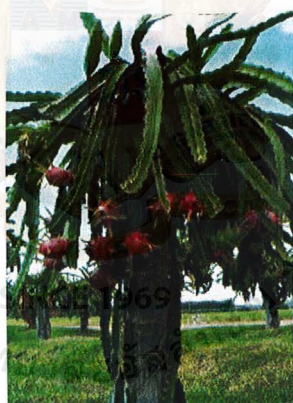


Figure 1: The Dragon fruit plants

Feature of this fruit are unique and different from the other plants such as the perennial, climbing cactus with triangular fleshy stems, that can grow 1-3 meters high or more and develop many side branches. This cactus may be terrestrial or epiphytic. To grow a commercial crop is a challenge because the cactus can get sunburn and frost damaged .Growing best in tropical, sub tropical or dry climates where there about 20-25'' rain per year. These plants can cope with extremes of temperatures from 104°F to

short periods of frost, tolerates light frosts when mature but needs protection when young. It flourishes in hot regions with a heavy rainfall. Best in sunny position away from strong wind but also grows in partial shade. They don't like being too wet since it will effect cropping so avoid excessive humidity and soil moisture. Long periods of cold weather can kill the plants. Dryness in summer will induce flowering but watering during fruit development is helpful. Water is well at planting, every few days for the first 2 weeks, fertilize a month after planting the lightly every 3 months with a balanced fertilizer. The plant propagates easily from stem cutting. It blooms only at night; they have large white fragrant flowers of the typical cactus flower shape, which are often called Moonflower or Night. However to counter this plants can product 4-6 crops of fruit each year. Oval to oblong fruit with overlapping scales fill out quickly and about 40 days after flowering the fruit ripens, ready for picking. The color of the flesh fruit depends on the species. Pitayas have a creamy pulp and a delicate aroma.

There are 3 types of Pitaya fruit. The first one is *H polyrhizus* which has small fruit up to 1kg with red skin, dark-red flesh and small black seeds. The stems of this species have more spins. The second is *Selenicereus megalanthus* has yellow skin and clear to white flesh containing edible black seeds. Is has smaller fruit and higher level of sugar. The third one is *Hylocereus undatus* is a red skinned with white flesh.



Figure 2: The varieties type of Dragon fruit

The fruit is loaded with fiber and vitamin C, as well as other important nutrients. One special health benefit of dragon fruit which helps to control of glucose blood sugar levels in type 2 diabetes , in addition to pitaya fruit nutrient profile being full of dietary fiber and Vitamin C. Fresh dragon fruit or dried dragon fruit both are great additions to a healthy diet. The dried pitaya fruit usually packs about 10 times the punch of the fresh pitaya fruit and has a wonderful chewy texture. The fresh dragon fruit is creamy and soft in comparison to the dried fruit. Mix dried pitaya fruit into your salads for a mild tasting chewy textured healthy nibble. Red-skinned pitayas are rich in vitamins, especially Vitamin C. They are rich in fiber and minerals, phosphorus and calcium. The red ones are richer than the former, yellow ones is the latter. In Taiwan, diabetics use the fruit as a food substitute for rice and as a source of dietary fiber. They are also rich in phytoalbumins which are highly valued for their antioxidant properties prevent the formation of cancer-causing free radicals.

Table 1: The typical nutritional value per 100g of raw dragon fruit

* Raw dragon fruit * Nutritional value per 100 g	
Water	80-90 g
Carbohydrates	9-14g ..
Protein	0.2-0.5g
Fat	0.1-0.6g
Fiber	0.3-0.9g
Ash	0.4-0.g
Calories	35-50
Calcium	6-10mg
Iron	0.3-0.7mg
Phosphorus	16-36mg
Carotene (Vitamin A)	Traces
Riboflavin (Vitamin B ₂)	Traces
Niacin (Vitamin B ₃)	0.2-0.45mg
Ascorbic acid (Vitamin C)	4-25mg

3. Pineapple

The pineapple (*Anana comosus* Merril) is a member of the Bromeliaceous family, is the common name for an edible tropical plant and also its fruit. It is native to the southern part of Brazil and Paraguay. It became widely distributed in South America and the West Indies and first known to Europeans when it was discovered by Columbus in 1493. It was named Pina because of its resemblance to a fir cone. The name Ananas is derived from the original Indian name. By the 17th century plantations had been established in India, Malaya and South Africa in addition to the existing ones in Brazil. Another 100 years further development in Australia, Singapore and particularly in Hawaii. The pineapple was introduced to Hawaii in 1813; they were sold canned by 1892. Pineapple cultivation by U.S. companies began in the early 1900s on Hawaii. Until the 1930s Hawaii was the largest producing area, accounting for over 50% of all pineapple grown in the world. In 1938 the total world production of the fresh fruit was 1.1 million tonnes and Hawaii was producing about 600 000 tonnes. By 1958 the total had increased to 1.8 million tonnes and the proportions remained much the same. By that time and indeed until today, the world pineapple production was largely in the hands of two large American corporations Castle and Cooke, who own Dole and Del Monte. (P.R Ashurst, 1995)



Figure 3 : The Pineapple fruit

The fruit of a pineapple are arranged in two interlocking spirals, eight spirals in one direction, thirteen in the other. The leaves of the cultivar 'Smooth Cayenne' mostly lack spines except at the leaf tip, but the cultivars 'Spanish' and 'Queen' have large spines along the leaf margins. The natural pollinator of the pineapple is the hummingbird. Pollination is required for seed formation; the presence of seeds negatively affects the quality of the fruit. The pineapple plant grows to a height around 80cm and consists of a rosette of sharp spiny leaves.



Figure 4: The Pineapple plant

Within about 15 months a flower spike appears from the centre of the plant and produces a hundred or more small flower whose fruits coalesce together to produce the multiple fruit which we recognize as a pineapple. The plant continues to fruit but each successive crop is smaller in size and eventually becomes uneconomic. Propagation is normally achieved by planting the crown from the top of the fruit, or from the shoots and suckers that develop from the stem. Planting density can be from about 45 000 to 60 000 plants per hectare yielding around 100 tonnes of fruit per year. Fresh pineapple is often somewhat expensive as the tropical fruit is delicate and difficult to ship. Pineapples can ripen after harvest, but require certain temperatures for this process to occurring like bananas, they are chill-sensitive and should not be stored in the refrigerator. They will, however, ripen if left outside of a refrigerator. The ripening of pineapples can be rather difficult as they will not ripen for some time and in a day or

two become over-ripe, therefore, pineapples are most widely available canned. (Wikipedia, 2008)

The juice has a soluble solids content averaging around 12-15% and a high Brix/acid ratio which can vary between 14 and 35, the pH tends to average 3.8-4.0 depending on origin. The processing industry is dominated by the canneries and pine apple juice has traditionally been a by product of this industry. During the preparation of the fruit for canning it is first trimmed into cylinders and then cut into the final segments, rings, etc. The waste from this operation including the core is pressed and the juice is added to the juice collected from the cutting table. This blend is then centrifuged to remove excess pulp, de-aerated pasteurized and concentrated. In 1979 in Brazil they start producing juice from the whole fruit which resulted in a product with better flavor and more stability than that previously available. The resulting product is much more expensive but its quality is superior so it made an immediate impact on the market and now accounts for nearly 20% of the consumption of pineapple juice.

Pineapple contains a proteolytic enzyme bromelain, which breaks down protein. Pineapple juice can thus be used as a marinade and tenderizer for meat. The enzymes in pineapples can interfere with the preparation of some foods, such as jelly or other gelatin-based desserts. The bromelain breaks down in the canning process, thus canned pineapple can generally be used with gelatin. These enzymes can be hazardous to someone suffering from certain protein deficiencies or disorders, such as Ehlers-Danlos syndrome. Pineapples should also not be consumed by those with Hemophilia or by those with kidney or liver disease, as it may reduce the time taken to coagulate a consumer's blood. Consumers of pineapple have claimed that pineapple has benefits for some intestinal disorders; others claim that it helps to induce childbirth when a baby is overdosed. Pineapple

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is a good source of manganese , as well as containing significant amounts of Vitamin C and Vitamin B1

Table 2 : The typical nutritional value per 100g of raw pineapple

Raw pineapple Nutritional value per 100 g	
Energy	50 kcal 200 kJ
Carbohydrates	12.63 g
- Sugars	9.26 g
- Dietary fiber	1.4 g
Fat	0.12 g
Protein	0.54 g
Thiamin (Vit. B1)	0.079 mg 6%
Riboflavin (Vit. B2)	0.031 mg 2%
Niacin (Vit. B3)	0.489 mg 3%
Pantothenic acid (B5)	0.205 mg 4%
Vitamin B6	0.110 mg 8%
Folate (Vit. B9)	15 µg 4%
Vitamin C	36.2 mg 60%
Calcium	13 mg 1%
Iron	0.28 mg 2%
Magnesium	12 mg 3%
Phosphorus	8 mg 1%
Potassium	115 mg 2%
Zinc	0.10 mg 1%

4. Ingredients

A. Water

Water is used for dilute the juice that extracted from the raw fruit especially in the single strength juice processing. The amount of water

would not be that much, so the ratio between raw fruit juice and water ranges from 1:1 or 1:2.

B. Sugar

The function of sugar in fruit juice is for its taste. The amount of sugar is used in fruit juice around 14-16% of the juice weight; it will be affected on the final product

C. Salt

Salt or sodium chloride is used in processing fruit juice not only for its salty taste but also for increasing the consumer taste of product. The level of salt used being around 1.5-4% of the juice weight.

D. Citric acid

About 50% of the world's citric acid production is used as flavor enhancers for beverages, while another 19% goes into food. It can be used in preserving foods and enhancing their flavor. It also acts as an antioxidant synergist in fatty foods.

5. Packaging by Beverage cartons

The birth of the beverage carton is related to the development of milk distribution, it is said that cartons of milk were available in California in 1906. The first packages entered the US market by the new brand name Pure Pak. In the 1930s, the Jagenberg Group of Germany introduced a paper-based and wax coated package for liquid dairy products and it became well known as the "Perga bloc" package in Germany and other EU countries. In 1960 this company was merged with another company and launched the "Combiloc" package, a packaging system could produce brick-shaped aseptic and non aseptic packages for liquid food. This packaging system became the most important product for many years and it was later made available in sizes above 1 liter. (Geoff H.Giles, 1999)

In the early 1930s the Swedish industrialist established a packaging company named Akerlund & Rausing. They developed a new concept aimed at minimizing the packaging material in liquid food packs, this was tetrahedron-shaped package called "Tetra Pak". Later, they managed to offer an aseptic version of the Tetra Classic carton in 1959 and an aseptic Tetra Brik carton in 1969. This carton has been used for different foods materials including milk, juice, vegetable oil, mineral water, wine. They were available today in sizes ranging from 100ml to 2 liters. In 1986 a new system was introduced the "Tetra Top" packaging system offering an injection-molded plastic top sealed to a squares-sectioned paper sleeve with rounded corners. The opening device makes this package easy to open, to pure from and to reclose. Today Tetra Pak is the leading supplier of cartons for liquid food to the world with the production rate more than 80 billion.

The most important role of packaging is to protect the product from microbial contamination during transportation and storage. The barriers in cartons protect the product from light which can accelerate the degradation of vitamin C when oxygen is present in the package. Laminated carton material consists of layer of paper board, coated internally and externally with polyethylene and a barrier is usually aluminum foil. Other barrier includes silicon dioxide on polyester, ethylene vinyl alcohol and polyamide. But the oxygen barrier properties of this carton is not only depend on the packaging material itself but also on the barrier properties of strips and closures, and on the tightness of the transverse seals at the end of the carton

Material and Methods

1. Materials and Apparatus :

- Ripe Dragon Fruit, ripe Pineapple
- Sugar
- Salt
- Citric acid, food grade
- Equipments for blending and extract juice.
- 0.1M NaOH, burette, phenolphthalein,
- Refractometer
- Thermometer
- pH meter

2. Methods

2.1 Procedure

Extraction of Red Dragon fruit juice

- Blend 1 part of red dragon fruit flesh with 2 parts of water
- Filter with sieve and cheese cloth
- Keep of red dragon fruit juice

Extraction of orange juice

- Clean the orange and cut it into half
- Squeeze the juice and remove the seeds

Extraction of pineapple juice

- Clean and peel the pineapple
- Chop the flesh into smaller pieces
- Blend 1 part of pineapple with 1 part of water
- Filter through cheese cloth and keep the extracted juice

Mixing and measurement of juices

- Mixed fruit juice from Red Dragon fruit juice and pineapple juice in a ratio of 1:1 and 1:2
- Determine pH for each ratio of mix fruit juice by using pH meter
- Measurement of the total soluble solid ($^{\circ}\text{Bx}$) is done by using refractometer
- Measurement of the percentage acidity by titration with the standardization 0.1M NaOH with phenolphthalein as indicator
- Calculate the amount of acid and sugar need to adjust.

2.2 Hedonic test and Just about right test

The preference test based on 9-point hedonic scale and Just about right test were used in order to analyze the satisfaction level of consumers on different types of fruit juice with Red Dragon fruit juice in different ratios

3. Sensory analysis: Quality and preference of mixed fruit juice

(A) Sensory evaluation based on Hedonic scale

The 9-point Hedonic scale was used in order to analyzed the satisfaction level of the consumer from the first product to final product

(B) Sensory evaluation based on Just about right test

This test was used to determine the attributes needed to be adjusted in order to formulate the

4. Product development steps and final product testing

Table 3: The preliminary specification for making mixed fruit juice from Red Dragon fruit juice with orange juice and red dragon fruit juice with pineapple juice (Somchai P, 2000)

Ingredients	Percentage (%)
Mix fruit juice	100
Sugar	14
Salt	0.4
Acid	0.2

(A) Comparing consumer evaluation of mixed fruit juice from Red Dragon fruit juice with orange juice and Red Dragon fruit juice with pineapple juice. It was rated on 7 attributes including overall liking, color, saltiness, sweetness, sourness, aftertaste by doing the preference test based on 9-points Hedonic scale with untrained 15 test panelists. The suitable mixed fruit juice was selected for further development.

(B) The mixed fruit juice from Red Dragon fruit juice with pineapple juice was chosen to adjust the taste into 2 different ratios 1:1 and 1:2. This treatment was obtained and tested with untrained 15 test panelists by using the preference test based on 9-points Hedonic scale and Just about right test

(C) The mixed fruit juice from Red Dragon fruit juice with pineapple juice ratio 1:2 was chosen to adjust the total soluble solid (the sweetness taste). This treatment was obtained and tested with untrained 15 test panelists by using the preference test based on 9- points Hedonic scale

(D) The most preferred formula was chosen to test in the finally consumer acceptance test with 100 consumers

5. Statistic analysis

The screening on the type and ratio of mixed fruit juice from 15 untrained test panelists was analyzed by using One Way ANOVA Design from SPSS program version 14.

The study of the sensory properties and consumer acceptance with 100 consumers was analyzed by using Independent sample t-test and One sample t-test from SPSS program version 14.

6. Experiment location

- Pilot plant and E8 laboratory, Faculty of Biotechnology, Assumption University
- Testing for sensory and consumer acceptance around Assumption University , Huarmark Campus

7. Time planning

Table 4 : Description of works

Task	Description
1	Discuss with advisor and searching for the project topic
2	Design on the material and method
3	Implement project, collect and analyze the data
4	Consumer acceptance test
5	Preparation for project report
6	Last checking of the special project by advisor
7	Presentation of the special project

Task	2008															
	August				September				October				November			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1																
2																
3																
4																
5																
6																
7																

Figure 5: Gant chart for project’s time planning

Result and Discussion

1. Sensory evaluation by Hedonic scale test and Just about right test

A. Process of making mixed fruit juice from Red Dragon fruit juice with pineapple juice with orange juice and with pineapple juice

In the commercial market there are many types of fruit juice but the Dragon fruit juice has not been produced and launched yet. This kind of fruit gives the beautiful color and good benefits in health but this juice is lacked of taste and flavor. Because of it low in flavor and taste, the project was aimed in making mixed fruit juice from Red Dragon fruit juice with pineapple juice with orange juice and with pineapple juice which has more flavor and taste than the Red Dragon fruit alone. The juice was produced by the specification given in the table 5.

Table 5: The specification of mixed fruit juice from Red Dragon fruit juice with orange juice and red dragon fruit juice with pineapple juice

Treatments	Red dragon fruit juice: orange juice		Red dragon fruit juice : pineapple juice	
	1:1	1:2	1:1	1:2
Brix degree	14.5	14.5	14	14.5
Acidity percentage	0.21	0.25	0.2	0.2
Salt percentage	0.4	0.4	0.4	0.4
pH*	4.7	4.7	4.5	4.4

*Measured after mixing and adjusting the taste

From the original specification of making mixed fruit juice the total soluble solid should be around 14-16% and acidity percentage is around 0.2%. After mixing the juice the total soluble solid was adjusted from 6-7 °Bx to around 14°Bx which given in the table 4, the acidity percentage of mixed fruit juice from Red Dragon fruit juice with orange juice was around 12 and

no need to adjust anymore. But for the mixed fruit juice from Red Dragon fruit juice with pineapple juice, its acidity percentage was increased from 0.15 to 0.2. The pH in the mixed fruit juice from Red Dragon fruit juice with orange juice should be lower than pH in the mixed fruit juice from Red Dragon fruit juice with pineapple juice but in this case it was higher, so it might be caused from the error reading of the pH meter. The mixed juice was tested with 15 untrained test panelists by preference test based on 9-point hedonic scale. Seven attributes included flavor, color, saltiness, sweetness, sourness, aftertaste and overall liking. Summarized result was shown in the table 6.

Table 6: Result of preference test of mixed fruit juice from red dragon fruit juice with orange juice and red dragon fruit juice with pineapple

Attributes	Red dragon fruit juice: orange juice		Red dragon fruit juice : pineapple juice	
	1:1	1:2	1:1	1:2
Flavor	4.8 ^b	5.4 ^b	6.4 ^a	6.4 ^a
Color	5.9 ^b	5.8	6.3 ^{ab}	6.7 ^a
Saltiness	3.3 ^b	4.7 ^b	4.8 ^a	5.2 ^a
Sweetness	5.0 ^b	5.8 ^{ab}	6.1 ^a	6.3 ^a
Sourness	4.5	5.2	5.4	5.5
Aftertaste	4.2 ^b	5.2 ^b	5.7 ^a	5.7 ^a
Overall liking	4.5 ^b	5.4 ^{ab}	6.0 ^a	6.2 ^a

* Non significant difference @ $p \leq 0.05$

For flavor, there was a significant different among samples. The test panelists preferred Red Dragon fruit juice with pineapple juice more than the mixed fruit juice from Red Dragon fruit juice with orange Juice which the highest score was found in 1:1 and 1:2. Both samples were rated around 6 referring to slightly like.

For color, there was significantly different in the color of the mixed fruit juice with the most preferred was Red Dragon fruit juice with

pineapple juice at ratio 1 : 2 of 7, indicating moderately like. Comparing mixed fruit juice, pineapple juice mixed with Red Dragon fruit juice was preferred more than orange juice

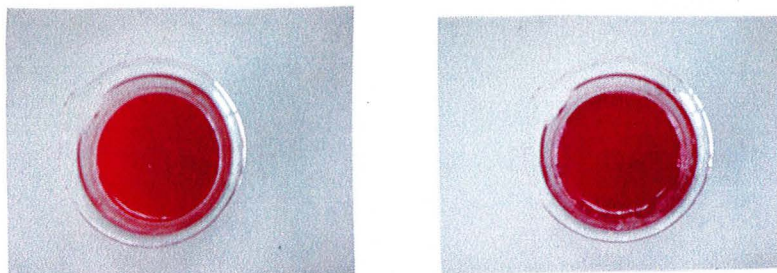


Figure 6 : The mixed fruit juice from Red Dragon fruit juice with orange juice and with pineapple juice in ratio 1:1 (from left to right)



Figure 7 : The mixed fruit juice from Red Dragon fruit juice with orange juice and with pineapple juice in ratio 1:2 (from left to right)

Taste includes saltiness, sweetness and sourness. There were significantly different among the samples in saltiness and sweetness though the amount of both, acid and sugar were adjusted according to the specification in the Table 4. Test panelists did not like saltiness in the product but pineapple juice was preferred than orange juice when mixed with Red Dragon fruit juice. The result from sweetness followed the some patterns as saltiness with better scores. The test panelists rated Red Dragon fruit juice with pineapple juice as slightly like while they rated neither like or nor dislike for Red Dragon fruit juice with orange juice. Sourness was not significant among samples. Some test panelists gave a comment that mixed juice from Red Dragon fruit juice and orange juice was too sour and

bitter. This could be due to the present of limomin from orange skin during extraction of the juice.

Aftertaste was significantly different. The lowest score indicating high aftertaste was found in ratio 1:1 of mixed juice from Red Dragon fruit juice and orange juice due to limomin from orange juice.

For overall acceptance, it was clearly seen that Red Dragon fruit juice mixed with pineapple juice was better than mixed with orange juice. Between two ratios 1:2 was preferred more than 1:1 in all attributes. As a result, pineapple juice was selected for further study.

The pH of the Red Dragon fruit juice and pineapple juice was 4.4-4.5 which was low enough to maintain microbial stability after making. For mixed fruit juice from Red Dragon fruit juice and orange juice, the pH was 4.7 which were not safe from microbial spoilage.

B. Process of making mixed fruit juice from Red Dragon fruit juice with pineapple juice

Due to the preference test and the high score from Part A, the project was now focused on using pineapple juice only. The juice was made into 2 different ratios; salt was decreased in both ratios from 0.4 to 0.2 as recommended from the test panelist of too salty in the product. The new formulas were shown in table 7.

Table 7: The specification of mixed fruit juice from Red Dragon fruit juice and pineapple juice

Treatments	Ratio 1:1	Ratio 1:2
Brix degree	14	14
Acidity percentage	0.27	0.27
Salt percentage	0.2	0.2
pH	4.3	4.2

The mixed juice was tested with 15 untrained test panelists by preference test based on 9-points hedonic scale. Seven attributes included overall liking, color, saltiness, sweetness, sourness, aftertaste and viscosity because the test panelists recommended that viscosity should be reduced in the sample. Summarized result of SPSS and the Just about right test are given in the table 8

Table 8: Result of Preference test of mixed fruit juice from Red Dragon fruit juice and pineapple juice

Attributes	Treatment	
	Ratio 1:1	Ratio 1:2
Overall liking	6.2	6.3
Color	5.8	6.9
Saltiness	5.8	6.1
Sweetness	6.5	5.2
Sourness	5.9	6.1
Viscosity	6.4	6.1
Aftertaste	6.4	6.7

* Non significant difference @ $p \leq 0.05$

The result from preference test was shown clearly that there were no significant different between the mixed fruit juice from Red Dragon fruit juice and pineapple juice in 2 different ratios.

There was no significantly different in color but the score at 6.9 for ratio 1:2 was higher than 1:1, it was indicated slightly like to moderately like of the sample. 86.7% of test panelist evaluated this color as just right

There was no significantly different in saltiness after adjusting. The score for ratio 1:2 at 6.1 was higher than ratio 1:1 at 5.8 which were

indicated slightly like. But over 80% of test panelists evaluated the saltiness was just right for both of ratios.

There was no significantly different in sweetness but in this case the score for ratio 1:1 at 6.3 was higher more than ratio 1:2 at 5.2 which was indicated neither like nor dislike. Only 20% rated just right for ratio 1:2 while 67% rated too much

There was no significantly different in sourness, the scores for both of ratios were not different but the ratio 1:2 was still higher more than ratio 1:1, they was rated around slightly like. 73.4% of test panelist evaluated the sweetness was just right for ratio 1:2. This sourness might be affected by the sourness from Pineapple Juice ratio.

There was no significantly different in viscosity. The juice was diluted with the Pineapple Juice but in the score for ratio 1:1 was higher than 1:2. They were rated slightly like as the score over 6. Over 70% of test panelist evaluated the viscosity was just right for both of ratios.

Aftertaste was no significantly different. The lowest score indicating high aftertaste was found in ratio 1:1 but over 80% of test panelist satisfy with this attribute. Aftertaste was no a problem with Pineapple Juice as Orange Juice. Therefore, the test panelists were no perceived this attribute.

Overall acceptance was no significantly different and the score for both of ratios were not different much, they were indicated slightly like at the scores of 6.2 and 6.3.

As a result, it was clearly seen that ratio 1:2 was better than ratio 1:1 in almost all attributes except the lowest score in sweetness. So in the next experiment, the sweetness was selected for further study to satisfy the consumer's desire.

Table 9 : Result from Just about right test of mixed fruit juice from Red Dragon fruit juice and pineapple juice in ratio 1:2

Attributes	Much too little	Too little	Just right	Too much	Much too much
Color	0	0	86.7	13.3	0
Saltiness	0	0	80	20	0
Sweetness	0	6.7	20	66.7	6.6
Sourness	0	13.3	73.4	13.3	0
Viscosity	0	13.3	73.3	13.4	0
Aftertaste	0	0	93.3	6.7	0

Just about right test was conducted with 15 untrained test panelists on 1:2 mixed fruit juice. The result from table 9 indicated that sweetness needed to be adjust as 66.7% of the test panelist rated it as too much or too high. Other attributes were rated more than 50% at just right and needed no adjustment.

C. Adjust the sweetness in the mixed fruit juice from Red Dragon fruit juice and pineapple juice

In this experiment, the amount of salt was decreased from 0.2 to 0.15 as it was commented of too salty. The fruit juice was adjusted the total soluble solid or Brix degree and shown in Table 10 and the Brix degrees were varied into 11, 12, 13 and 14 as control

Table 10: The adjusting of the total soluble solid (°Bx) in the mixed fruit juice from Red Dragon fruit juice and pineapple juice (ratio 1:2)

Treatment	11 °Bx	12 °Bx	13 °Bx	14 °Bx
Acidity percentage	0.28	0.27	0.27	0.28
Salt percentage	0.15	0.15	0.15	0.15
pH	4.2	4.3	4.3	4.2

For this experiment, the appearance of the juice was not focused, so only 5 attributes including sweetness, saltiness, sourness, overall flavor and overall liking were asked. The preference test based on 9-points Hedonic scale was done by 15 untrained test panelists and the results were shown in the table 11

Table 11 : Result of preference test for 4 different Brix degree of mixed fruit juice from Red Dragon fruit juice and pineapple juice (ratio 1:2)

Attributes	Treatments			
	Control	11°Bx	12°Bx	13°Bx
Sweetness	5.1 ^c	6.8 ^{bc}	7.3 ^a	6.3 ^b
Saltiness	6.3 ^b	6.3 ^b	7.3 ^a	7.2 ^a
Sourness	6.1	6.2	6.7	6.1
Overall flavor	6.8 ^c	7.1 ^{bc}	7.7 ^a	7.5 ^{ab}
Overall liking	6.4 ^b	6.6 ^{ab}	7.2 ^a	6.7 ^{ab}

* Non significant difference @ $p \leq 0.05$

There was significantly different in sweetness of 4 treatments. The lowest score was 5.1 for control of 14°Bx which indicated neither like nor dislike while the highest score was 7.3 for 12°Bx indicating moderately like. So the test panelists did not like the juice with too high nor too low of sweetness.

There was significantly different in saltiness among sample. 12°Bx and 13°Bx were not significantly different but were significantly different from 11°Bx and 14°Bx as control. 12°Bx and 13°Bx received higher score than 11°Bx and 14°Bx, 7.2>6.3.

There was no significantly different in sourness for all treatments. They gained the scores from 6.1 to 6.7 indicating slightly like but the highest for treatment was found with 12°Bx at 6.7. It was not the expected score but the test panelist began to like the sour taste in the product.

Though the mixed fruit juice came mostly from pineapple juice, not the Red Dragon fruit juice as it had low in flavor and aroma. Addition different amounts of sugar in the mixed juice had effected on the preference score in flavor. The highest score was given to 12°Bx mixed juice of 7.7. Sugar could enhance the flavor of pineapple. However, at high sugar 13°Bx and 14°Bx the test panelists gave these sample scores lower than 12°Bx.

For overall acceptance, 12°Bx mixed fruit juice gained the highest score of 7.2 which was significantly different from the rest. The test panelists gave the high scores for this sample in all attributes. It was rated in 7 referring to moderately like in all attributes except sourness, 6.7. After measuring pH, the mixed fruit juice had pH from 4.2-4.3 in acid food and was stable against spoilage microorganism.

12°Bx was the proper total soluble solid content to prepare mixed fruit juice from Red Dragon fruit juice and pineapple juice ratio 1:2. However, the sourness of the mixed fruit juice needed to be adjusted. The test panelist criticized that it was not score enough. Therefore the amount acid was increased from 0.27 to 0.3% by adding citric acid in the final specification, given in table 12.

Table 12: The specification for the final product of mixed fruit juice from Red Dragon fruit juice and pineapple juice in ratio 1:2

Ingredient	Percentage
Total soluble solid as °Bx	12
Acidity as citric acid	0.3
Salt	0.15
pH	4.3

D. Consumer acceptance based on the Hedonic scale test

The final product of Mixed Fruit Juice from Red Dragon Fruit Juice and Pineapple Juice ratio 1:2 was tested with 100 consumers for the consumer acceptance. The questionnaire consisted of demographic part, consumer behavior part and product evaluation part. The data was analyzed by using SPSS version 14 and the raw data were shown in Appendix D2. The consumers included 63% female and 37% male with the age range above 15 year old. Most of them were student with Bachelor degree or higher education and the income per month was less than 5000 Baht to 10000 Baht. The consumers were asked to identify the brand and the type of fruit juice they preferred in the consumer behavior part. The result showed that 35% of consumer preferred Malee, 28% Tipco, 14% Unif, 15% Chabaa and the remaining for other brand. Most consumers believed in Malee and Tipco brand because their products were good and had many varieties.

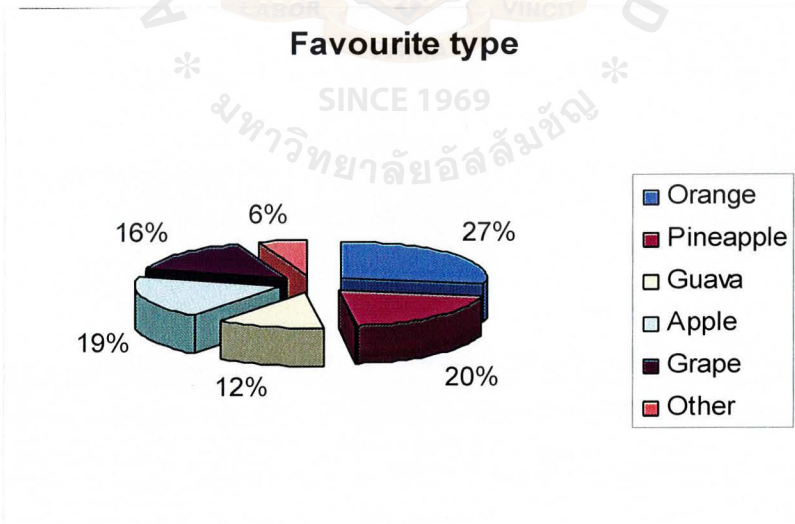


Figure 8 : Pie chart for consumer’s favorite types of fruit juice

The figure 8 showed that 27% of consumers preferred to consume orange juice, 20% for pineapple, 12% for guava, 19% for apple, 16% for grape and the remaining for other juice. Orange juice was consumed more than the other juice because it consisted of Vitamin C and good for consumer health.

The result in the Appendix D2, the fruit juice was consumed once per week to 2-3 times per week because they have health benefits. The suitable price for the consumers was range from 5-10 and 10-15 Baht per size 200 ml. Consumer preferred buy fruit juice in Supermarket or convenient store where the quality of product was guaranteed by the seller.

The 100 consumers were asked for the consumer acceptance based on 9-points hedonic scale, the results were shown in the table 13.

Table 13: Score of the final product from preference test based on Hedonic test (n=100)

Attributes	Score ± SD
Overall liking	7.2 ± 0.82
Saltiness	7.2 ± 0.74
Sweetness	7.2 ± 0.85
Sourness	7.0 ± 0.70
Overall flavor	7.3 ± 0.59

From the result, the product received the liking score range from 7.0 - 7.3, referring “moderately like”. The lowest score was found in sourness. The preference test indicated that the consumers had expected more of sourness in the product. When asking about their acceptance of the product, 77% of consumers said “yes” cause of they liked the new product. While the remaining consumers said “no” because of they didn’t like dragon fruit and some consumers could not consume pineapple. For the purchasing intention, 74% of consumer had the intention to purchase this product while

20% and 6% were not sure and would not purchase the product. The consumers were asked for the price that they were willing to pay for 200 ml. The result showed that 34% of consumer accepted the product at 5-10 Baht, 57 % of consumer accepted the product at 10-15 Baht while 9% of consumer could pay more than 15 Baht for this product. This accepted price was related to the consumer's income, because they were student with low income that could not pay the higher price for the product.

E. Cost of product

Table 14 : Raw material cost of 1 batch of Mixed Fruit Juice from Red Dragon Fruit Juice and Pineapple Juice

Ingredients	Net Weight	Price (Baht)
Red dragon fruit	450	13.5
Pineapple	1200	45
Sugar	395	9.1
Salt	5.4	0.54
Acid	5.4	10.4
Total 3600g		78.5

Estimation of raw material cost used in the production of mixed Dragon fruit juice with pineapple juice was shown in table 13. Based on 3,600 gm of the mixed fruit juice, the raw material cost was 78.50 Baht. This value was used in determining the production cost of the final product.

Table 15: The price of the final product

Ingredients	Price (Baht)/200g
Raw material	4.4
Production	0.9
Marketing	0.7
Total	6

From the Table 15, the price of the final product, 200 grams, was 6 Baht which included raw material cost 4.4 ฿, production cost (20% of raw material cost) 0.9 ฿ and marketing cost (15% of raw material cost) 0.7 ฿. Based on the consumer acceptance test 57% of consumer was willing to buy the product at 10 – 15 Baht so the profit gained after deduction of the production cost was 4 – 9 Baht or 40 – 60% per box.



Conclusion

In the development of mixed fruit juice, the Red Dragon fruit that has beautiful color and health benefits to consumer but lacking in taste and flavor was mixed with orange Juice and with pineapple juice to enhance taste and flavor. After screening with 15 test panelists, most of them preferred mixed fruit juice from Red Dragon fruit juice and pineapple juice more than orange juice based on their taste and flavor.

Mixed fruit juice from Red Dragon fruit juice and pineapple juice was prepared in 2 ratios 1:1 and 1:2. The saltiness was reduced from 0.4 to 0.15% based on the consumer's preference. From the preference test from 9-points Hedonic scale and Just about right test, the test panelist liked the mixed fruit juice in ratio 1:2 but sweetness and sourness were needed to be adjusted. The sugar content was varied from 11 – 14% in the formulas and the preference test indicated that the best sweetness juice was in 12° Bx. 0.3% acid content was preferred most.

Finally, the consumer acceptance test was done with 100 consumers and the result showed that the consumer liked the new product of mixed fruit juice from Red Dragon fruit juice and pineapple juice in ratio 1:2. All attributes with the average score in “Like Moderately” level with the overall liking of 7.2. 77% of consumer accepted the product and 74% of consumer had an intention to purchase this product.

Recommendation

In this project, heat treatment as pasteurization in-container was used to produce the mixed fruit juice. The development of packaging is recommended by using heat treatment as UHT sterilization to prevent the spoilage microorganism and make the long shelf-life, high quality product.

Mixed juice should be mixed with another type of juices to find more new varieties of fruit juice and satisfy the consumer's desire.



References

- Ashurst P.R. 1995. **Production and Packaging of Non Carbonated Fruit Juice and Fruit Beverages**. 2nd Ed. pp 27-28, 117-121. Blackie Academic and Professional
- Askar A. and H. Treptow. 1993. **Assurance in Tropical Fruit Processing Quality**. pp. 45-60 Springer-Verlag, Berlin Heidelberg
- Giles G. H. 1999. **Handbook of Beverage Packaging**. pp.110-115 Academic Press Ltd, Sheffield
- Anonymous, **Citric acid** available at http://en.wikipedia.org/wiki/Citric_acid
- Anonymous, **Dragon Fruit Nutrition & Dragon Fruit Health Benefits** available at http://diabeticlifediet.com/my_diabetic_diet_foods/dragon_fruit_pitaya_fruit/dragon_fruit_health_benefit/
- Anonymous, **Dragon Fruit Nutrition & Dragon Fruit Health Benefits** available at http://dragon.fruit.pitaya.fruit.foodlywise.com/dragon_fruit_health_benefits
- Anonymous, **Fruit juice** available at http://en.wikipedia.org/wiki/Fruit_juice
- Anonymous, **Pitaya** available at <http://en.wikipedia.org/wiki/Pitaya>
- Anonymous, **The fruit of the Dragon** available at http://www.ciao.co.uk/Dragon_Fruit__Review_5736706

Appendices



(A) The formulation for the fruit juice mix between dragon fruit with orange and dragon fruit with pineapple

A1. Questionnair

Formulation using hedonic scale

Name:

Date:

Instruction:

Please rinse your mouth with water before starting
Please taste the four samples in the order presented, from left to right. Then evaluate hedonic scale in each attribute of sample by using the following numbers:

- 1 = dislike extremely
- 2 = dislike very much
- 3 = dislike moderately
- 4 = dislike slightly
- 5 = neither like nor dislike
- 6 = like slight
- 7 = like moderately
- 8 = like very much
- 9 = like extremely

Sample	1	2	3	4
Odor				
Color				
Saltiness				
Sweetness				
Sourness				
After taste				
Overall liking				

Note :

- 1 for ratio 1 orange : 1 dragon fruit
- 2 for ratio 2 orange : 1 dragon fruit
- 3 for ratio 1 pineapple : 1 dragon fruit
- 4 for ratio 2 pineapple : 1 dragon fruit

A2. Data from SPSS for the Hedonic scale test

1. Flavor result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	28.050	3	9.350	5.888	.001
Within Groups	88.933	56	1.588		
Total	116.983	59			

Post Hoc Tests

Multiple Comparisons

Dependent Variable:

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
LSD	A	B	-.60000	.46016	.198	-1.5218	.3218
		C	-1.60000(*)	.46016	.001	-2.5218	-.6782
		D	-1.60000(*)	.46016	.001	-2.5218	-.6782
	B	A	.60000	.46016	.198	-.3218	1.5218
		C	-1.00000(*)	.46016	.034	-1.9218	-.0782
		D	-1.00000(*)	.46016	.034	-1.9218	-.0782
	C	A	1.60000(*)	.46016	.001	.6782	2.5218
		B	1.00000(*)	.46016	.034	.0782	1.9218
		D	.00000	.46016	1.000	-.9218	.9218
	D	A	1.60000(*)	.46016	.001	.6782	2.5218
		B	1.00000(*)	.46016	.034	.0782	1.9218
		C	.00000	.46016	1.000	-.9218	.9218

* The mean difference is significant at the 0.05 level.

Homogeneous Subsets

	trt	N	Subset for alpha = .05	
		1	2	1
Duncan(a)	A	15	4.8667	
	B	15	5.4667	
	C	15		6.4667
	D	15		6.4667
	Sig.		.198	1.000

2. Color result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.183	3	4.061	2.145	.105
Within Groups	106.000	56	1.893		
Total	118.183	59			

Post Hoc Tests

Multiple Comparisons

Dependent Variable:

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
LSD	A	B	.06667	.50238	.895	-.9397	1.0730
		C	-.40000	.50238	.429	-1.4064	.6064
		D	-1.06667(*)	.50238	.038	-2.0730	-.0603
	B	A	-.06667	.50238	.895	-1.0730	.9397
		C	-.46667	.50238	.357	-1.4730	.5397
		D	-1.13333(*)	.50238	.028	-2.1397	-.1270
	C	A	.40000	.50238	.429	-.6064	1.4064
		B	.46667	.50238	.357	-.5397	1.4730
		D	-.66667	.50238	.190	-1.6730	.3397
	D	A	1.06667(*)	.50238	.038	.0603	2.0730
		B	1.13333(*)	.50238	.028	.1270	2.1397
		C	.66667	.50238	.190	-.3397	1.6730

- The mean difference is significant at the .05 level.

Homogeneous Subsets

	trt	N	Subset for alpha = .05	
			2	1
Duncan(a)	B	15	5.8667	
	A	15	5.9333	
	C	15	6.3333	6.3333
	D	15		7.0000
	Sig.		.387	.190

3. Saltiness result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	31.333	3	10.444	3.449	.023
Within Groups	169.600	56	3.029		
Total	200.933	59			

Post Hoc Tests

Multiple Comparisons

Dependent Variable:

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
LSD	A	B	-1.40000(*)	.63546	.032	-2.6730	-.1270
		C	-1.46667(*)	.63546	.025	-2.7396	-.1937
		D	-1.93333(*)	.63546	.004	-3.2063	-.6604
	B	A	1.40000(*)	.63546	.032	.1270	2.6730
		C	-.06667	.63546	.917	-1.3396	1.2063
		D	-.53333	.63546	.405	-1.8063	.7396
	C	A	1.46667(*)	.63546	.025	.1937	2.7396
		B	.06667	.63546	.917	-1.2063	1.3396
		D	-.46667	.63546	.466	-1.7396	.8063
	D	A	1.93333(*)	.63546	.004	.6604	3.2063
		B	.53333	.63546	.405	-.7396	1.8063
		C	.46667	.63546	.466	-.8063	1.7396

* The mean difference is significant at the .05 level.

Homogeneous Subsets

	trt	N	Subset for alpha = .05	
			2	1
Duncan(a)	A	15	3.3333	
	B	15		4.7333
	C	15		4.8000
	D	15		5.2667
	Sig.		1.000	.435

4. Sweet result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13.917	3	4.639	3.430	.023
Within Groups	75.733	56	1.352		
Total	89.650	59			

Post Hoc Tests

Multiple Comparisons

Dependent Variable:

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
LSD	A	B	-.80000	.42464	.065	-1.6507	.0507
		C	-1.26667(*)	.42464	.004	-2.1173	-.4160
		D	-1.06667(*)	.42464	.015	-1.9173	-.2160
	B	A	.80000	.42464	.065	-.0507	1.6507
		C	-.46667	.42464	.276	-1.3173	.3840
		D	-.26667	.42464	.533	-1.1173	.5840
	C	A	1.26667(*)	.42464	.004	.4160	2.1173
		B	.46667	.42464	.276	-.3840	1.3173
		D	.20000	.42464	.639	-.6507	1.0507
	D	A	1.06667(*)	.42464	.015	.2160	1.9173
		B	.26667	.42464	.533	-.5840	1.1173
		C	-.20000	.42464	.639	-1.0507	.6507

* The mean difference is significant at the .05 level.

Homogeneous Subsets

	trt	N	Subset for alpha = .05	
			2	1
Duncan(a)	A	15	5.0667	
	B	15	5.8667	5.8667
	D	15		6.1333
	C	15		6.3333
	Sig.		.065	.306

5. Sour result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.983	3	2.994	1.035	.384
Within Groups	162.000	56	2.893		
Total	170.983	59			

Post Hoc Tests

Multiple Comparisons

Dependent Variable:

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Upper Bound	Lower Bound
LSD	A	B	-.73333	.62106	.243	-1.9775	.5108
		C	-.86667	.62106	.168	-2.1108	.3775
		D	-1.00000	.62106	.113	-2.2441	.2441
	B	A	.73333	.62106	.243	-.5108	1.9775
		C	-.13333	.62106	.831	-1.3775	1.1108
		D	-.26667	.62106	.669	-1.5108	.9775
	C	A	.86667	.62106	.168	-.3775	2.1108
		B	.13333	.62106	.831	-1.1108	1.3775
		D	-.13333	.62106	.831	-1.3775	1.1108
	D	A	1.00000	.62106	.113	-.2441	2.2441
		B	.26667	.62106	.669	-.9775	1.5108
		C	.13333	.62106	.831	-1.1108	1.3775

Homogeneous Subsets

	trt	N	Subset for alpha = .05
			1
Duncan(a)	A	15	4.5333
	B	15	5.2667
	C	15	5.4000
	D	15	5.5333
	Sig.		.148

6. After taste result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	23.517	3	7.839	5.310	.003
Within Groups	82.667	56	1.476		
Total	106.183	59			

Post Hoc Tests

Multiple Comparisons

Dependent Variable

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
LSD	A	B	-1.00000(*)	.44365	.028	-1.8887	-.1113
		C	-1.53333(*)	.44365	.001	-2.4221	-.6446
		D	-1.53333(*)	.44365	.001	-2.4221	-.6446
	B	A	1.00000(*)	.44365	.028	.1113	1.8887
		C	-.53333	.44365	.234	-1.4221	.3554
		D	-.53333	.44365	.234	-1.4221	.3554
	C	A	1.53333(*)	.44365	.001	.6446	2.4221
		B	.53333	.44365	.234	-.3554	1.4221
		D	.00000	.44365	1.000	-.8887	.8887
	D	A	1.53333(*)	.44365	.001	.6446	2.4221
		B	.53333	.44365	.234	-.3554	1.4221
		C	.00000	.44365	1.000	-.8887	.8887

* The mean difference is significant at the .05 level.

Homogeneous Subsets

	trt	N	Subset for alpha = .05	
			2	1
Duncan(a)	A	15	4.2000	
	B	15		5.2000
	C	15		5.7333
	D	15		5.7333
	Sig.		1.000	.263

7. Overall result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	25.200	3	8.400	5.242	.003
Within Groups	89.733	56	1.602		
Total	114.933	59			

Post Hoc Tests

Multiple Comparisons

Dependent Variable:

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
LSD	A	B	-.86667	.46222	.066	-1.7926	.0593
		C	-1.46667(*)	.46222	.002	-2.3926	-.5407
		D	-1.66667(*)	.46222	.001	-2.5926	-.7407
	B	A	.86667	.46222	.066	-.0593	1.7926
		C	-.60000	.46222	.200	-1.5259	.3259
		D	-.80000	.46222	.089	-1.7259	.1259
	C	A	1.46667(*)	.46222	.002	.5407	2.3926
		B	.60000	.46222	.200	-.3259	1.5259
		D	-.20000	.46222	.667	-1.1259	.7259
	D	A	1.66667(*)	.46222	.001	.7407	2.5926
		B	.80000	.46222	.089	-.1259	1.7259
		C	.20000	.46222	.667	-.7259	1.1259

* The mean difference is significant at the .05 level.

Homogeneous Subsets

	trt	N	Subset for alpha = .05	
			2	1
Duncan(a)	A	15	4.5333	
	B	15	5.4000	5.4000
	C	15		6.0000
	D	15		6.2000
	Sig.		.066	.107

(B) The formulation for the fruit juice mix between dragon fruit with pineapple

B1. Questionnaire

Formulation using just about right

Name:

Date:

Instruction:

Please rinse your mouth with water before starting. You may rinse again at anytime during the test you need to.

Please taste the samples in the order presented, from left to right

Please rate whether the level of a sensory attribute of the sample is “too high”, “just right” or “too low” and rate the samples from most preferred to least preferred using the following numbers:

1 = dislike extremely

2 = dislike very much

3 = dislike moderately

4 = dislike slightly

5 = neither like nor dislike

6 = like slight

7 = like moderately

8 = like very much

9 = like extremely

Sample code

Hedonic rating

1. Overall liking

2. Color ()

Much too light	Too light	Just right	Too dark	Much too dark

3. Saltiness ()

Much too little	Too little	Just right	Too much	Much too much

4. Sweetness ()

Much too little	Too little	Just right	Too much	Much too much

5. Sourness ()

Much too little	Too little	Just right	Too much	Much too much

6. Viscosity ()

Much too little	Too little	Just right	Too much	Much too much

7. After taste ()

Much too little	Too little	Just right	Too much	Much too much



B2. Data from SPSS for the Hedonic scale test

1. Over liking

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	RATIO1	6.2000	15	.94112	.24300
	RATIO2	6.3333	15	1.29099	.33333

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	RATIO1 & RATIO2	15	.118	.676

2. Color

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	RATIO1	5.8667	15	.99043	.25573
	RATIO2	6.9333	15	1.09978	.28396

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	RATIO1 & RATIO2	15	.450	.092

3. Saltiness

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	RATIO1	5.8000	15	.94112	.24300
	RATIO2	6.1333	15	1.24595	.32170

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	RATIO1 & RATIO2	15	.694	.004

4. Sweetness

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	RATIO1	6.5333	15	.99043	.25573
	RATIO2	5.0667	15	1.48645	.38380

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	RATIO1 & RATIO2	15	-.074	.792

5. Sourness

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	RATIO1	5.8667	15	1.45733	.37628
	RATIO2	6.0667	15	1.09978	.28396

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	RATIO1 & RATIO2	15	.452	.091

6. Viscosity

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	RATIO1	6.4000	15	.98561	.25448
	RATIO2	6.0667	15	1.43759	.37118

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	RATIO1 & RATIO2	15	.484	.068

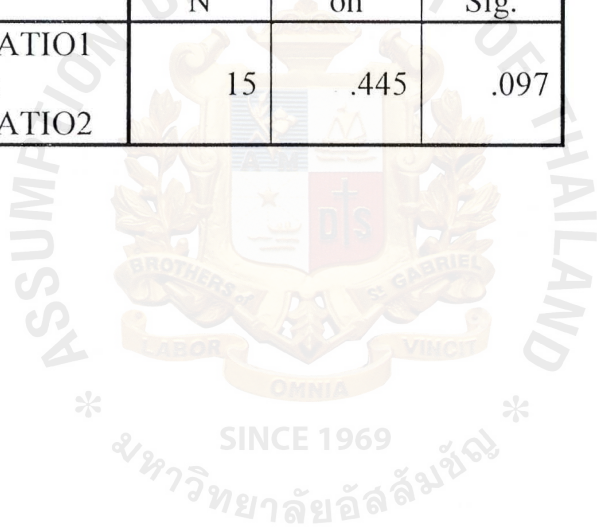
7. After taste

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	RATIO1	6.4000	15	.82808	.21381
	RATIO2	6.7333	15	1.27988	.33046

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	RATIO1 & RATIO2	15	.445	.097



(C)The adjusting of the total soluble solid (Brix degree) in the fruit juice mix between dragon fruit and pineapple (ratio 1:2)

C1 .Questionnair

Formulation using hedonic scale

Name:

Date:

Instruction:

Please rinse your mouth with water before starting
Please taste the four samples in the order presented, from left to right. Then evaluate hedonic scale in each attribute of sample by using the following numbers:

- 1 = dislike extremely
- 2 = dislike very much
- 3 = dislike moderately
- 4 = dislike slightly
- 5 = neither like nor dislike
- 6 = like slight
- 7 = like moderately
- 8 = like very much
- 9 = like extremely

Sample	Brix 10	Brix 12	Brix13	Brix 14 (Control)
Overall acceptance				
Saltiness				
Sweetness				
Sourness				
Overall flavor				

C2.Data from SPSS for Hedonic scale test

1. Overall acceptance result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.200	3	1.733	2.395	.078
Within Groups	40.533	56	.724		
Total	45.733	59			

Multiple Comparisons

Dependent Variable

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	brix11	brix12	-.60000	.31066	.059	-1.2223	.0223
		brix13	-.13333	.31066	.669	-.7557	.4890
		control	.20000	.31066	.522	-.4223	.8223
	brix12	brix11	.60000	.31066	.059	-.0223	1.2223
		brix13	.46667	.31066	.139	-.1557	1.0890
		control	.80000(*)	.31066	.013	.1777	1.4223
	brix13	brix11	.13333	.31066	.669	-.4890	.7557
		brix12	-.46667	.31066	.139	-1.0890	.1557
		control	.33333	.31066	.288	-.2890	.9557
	control	brix11	-.20000	.31066	.522	-.8223	.4223
		brix12	-.80000(*)	.31066	.013	-1.4223	-.1777
		brix13	-.33333	.31066	.288	-.9557	.2890

* The mean difference is significant at the .05 level.

	trt	N	Subset for alpha = .05	
			1	2
Duncan(a)	control	15	6.4000	
	brix11	15	6.6000	6.6000
	brix13	15	6.7333	6.7333
	brix12	15		7.2000
	Sig.		.318	.072

2. Salty result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.183	3	4.061	4.374	.008
Within Groups	52.000	56	.929		
Total	64.183	59			

Multiple Comparisons

Dependent Variable

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
LSD	brix11	brix12	-.93333(*)	.35187	.010	-1.6382	-.2285
		brix13	-.86667(*)	.35187	.017	-1.5715	-.1618
		control	.00000	.35187	1.000	-.7049	.7049
	brix12	brix11	.93333(*)	.35187	.010	.2285	1.6382
		brix13	.06667	.35187	.850	-.6382	.7715
		control	.93333(*)	.35187	.010	.2285	1.6382
	brix13	brix11	.86667(*)	.35187	.017	.1618	1.5715
		brix12	-.06667	.35187	.850	-.7715	.6382
		control	.86667(*)	.35187	.017	.1618	1.5715
	contro l	brix11	.00000	.35187	1.000	-.7049	.7049
		brix12	-.93333(*)	.35187	.010	-1.6382	-.2285
		brix13	-.86667(*)	.35187	.017	-1.5715	-.1618

* The mean difference is significant at the .05 level.

Homogeneous Subsets

trt		N	Subset for alpha = .05	
		1	2	1
Duncan(a)	brix11	15	6.3333	
	control	15	6.3333	
	brix13	15		7.2000
	brix12	15		7.2667
	Sig.		1.000	.850

3. Sweetness result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	42.333	3	14.111	12.046	.000
Within Groups	65.600	56	1.171		
Total	107.933	59			

Multiple Comparisons

Dependent Variable

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
LSD	brix11	brix12	-.53333	.39521	.183	-1.3250	.2584
		brix13	.53333	.39521	.183	-.2584	1.3250
		control	1.73333(*)	.39521	.000	.9416	2.5250
	brix12	brix11	.53333	.39521	.183	-.2584	1.3250
		brix13	1.06667(*)	.39521	.009	.2750	1.8584
		control	2.26667(*)	.39521	.000	1.4750	3.0584
	brix13	brix11	-.53333	.39521	.183	-1.3250	.2584
		brix12	-1.06667(*)	.39521	.009	-1.8584	-.2750
		control	1.20000(*)	.39521	.004	.4083	1.9917
	contro l	brix11	-1.73333(*)	.39521	.000	-2.5250	-.9416
		brix12	-2.26667(*)	.39521	.000	-3.0584	-1.4750
		brix13	-1.20000(*)	.39521	.004	-1.9917	-.4083

* The mean difference is significant at the .05 level.

trt		N	Subset for alpha = .05		
		1	2	3	1
Duncan(a)	control	15	5.0667		
	brix13	15		6.2667	
	brix11	15		6.8000	6.8000
	brix12	15			7.3333
	Sig.		1.000	.183	.183

4. Sour result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.650	3	1.217	1.431	.243
Within Groups	47.600	56	.850		
Total	51.250	59			

Multiple Comparisons

Dependent Variable

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
LSD	brix11	brix12	-.46667	.33665	.171	-1.1411	.2077
		brix13	.13333	.33665	.694	-.5411	.8077
		contro l	.13333	.33665	.694	-.5411	.8077
	brix12	brix11	.46667	.33665	.171	-.2077	1.1411
		brix13	.60000	.33665	.080	-.0744	1.2744
		contro l	.60000	.33665	.080	-.0744	1.2744
	brix13	brix11	-.13333	.33665	.694	-.8077	.5411
		brix12	-.60000	.33665	.080	-1.2744	.0744
		contro l	.00000	.33665	1.000	-.6744	.6744
	control	brix11	-.13333	.33665	.694	-.8077	.5411
		brix12	-.60000	.33665	.080	-1.2744	.0744
		brix13	.00000	.33665	1.000	-.6744	.6744

	trt	N	Subset for alpha = .05
		1	1
Duncan(a)	brix13	15	6.0667
	control	15	6.0667
	brix11	15	6.2000
	brix12	15	6.6667
	Sig.		.109

5. Overall flavor result of hedonic scale

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.850	3	2.283	4.502	.007
Within Groups	28.400	56	.507		
Total	35.250	59			

Multiple Comparisons

Dependent Variable

	(I) trt	(J) trt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
LSD	brix11	brix12	-.60000(*)	.26004	.025	-1.1209	-.0791
		brix13	-.40000	.26004	.130	-.9209	.1209
		control	.26667	.26004	.310	-.2542	.7876
	brix12	brix11	.60000(*)	.26004	.025	.0791	1.1209
		brix13	.20000	.26004	.445	-.3209	.7209
		control	.86667(*)	.26004	.002	.3458	1.3876
	brix13	brix11	.40000	.26004	.130	-.1209	.9209
		brix12	-.20000	.26004	.445	-.7209	.3209
		control	.66667(*)	.26004	.013	.1458	1.1876
	control	brix11	-.26667	.26004	.310	-.7876	.2542
		brix12	-.86667(*)	.26004	.002	-1.3876	-.3458
		brix13	-.66667(*)	.26004	.013	-1.1876	-.1458

* The mean difference is significant at the .05 level.

	trt	N	Subset for alpha = .05		
		1	2	3	1
Duncan(a)	control	15	6.8000		
	brix11	15	7.0667	7.0667	
	brix13	15		7.4667	7.4667
	brix12	15			7.6667
	Sig.		.310	.130	.445

(D) Consumer acceptance

D1. Questionnaire

Customer behavior on Mix fruit juice of Dragon fruit and Pineapple

Dear participant,

According to the development of “Fruit juice” which has been carried out by Biotechnology students, we would like to ask for your cooperation in answering this questionnaire subjective to your real opinion and behavior. All of your information provided to us will be beneficial to such research and be kept confidentially.

Your cooperation will be highly appreciated.

Faculty of Biotechnology, Assumption University

February, 2006

Part1: Demographic data

1. Gender

☐ Male

☐ Female

2. Age:

☐ Under 10 years old

☐ 10 – under 15 years

☐ 15 – 20 years old

☐ Over 20 years old

3. Education:

☐ High school

☐ Bachelor

☐ Master

☐ Other

4. Occupation:

☐ Student

☐ Lecturer

☐ Employee

☐ Other

5. Income:

☐ Less than 5000 Baht

☐ 5000 – 10000 Baht

☐ 10000 – 15000 Baht

☐ Other

Part 2: Consumer behavior

6. What brands of fruit juice do you familiar the most:

Malee

Unif

Other

Tipco

Chabaa

7. Please identify your 2 most preferred flavors you often drink

Orange

Guava

Grape

Pineapple

Apple

Other

8. Frequency of fruit juice consumption:

☐ Once per week

☐ Once per month

- 3-4 times per week

☐ Other (please specify) _____

9. Which price of fruit juice that is suitable for you

(size 200ml) ?

☐ 5-10 baht

□ 15-20 baht

☐ 10-15 baht

- Over 20 baht

10. Where do you purchase this product?

- Supermarket

☐ Vendor

- Convenient store

☐ Other (please specify)

Part 3: Product evaluation

Please rinse your mouth with water before starting. Please taste the sample and rate in each attribute by ticking in this following table:

1 = dislike extremely

2 = dislike very much

3 = dislike moderately

4 = dislike slightly

5 = neither like nor dislike

6 = like slight

7 = like moderately

8 = like very much

9 = like extremely

[illegible]

11. Is this product acceptable? Please specify your reason(s)

- ☐ Yes, because
- ☐ No, because

12. Will you buy this product if it's available in the market?

- ☐ Will buy
- ☐ Not sure
- ☐ Will not buy

13. What is your most acceptable price for this product (1 carton 200ml)

- ☐ 5 – 10B
- ☐ 10- 15B
- ☐ 15-20 B
- ☐ Over 20B

14. Comments:



D2. Data from SPSS for the Hedonic scale of the product evaluation

Gender

	Frequency	Percentage
Male	37	37.0
Female	63	63.0
Total	100	100.0

Age

	Frequency	Percentage
Under 10 years old	0	0.0
10 – 15 years old	0	0.0
15 – 20 years old	42	42.0
Over 20 years old	58	58.0
Total	100	100.0

Education

	Frequency	Percentage
High school	15	15.0
Bachelor	71	71.0
Master	14	14.0
Other	0	0.0
Total	100	100.0

Occupation

	Frequency	Percentage
Student	82	82.0
Lecturer	0	0.0
Employee	18	18.0
Other	0	0.0
Total	100	100.0

Income

	Frequency	Percentage
Less than 5000 Baht	47	47.0
5000 – 10000 Baht	32	32.0
10000 – 15000 Baht	9	9.0
Other	12	12.0
Total	100	100.0

Frequency of the fruit juice brands that consumer familiar the most

	Frequency	Percentage
Malee	35	35.0
Tipco	28	28.0
Unif	14	14.0
Chabaa	15	15.0
Other	8	8.0
Total	100	100.0

Frequency of the 2 most preferred juice that consumer often drink

	Frequency	Percentage
Orange	51	25.5
Pineapple	45	22.5
Guava	24	12
Apple	38	19
Grape	31	15.5
Other	11	5.5
Total	200	100

Frequency of fruit juice consumption

	Frequency	Percentage
Once per week	26	26.0
3-4 times per week	52	52.0
Once per month	7	7.0
Other	15	15.0
Total	100	100.0

**Frequency of fruit juice price that is suitable for consumer
(size 200g)**

	Frequency	Percentage
5-10 baht	32	32.0
10-15 baht	51	51.0
15-20 baht	17	17.0
Over 20 baht	0	0.0
Total	100	100.0

Frequency of the place that consumer purchase fruit juice

	Frequency	Percentage
Supermarket	53	53.0
Convenient store	41	41.0
Vendor	5	5.0
Other	0	0.0
Total	100	100.0

Frequency of the consumer acceptance for this product

	Frequency	Percentage
Yes	73	73.0
No	27	27.0
Total	100	100.0

Frequency of buying decision

	Frequency	Percentage
Buy	71	71.0
Not sure	23	23.0
Not buy	6	6.0
Total	100	100.0

Frequency of the acceptable price for this product

	Frequency	Percentage
5-10 baht	34	47.0
10-15 baht	57	44.0
15-20 baht	9	9.0
Over 20 baht	0	0.0
Total	100	100.0

T-Test

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Liking	100	7.1900	.82505	.08250
Salty	100	7.1600	.74833	.07483
Sweetness	100	7.2400	.85422	.08542
Sour	100	7.0400	.70953	.07095
Flavor	100	7.3000	.59459	.05946

One-Sample Test

	Test Value = 5					
	t	df	Sig. (2- tailed)	Mean Differen ce	95% Confidence Interval of the Difference	
					Lower	Upper
Liking	26.544	99	.000	2.19000	2.0263	2.3537
Salty	28.864	99	.000	2.16000	2.0115	2.3085
Sweetness	26.223	99	.000	2.24000	2.0705	2.4095
Sour	28.751	99	.000	2.04000	1.8992	2.1808
Flavor	38.682	99	.000	2.30000	2.1820	2.4180

