



**DATE JUICE POWDER PRODUCTION FROM
PREMATURE FRUIT DROP**

MS. PATTARACHA CHUMPORN

ID 591-5118

**A special project submitted to the School of Biotechnology, Assumption
University in part of fulfilment of the requirement for the Degree of
Bachelor of Science in Biotechnology**

2019

**DATE JUICE POWDER PRODUCTION FROM
PREMATURE FRUIT DROP**

MS. PATTARACHA CHUMPORN

ID 591-5118



**A special project submitted to the School of Biotechnology, Assumption
University in part of fulfilment of the requirement for the degree of
Bachelor of Science in Biotechnology**

2019

COPYRIGHT OF ASSUMPTION UNIVERSITY

Title : Date juice powder production from premature fruit drop
By : Ms. Pattaracha Chumporn
Advisor : Dr.-Ing. Tatsawan Tipvarakarnkoon
Level of Study : Bachelor of Science
Department : Food Technology
Faculty : Biotechnology
Academic Year : 2019




.....
(Dr.-Ing Tatsawan Tipvarakarnkoon)
(Thesis Advisor)

All Right Reserved by Biotechnology Faculty

Assumption University

CONTENTS

	Page
ACKNOWLEDGEMENT	i
ABSTRACT	ii
Table content.....	iii
Figure content	iv
Objectives.....	1
Introduction.....	2
Literature review	5
Relative work	7
Materials and Methods.....	9
1. The comparison of drying process for product development between freeze-drying and tray drying process.	9
2. The study the effect of maltodextrin concentrations on yield and physicochemical properties of product.	11
3. The conduct the consumer survey of a product.	11
Analysis Methods.....	12
Results and Discussion	18
1. The comparison of drying process between freeze-drying and tray drying process.	18
2. The study the effect of maltodextrin concentration on yield and physicochemical propertieess of product.	19
3. The conduct the consumer survey of a product.....	29
Conclusion	34
References	35
Appendix	37

ACKNOWLEDGEMENT

I would like to express my deep gratitude to Dr. -Ing Tatsawan Tipvarakarnkoon, School of Biotechnology, my research supervisors, for their patient guidance, enthusiastic encouragement, and useful critiques of this research work. I would also like to thank Assistant Professor Dr. Kamolnate Kitsawad and Dr. Rongdao Klinjapo for her valuable advice and useful comments to improve this thesis.

I would also like to extend my thanks to the technicians of the laboratory, Assumption university of their help in offering me the resources in running the program.

Finally, I wish to thank my parents for their support and encouragement throughout my study.



Pattaracha Chumporn

July, 2020

DATE JUICE POWDER PRODUCTION FROM PREMATURE FRUIT DROP

ABSTRACT

The aim of this project was to develop an instant date juice powder and investigate their physiochemical properties. Premature fruit drop, a nonconforming fruit crop from Barhi (or Barhee) variety, was used in order to value added to the agricultural product. To produce a dried powder product from fresh date juice, drying methods of freeze-drying and conventional tray drying processed were investigated and compared. The results showed that a dried powder was unable to form by the conventional tray drying method. Date juice can be successfully dried from the freeze-drying process onto a moisture content less than 5%. It was able to form a stable state of dried powder, however, solely when the maltodextrin was added. The effects of maltodextrin concentrations (5,10, and 15% w/v) was therefore studied. Among all, 15% maltodextrin date powder showed highest percentage of yield and highest L* value, with lowest moisture content, Carr's compressibility index, a* and b* values. The addition of maltodextrin to date juice improved the powder quality showing in significantly decreasing in lumping of the date powder and can delay the moisture absorption of dried form. The results from scanning electron microscope (SEM) showed that date powder prepared by 15% maltodextrin had a crystalline structure, allowing to absorb moisture much slower than those made from lower maltodextrin contents. Date powder produced in this experiment held a water activity content less than 0.389. When reconstituted, all samples had % solubility higher than 97%. The reconstituted date juice (14 °Brix) from date powder produced golden yellow color with original date aroma and flavor and showed highest opacity of 50% from 15% maltodextrin sample. Furthermore, in order to test the product concept to a potential market, a consumer survey has been conducted by 108 respondents. Only 36.1% have ever tried date products in any form and only 36% of them have ever tried date juice made from fresh date fruit. The main reasons for never consume date products were not know or no chance to try. From the product concept, consumer interested to purchase the product for 53% while 44% decided not sure. They preferred the product with light brown in powder and its juice color. Consumer expected this product to refresh the day and to improve their health in terms of helping laxation and decreasing their cholesterol the most. To feel refresh and relax, the best suit in their thoughts was drinking during or after work, preferred to drink with ice. And their most concern was too sweet taste of the product.

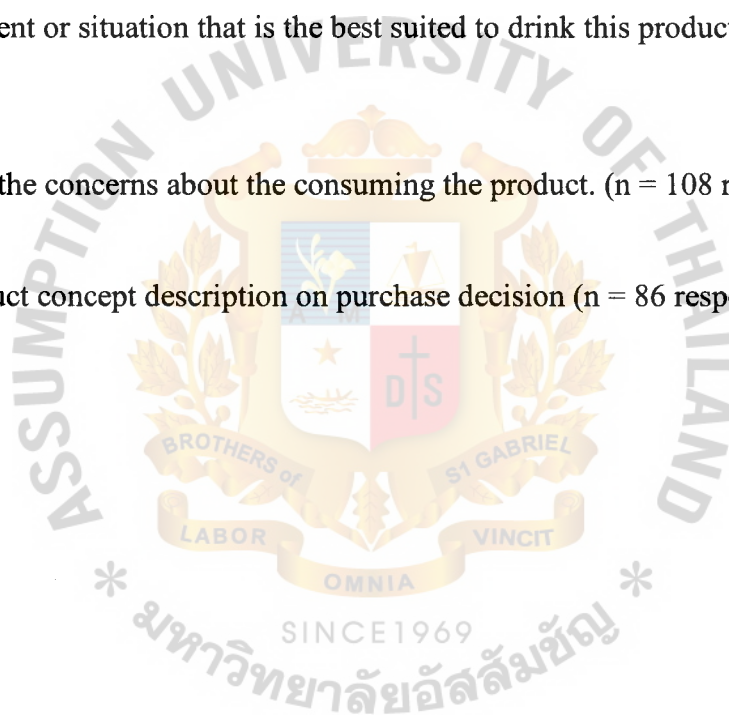
Table content

Table	Page
Table 1. Formulation of date juice and maltodextrin concentration. Error! Bookmark not defined.	
Table 2. Relationship between powder flowability and % compressibility (Abdolhossein Moghbel and Hamideh Abbaspour Iranian, 2013)	15
Table 3. Comparison between moisture content and total solid of different drying method (tray drying and freeze drying).	18
Table 4. The advantage and disadvantage of different powdering processes.	19
Table 5. Color parameter of date juice powder before finding (chunk).	20
Table 6. The properties of maltodextrin used in date juice effect on chunk powder.	20
Table 7. Color parameter of date juice powder after fined (fine particle.)	20
Table 8. The different effect of maltodextrin in date juice fine powder.	21
Table 9. Maltodextrin on properties of date juice powder.	22
Table 10. Physiochemical properties of reconstituted date juice powder (premature fruit drop, Barhee variety), made from different levels of maltodextrin.	23
Table 11. The characteristics among three different levels of maltodextrin added in reconstituted date juice.	24
Table 12. Chemical composition of date juice powder on Sugar profile and total dietary fiber.	25

Figure content

Figure	Page
Figure 1. The five growth stages of a date fruit by days post pollination (DPP) (Reem A. Al-Alawi, 2017)	2
Figure 2. Scanning Electron Microscope (S-3400N)	15
Figure 3. Date juice production.	16
Figure 4. Preparation of date juice maltodextrin powders.	17
Figure 5. Physicochemical properties of 5% maltodextrin act on the surface topography and composition of the date juice powder. (x50SE)	26
Figure 6. Physicochemical properties of 5% maltodextrin act on the surface topography and composition of the date juice powder. (x150SE)	26
Figure 7. Physicochemical properties of 10% maltodextrin act on the surface topography and composition of the date juice powder. (x50SE)	27
Figure 8. Physicochemical properties of 10% maltodextrin act on the surface topography and composition of the date juice powder. (x150SE)	27
Figure 9. Physicochemical properties of 15% maltodextrin act on the surface topography and composition of the date juice powder. (x50SE)	28
Figure 10. Physicochemical properties of 15% maltodextrin act on the surface topography and composition of the date juice powder. (x150SE)	28
Figure 11. Pie chart of Demographic data on gender (n=108 responses)	29
Figure 12. Demographic data on Consumer behavior: Consumer ever tried products from date palms? (n = 108 responses)	29

Figure 13.Consumer behavior: Have consumer ever tried date juice made from fresh date fruit? (n = 69 responses)	30
Figure 14.Consumer behavior: The reason why consumer not consume date juice?	30
Figure 15.Consumer preference: Consumer requirement about the function of product that consumer prefer.	31
Figure 16.Expectation on health benefits that this product would suits consumer the three most. (n = 108 responses)	31
Figure 17.The moment or situation that is the best suited to drink this product drink. (n = 108 responses)	32
Figure 18.What are the concerns about the consuming the product. (n = 108 responses)	32
Figure 19.The product concept description on purchase decision (n = 86 responses)	33



Objectives

This research aimed to develop instant of date powder from premature fruit drop. The objectives are as follow

1. To compare drying process for product development between freeze-dry and tray dry.
2. To study the effect of maltodextrin concentrations on yield and physicochemical properties of product
3. To conduct the consumer survey of a product.



Introduction

Date palm tree belongs to *Arecaceae* family (*Angiosperms, monocotyledon*) consisting of about 200 genre and more than 2,500 species. (Reem A. Al-Alawi, 2017) Date palm fruits are berry containing a single seed enclosed by fibrous parchment like endocarp, fleshy mesocarp and the fruit skin (pericarp). Different regions give different dates which vary in shape, size, and weight. Also, they can vary in their organoleptic, physical, and chemical characteristics

The five stages of pre-maturation, maturation and ripening of date are Hababauk, Kimri, Khalal, Rutab, and Tamer. Depending on the maturity and ripeness stages during growth and development of the date, different external and internal changes are observed with color, sweetness, texture and chemical. Date contains many nutrients such as: carbohydrates, proteins, fat, minerals, and vitamins. (Reem A. Al-Alawi, 2017)

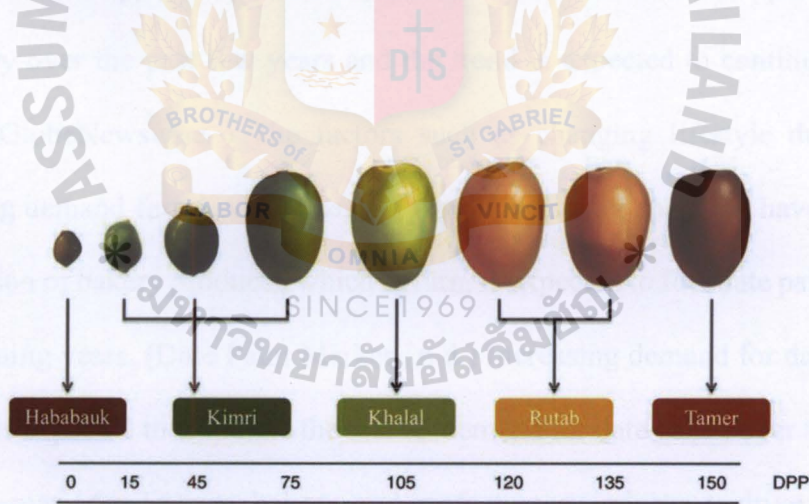


Figure 1. The five growth stages of a date fruit by days post pollination (DPP) (Reem A. Al-Alawi, 2017)

Date palm (*Phoenix dactylifera*) is great source of carbohydrate energy which has low glycemic index (GI) rates. Carbohydrates with a low GI value (55 or less) are more slowly digested, absorbed and metabolized and cause slower rise in blood glucose and insulin levels. (Gisymbol, n.d.) Dates are a good source of energy, vitamins, and important elements such as phosphorus, iron, potassium, and a significant amount of calcium. Besides nutritional value, date fruits are rich in phenolic compounds possessing free radical scavenging and antioxidant activity. (Med., n.d.)

This statistic shows the market value of date palm worldwide from 2014 to 2023. In 2018, the global date market was valued at about 13 billion U.S. dollars and is forecast to reach 18.2 billion U.S. dollars by 2023. (Shahbandeh, 2020)

Global date palm consumption in 2018 reached 9,366.06 kilo tons. Increasing per capita consumption of confectionery, bakery products, and ice cream has increased penetration of dates in this industry over the past few years and the trend is expected to continue over the forecasted period. (GlobeNewswire) The factors such as changing lifestyle due to busy schedules, increasing demand for convenience, and rise in consumer spending have led to the increased consumption of bakery products, which in turn, is expected to fuel date palms market growth over the coming years. (Date Palm Market , n.d.) Increasing demand for date syrup in the US and Canada is expected to stimulate the market demand for date palms over the forecast period. Increasing demand for desserts, bakery, and confectionery industry to drive global date palm market demand.

As stated, premature fruit drop was the low-price date fruit product. Instead of selling as a lowest price, it could be turn into the value-added product. The premature fruit drop has contained similar value to the fresh date. In modern day, people rarely consume. The development of date fruit to be more innovative food product by add more new idea from new generation to promote more modern form of date palm fruit to meet consumer acceptance.



Literature review

Phoenix dactylifera, commonly known as date or date palm, is a flowering plant species in the palm family. The date palm fruits (*Phoenix dactylifera* L.) contain a high percentage of carbohydrate (total sugars, 44-88%), fat (0.2-0.5%), 15 salts and minerals, protein (2.3-5.6%), vitamins and a high percentage of dietary fiber (6.4-11.5%). The flesh of dates contains 0.2-0.5% oil, whereas the seed contains 7.7-9.7% oil. The weight of the seed is 5.6-14.2% of the date. (Marshall, 2009) Belonging to the Angiosperms Monocotyledones, *Palmaceae* is a family of about 200 genera and 1,500 species (Wet, n.d.). In Thailand, date palm suitable for commercial planting in Thailand are Barhee, Khalas, Medjool, Shishi, and date crown (Chumchong, 2017). Date fruits (dates) are oval-cylindrical, 3 to 7 centimeters (1.2 to 2.8 in) long, and about 2.5 centimeters (0.98 in) in diameter, ranging from bright red to bright yellow in color, depending on variety. They are very sweet, containing about 75 percent of sugar when dried.

It has been found that the date palm possesses several highly beneficial properties such as antiviral, antifungal, antioxidant, antihyperlipidemic activity and hepatoprotective activity. These are attributed to the rich contents of antioxidant in date fruit such as the coumaric acid and ferulic acid. Moreover, it contains flavonoids, sterols, procyanidins, carotenoids, anthocyanins, sugar (glucose, sucrose and fructose) with low GI, dietary fibers, less protein and fats, vitamins such as riboflavin, biotin, thiamine, ascorbic and folic acid, and minerals for example calcium, iron, copper, cobalt magnesium, fluorine, manganese, phosphorus, potassium, sodium, boron, sulfur, zinc and selenium within the date palm itself. (Radzi, 2013)

Maltodextrin is a polysaccharide that is used as a food additive. It is produced from starch by partial hydrolysis and is usually found as a white hygroscopic spray-dried powder. Maltodextrin is used to improve the mouthfeel of food and beverage products.

Maltodextrin is used as an inexpensive additive to thicken food products. It is also used as a filler in sugar substitutes and other products. Maltodextrin and glucose syrups are the usual carriers for orange, lemon, apricot and mango juices and facilitate drying. Currently, maltodextrin is the most widely used additive to obtain fruit juice powders since it satisfies the demand and is also reasonably cheap. Appears to be useful for bodybuilders. It has certain properties which are useful in food manufacture, i.e. bulk and texture. It can be fluffed up to provide bulk to artificial sweeteners, while keeping weight and calories down. Regardless of the source, i.e. wheat or corn, it contains no gluten, it is pure carbohydrate. (Maltodextrin, n.d.)

Maltodextrins are obtained from the acid and/or enzymatic controlled hydrolysis of starch. Maltodextrins are composed of d-glucose units connected by (1–4) glucosidic linkage to give d-glucose polymers of variable length and therefore different molecular weight. The number of the reducing sugar content is defined by the dextrose equivalent value (DE-value), which is calculated on a dry weight basis. Maltodextrins are a mixture of saccharides with a DE-value ranging from 3 to 20. Starch is associated to a DE-value of zero, and glucose to a DE-value of 10. (Natalia Castro, Vanessa Durrieu, Christine Raynaud, Antoine Rouilly, 2016)

Freeze drying is a low temperature dehydration process that involves freezing the product, lowering pressure, then removing the ice by sublimation. This contrasts with dehydration by most conventional methods that evaporate water using heat (Freeze-drying, 2019). Drying is a mass transfer process consisting of the removal of water or another solvent by evaporation from a solid, semi-solid or liquid.

Relative work

The related work is date syrup powder. Preliminary experiments were carried out to find out the maltodextrin percentage range and mixing condition of date syrup and maltodextrin. In terms of product quality, it is best to keep the anti-plasticizer level to its minimum due to its adverse effects on color, flavor, and solubility of the final products.

However, if very low levels of anti-plasticizers are used, on one hand drying and scrapping off of the dried sample from the surface of drum drier will become impractical, and on the other hand final dry powder will be too sticky to handle and process.

A wide range of maltodextrin percentages including 5, 10, 20, 30, 40, 50, 60 and 70% (dry basis) were tested during a preliminary drum drying study in date syrup. The results indicated that to produce a dry powder, a minimum of 30% of maltodextrin is required. Therefore, in the main experimental design the maltodextrin range of 30 to 60% was investigated. In terms of mixing, two mixing conditions of mixing at room temperature (cold mixing) and mixing and heating to 80°C (hot mixing) were compared. The preliminary results indicated that to have a homogenous mix of date syrup and maltodextrin the mix would be heated to 80°C and kept there for 5 min prior to drum drying. Cold mixing of date syrup and maltodextrin resulted in a sticky material in which maltodextrin was not mixed with date syrup properly and hence did not act as an anti-plasticizer. Therefore, hot mixing condition was used for further experiments. Each prepared mix was then spread on the surface of a preheated twin drum dryer (Reliance, USA) with a surface temperature of 130°C, a clearance between the drums of 0.4 mm and rotation speed of 5 rpm. The length and diameter of the drums were 30 and 20 cm, respectively. The dry product was surface scrapped by a sharp blade, cooled and then ground using a hammer mill (CG, England) with a rotating disk diameter of 15 cm and a sieve pore size of 500 μ m to produce date syrup powder.

The powder was immediately collected in polyethylene plastic pouches to avoid any moisture gain from the surrounding air. The powder was then stored in airtight plastic bottles for further analysis. (Farahnaky, 2016)



Materials and Methods

Materials

- Premature date fruit drop (Barhi variety) purchased from Inone (Western Date Palm Group)
- Maltodextrin(DE-19) was kindly donated from Corn Products (Thailand) Co.,Ltd.

1. The comparison of drying process for product development between freeze-drying and tray drying process.

1.1 Date Juice preparation

Date fruit (premature fruit drop, Barhee variety) were weighed and cleaned before removing the seeds. The date's flesh were cut into small pieces and soaked in hot water (92°C) for 15 minutes 1:2 (date:water). The soaked date pieces were blended for 10 seconds. The date paste was filtered to separate date juice and pulp by using double sheet cloth. Date juice was pasteurized at 75 °C, 1 min in double jacket. Date juice was then cooled rapidly in an cooling bath. Pastuerized date juice was then mixed with maltodextrin 20% by overhead stirrer at 400 rpm for 5 minutes. Date juice was than kept at 4°C for furthur process and analysis.

1.2 Date Powder production

1.2.1 Tray drying

The tray drying experiment were performed with in a pilot scale tray dryer. 200 ml of date juice was mixed with different amount of maltodextrin (DE-19). Date juice containing maltodextrin was dried at 45°C in a tray dryer for 48 hr. Percent of moisture content has been measured.

1.2.2 Freeze-drying

Freeze drying experiment were performed in a pilot scale freeze dryer (FD8-Economic Series, Epsilon Co., Ltd.) for 30 hours. 200 ml date juice were mixed with different percentage of maltodextrin (20% w/v) were poured into freeze-dried tray. The freeze drying was operated under vacuum, pre-freeze at -35 °C, primary-drying at 15°C and secondary-drying at 45°C. Powder was obtained by hand crusher and stored in airtight laminated aluminum foil bag before physiochemical analysis.

2. The study the effect of maltodextrin concentrations on yield and physicochemical properties of product.

2.1 Preparation of date juice maltodextrin powders.

Pasteurized date juice was mixed with maltodextrin (DE19) by overhead stirrer at 400 rpm for 5 minutes with different concentrations of maltodextrin (5,10, and 15%w/v) in the production of date juice powders. Each prepared solution was then freeze dried. The freeze drying was operated under vacuum, pre-freeze at -35 °C, primarydrying at 15°C and secondary drying at 45°C. The powder was immediately collected in aluminum pouches to avoid any moisture absorption from the surrounding atmosphere. The powder was then stored for further analysis.

Table 1. Formulation of date juice and maltodextrin concentration.

	5% MD	10% MD	15% MD
Date juice	1000ml	1000ml	1000ml
Maltodextrin (DE19)	50g	100g	150g

3. The conduct the consumer survey of a product.

A questionnaire in google form had been created in order to analyze consumer behavior, perception, and opinion towards date palm juice and date palm product. 108 panelists have been participated. Nominal scale questionnaire was used in order to analyze the frequency of the data. The data was collected and analyzed by Excel Pivot Table.

Analysis Methods

1. Color Measurement

The color parameter CIE L*, a*, and b* were measured and analyzed by using HunterLab colorimeter (MiniScan ® EZ 4500L Spectrophotometer). It expresses color as three values: L* for the lightness from black (0) to white (100), a* from green (−) to red (+), and b* from blue (−) to yellow (+). The measurement was done using diffuse illumination of 45°/0° viewing geometry with medium large viewing area port. All measurements were done using D65/10 as a light source. Calibration was performed using standard black glass and standard white tile. Only reflected light to specimen surface was collected.

Freeze-dried sample was then measured the color before milling. Dried sample in chunk before milling was used to measure using small viewing area port by 6 different points suitable for solid material measurement. Milled sample (approx. 10 g) was then also poured onto petri dish in order to measure the fine particle date powder color.

Rehydrated date juice from fine powder was then measured the color. The fresh prepared rehydrated date juice was filled in a standard transparent glass cup with 88 mm depth of sample and covered with black cover lid and white cover with at least 3 replicates. The percentage of opacity was also calculated as shown by Riquelme et al. (2015).

$$\text{Opacity (\%)} = \frac{L^* \text{ black background}}{L^* \text{ white background}} \times 100$$

2. Total Soluble Solid (°Brix)

The date powder was reconstituted, 4 g of date powder per 25 ml water. Reconstituted date powder and date juice powder were determined total soluble solid by using an Refractometer (Iymen Optic system) Brix:0-32% at ambient temperature (25±2°C).

3. Sugar profile analysis

The reconstituted date powder was analyzed for total sugar (glucose, fructose, lactose, maltose, and sucrose). Sugar profile was determined by HPLC according to AOAC (2019) 982.14 Sugar profile at the Foundation for industrial development national food institute (nfi). Sample was prepared by weighing 4 g per 25 ml of water.

4. pH

The date juice without maltodextrin, date juice before freeze-drying and reconstituted date powder were measured by pH meter (Haida HD-024 Bench Top pH meter, Japan). The 25 ml of sample was sampled and measured for triplication at ambient temperature (25±2°C). The pH meter was calibrated with buffer solutions of pH 4 and 7 before used.

5. % Moisture content and Total solid

6. The moisture content of date juice powders was determined according to the (AOAC, 2000 determination of moisture content). 3 g of date juice powder was weighed in a moisture can, heated in an oven dry for 5 hours, the known weight of the sample was determined and calculated for the % moisture content and % total solid. **Yield (%)**

The percentage of overall yield of date juice powder was calculated by final date juice powder divided with initial date juice and multiplied by 100%

$$\% \text{ yield of date juice powder} = \frac{\text{Final date juice powder}}{\text{initial date juice}} \times 100$$

7. Sensory Test

The sensory test was done by 30 untrained panelists for reconstituted date juice. Panelists asked to rate the liking score on 9- point hedonic scale (1=disliked extremely, 5=neither liked nor disliked and , 9=liked extremely) on 6 attributes including color, aroma, flavor, sweetness, thickness, and overall liking.

8. % Solubility

For determination of solubility, 8 g of powder was mixed with 50 ml of water at ambient temperature. The date juice then was left for 15 min. After which it is stirred with a spatula. 10ml was filled in to a graduated 15 ml centrifuge tube with conically graduated bottom. The glass was spun in a centrifuge at 2000 rpm for 5 min, the free liquid is sucked off. The sediment was then washed with distilled water to be able to pour on to the pre-dried moisture aluminum can. The sediment was then oven dried at 105°C for 6 hours to determine the dried matter.

9. Carr's compressibility index

The tapped density is obtained by mechanically tapping a graduated cylinder containing the sample until little further volume change is observed. About 10 ml of powder was first sieved (60 mesh) and poured into the cylinder (25 ml glass cylinder), 180 taps over a period of 5 min. The tapped density is calculated as mass divided by the final volume of the powder. % Carr's compressibility index was then calculated and compared to the following table to see the flowability of the powder. (Abdolhossein Moghbel and Hamideh Abbaspour Iranian, 2013)

$$\text{Carr's index (\%)} = (\text{Poured or bulk density} / \text{Tapped density}) \times 100$$

$$\text{Bulk density} = \text{Weight} / \text{Bulk volume}$$

$$\text{Tapped density} = \text{Weight} / \text{True volume}$$

Table 2. Relationship between powder flowability and % compressibility (Abdolhossein Moghbel and Hamideh Abbaspour Iranian, 2013)

Flow description	% Compressibility
Excellent Flow	5-15
Good	16-18
Fair	19-21
Poor	22-35
Very poor	36-40
Extremely poor	>40

10. Fiber analysis

Total dietary fiber analysis had been analyzed according to AOAC (2016) 995.29 Enzymatic-Gravimetric Method by Chem lab services Thailand.

11. The surface topography and composition analysis.

The surface topography and composition had been analyzed by using scanning electron microscope (SEM). Sample was coated with gold, ultrathin layer of gold, which is highly conductive. (GOLD COATINGS FOR SCANNING ELECTRON MICROSCOPY, 2017) A scanning electron microscope (SEM) scans a focused electron beam (20kv) over a surface to create an image at magnification of 50SE and 150SE. The electrons in the beam interact with the sample, producing various signals that can be used to obtain information about the surface topography and composition.

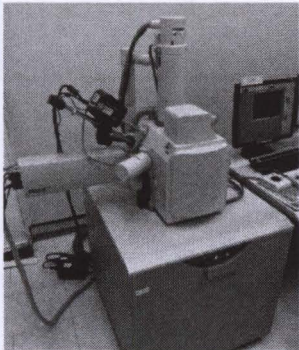





Figure 2.Scanning Electron Microscope (S-3400N)

Remarks:

-  Processing
-  Measurement
-  Waste

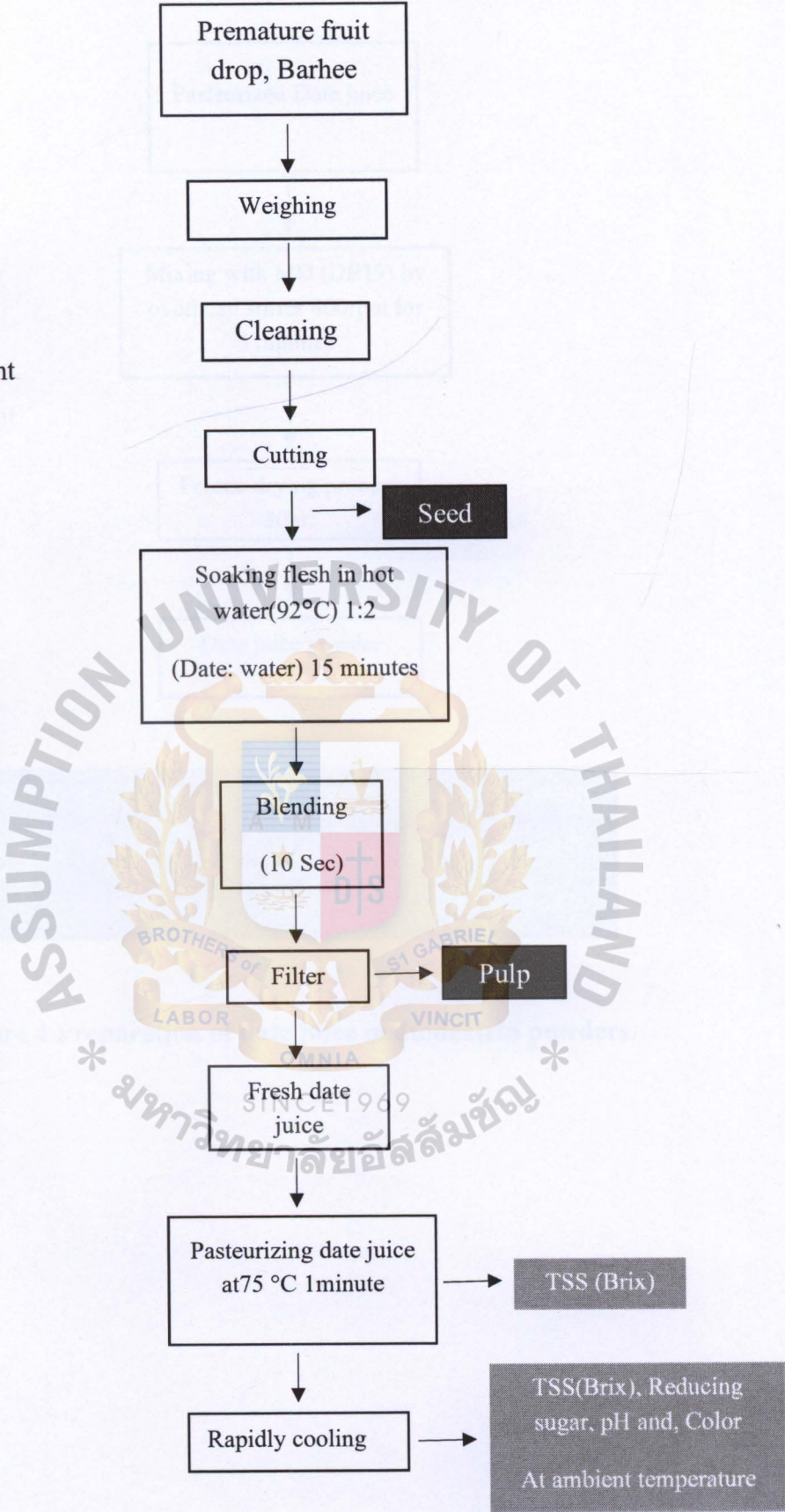


Figure 3.Date juice production.

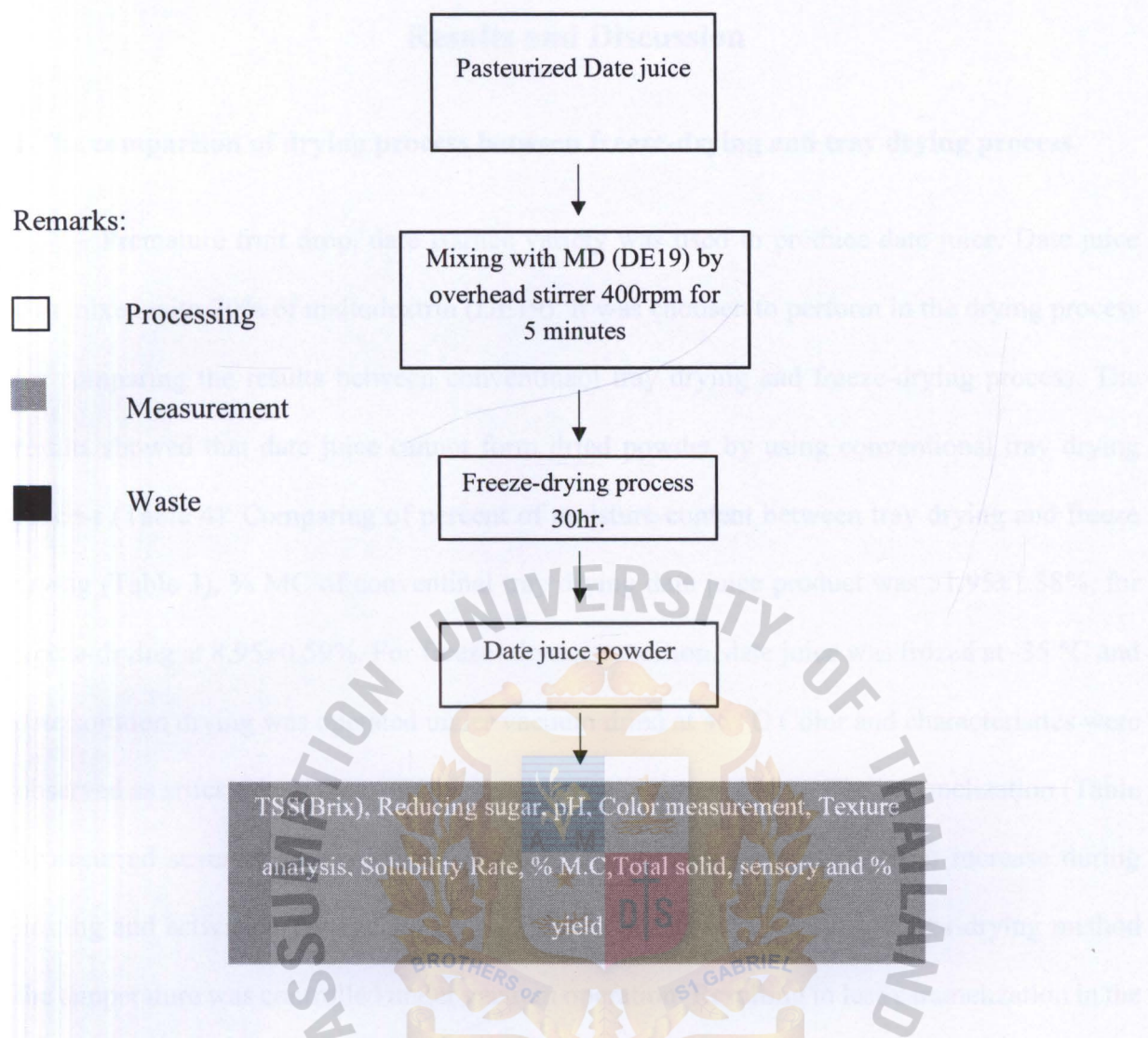


Figure 4.Preparation of date juice maltodextrin powders.

Drying process			
Tray drying		Freeze drying	
% MC	% Total solid	% MC	% Total solid
21.95±1.58	91.03±1.13	2.95±0.59	91.03±0.58

Results and Discussion



1.The comparison of drying process between freeze-drying and tray drying process.

Premature fruit drop, date Barhee variety was used to produce date juice. Date juice was mixed with 20% of maltodextrin (DE19). It was choosen to perform in the drying process for comparing the results between conventinaol tray drying and freeze-drying process. The results showed that date juice cannot form dried powder by using conventional tray drying process (Table 4). Comparing of percent of moisture content between tray drying and freeze drying (Table 3), % MC of conventinal tray drying date juice product was 31.95±1.38%, for freeze-drying at 8.95±0.59%. For freeze- drying condition, date juice was frozed at -35 °C and date solution drying was operated under vacuum dried at 45 °C Color and characteristics were observed as srsticky dark syrup occurred at conventinal tray drying. The caramelization (Table 3) occurred severely at tray drying method since temperature in tray drier increase during heating and activating caramelization reaction in product. However in freeze-drying method the temperature was controlled under vacuum operation. Resulting in less caramelization in the final product.

Table 3. Comparison between moisture content and total solid of different drying method (tray drying and freeze drying).

Sample	Drying process			
	Tray drying		Freeze drying	
	% MC	%Total solid	% MC	%Total solid
20%MD	31.95±1.38	68.05±1.13	8.95±0.59	91.05±0.58

Table 4. The advantage and disadvantage of different powdering processes.

	a) Tray drying	b) Freeze- drying
		
Characteristics	Sticky brown syrup	Lighter brown color of pack powder
Caramel flavor	✓	×
Flowability	×	✓
Dark Color	✓	×
Stickiness	Sticky	Caking
Moisture content (%)	31.95±1.38	8.95±0.59

2.The study the effect of maltodextrin concentration on yield and physicochemical properties of product.

The effect of maltodextrin concentrations (5,10, and 15%) was studied on yield and physicochemical properties in date juice powder production. Results of color parameters of date juice powder chunk (Table 5) and fine powder (Table 7) was reported. L*, a* and b* were different, due to the light reflection of the samples. The observation of powder characteristics on color and grinding properties of date powder (Table 6), the color of date powder was lighter, L* increase while and a* and b* decrease when maltodextrin increase (Table 5.)

Table 5. Color parameter of date juice powder before finding (chunk).

Sample	Color parameter		
	L*	a*	b*
5% MD (chunk)	66.7±1.93 ^b	2.26±0.42 ^a	28.15±0.96 ^a
10 % MD (chunk)	77.99±0.98 ^a	0.21±0.08 ^b	21.67±0.79 ^b
15%MD (chunk)	77.94±1.79 ^a	-0.81±0.22 ^c	16.39±1.19 ^c

Note: Different letters in the same column mean significantly different (p≤0.05).

Table 6.The properties of maltodextrin used in date juice effect on chunk powder.



	a) 5% MD	b) 10% MD	c) 15% MD
			
Color	Light brown	Brownish yellow	Yellow off white
Texture	Sticky hard	Brittle hard	Fragile brittle
Grinding	Grinding to fine	Can be grind to a level	Easy to grind
properties	particle quite difficult	Soft fine particle	




Table 7.Color parameter of date juice powder after fined (fine particle.)

Sample	Color parameter		
	L*	a*	b*
5% MD (fine)	73.08±0.64 ^c	0.86±0.31 ^a	20.19±0.32 ^a
10%MD (fine)	78.49±0.22 ^b	0.5±0.04 ^a	19.92±0.32 ^b
15%MD (fine)	81.77±0.32 ^a	0.54±0.26 ^b	15.68±0.69 ^c

Note: Different letters in the same column mean significantly different (p≤0.05)

The results showed that 5% w/v MD showed light brown color powder with sticky hard texture and difficult to grind to fine particle, 10% w/v MD showed brownish yellow with brittle hard texture and can be ground easily to a fine particle, and 15% w/v MD showed yellow off white color, fragile brittle texture and most easily to grind. The properties and characteristics of fine date juice powder has shown in Table 8 The results showed that 5%w/v MD immediately lumped after grinding, 10% w/v MD moderately lumped, and 15% w/v MD completely dried with no lumping after grinding.

Table 8.The different effect of maltodextrin in date juice fine powder.

	a) 5% MD	b) 10% MD	c) 15% MD
			
Color	Light brown	Brownish yellow	Yellow off white
After Grinding properties	<ul style="list-style-type: none">-Easily lumped-Absorb moisture quickly-Lumping immediately after grinding	<ul style="list-style-type: none">-Lump-Absorb little moisture-Slightly lumped after grinding	<ul style="list-style-type: none">- Completely dry, not lumped-Not easily absorb moisture-Not lumping after grinding
% undersize at 60 mesh	40.68%	67.06%	63.87%

From Table 9 the results showed that maltodextrin increased yield percentage. 15% MD contained 22.5% which showed highest percentage of yield and also highest L* value at 81.77±0.32 (Table 7), with lowest moisture content at 3.78±0.25% and Carr’s compressibility index of 72.72%. The solubility of 5, 10, and 15% MD were non significantly different at 96.69±0.0, 98.28±1.004, and 97.25±0.021%, respectively.

Table 9. Physicochemical properties of date juice powder at different maltodextrin concentrations.

Sample	Yield	Solubility ^{ns}	Flowability and Carr’s compressibility index		Moisture content	Water activity (a _w)
			Flow description	%		
5% MD	14.5	96.69±0.00	Extremely poor	80.00	5.02±0.40 ^a	0.341
10 % MD	18.8	98.28±1.00	Extremely poor	72.72	3.99±0.40 ^{ab}	0.322
15% MD	22.5	97.25±0.00	Extremely poor	75.01	3.78±0.25 ^b	0.389

Note: Different letters in the same column mean significantly different (p≤0.05).

Flow description as described earlier by (Abdolhossein Moghbel and Hamideh Abbaspour Iranian, 2013)

The addition of maltodextrin to date juice decreased the lumping of the date powder, lower moisture absorption or hydrophilic properties and improved the powder quality. Maltodextrin can contribute to reduce the hygroscopic behavior of the fruit powder. The presence of maltodextrin in date juice powder probably modified the balance of hydrophilic/hydrophobic sites, promoting a less amount of water absorption. The density of date syrup powders increased with maltodextrin level. Similar results were found among other research stated maltodextrins improve juice powder quality, decrease water absorption and lumping of the juice powder. (Asgar Farahnakya,b,*, Nasim Mansoorib, Mahsa Majzoobia,b, Fojan Badiica, 133–141).

Also, solubility properties of 5, 10, and 15%w/v MD date juice powder were seemingly high where all samples gave high % solubility higher than 97%.




From Table 10, %opacity of reconstitute date juice was increased when maltodextrin increased. Total soluble solid and pH of three different level of maltodextrin are not significantly different in reconstitute date juice. Reconstituted date juice by adding 4 g in 25 ml water maintained 14 °Brix with pH of 7.08 – 7.53. From observation (Table 11). The characteristics of reconstituted juice at 5, 10, and 15%w/v MD gave slightly sweet, sweet, and high sweet taste, respectively. For stability test, 5, 10, and 15%w/v MD was observed to be slightly sediment, moderately sediment, and highly sediment after left it stand for 2 hours. 15% w/v MD gave opaque sample solution.

Table 10. Physiochemical properties of reconstituted date juice powder (premature fruit drop, Barhee variety), made from different levels of maltodextrin.

Sample	Color	TSS ^{ns}	pH ^{ns}
	(Opacity)	(°Brix)	
	%	%	
5% MD	26.50±0.14 ^c	14.13±0.32	7.53±0.52
10 % MD	40.01±0.21 ^b	14.00±0.50	7.16±0.06
15% MD	50.37±2.09 ^a	13.93±0.12	7.08±0.13

Note: Different letters in the same column mean significantly different (p≤0.05)

Table 11. The characteristics among three different levels of maltodextrin added in reconstituted date juice.

	a) 5% MD	b) 10% MD	c) 15% MD
			
Color	-Yellow -Clear	-Brownish yellow -Slightly opaque	-Slightly yellowish orange -Quite turbid
Aroma	-Mild odor -Light fragrance -Sweet smell	-Good fragrant of date palm -Sweet scent	-Good fragrant of date palm -Sweet scent
Flavor	-The flavor in the mouth is not much.	-The flavor and aroma good fragrant in the mouth.	-The flavor and aroma good fragrant in the mouth
Sweetness	- Slightly sweet	- Sweet	-Sweet
Dissolubility (stirring)	Completely dissolved	Dissolves easily when stirred, except for coagulation part, it will be difficult to dissolve, requiring strong stirring	Dissolves easily when stirred
Stability(Set aside for >2 hours)	There is very little have sediment particle.	There is moderately have sediment particle.	There quite a lot of sediment.

Sugar profile or total sugar of reconstitute date juice was shown in Table 12 The prepared date powder contained less than 10 g/100 ml of prepared. Indicated that glucose and fructose are the major sugars present in date juice powder. Higher in maltodextrin concentrations, prepared date powder contained less of sugar content. In addition, date juice powder with 15% maltodextrin contained 0.11 g/ml of total dietary fiber.

Table 12. Chemical composition of date juice powder on Sugar profile and total dietary fiber.

Sample	Sugar profile						Total dietary fiber
	Total sugar	Glucose	Fructose	Lactose	Sucrose	Maltose	
							g/100ml
5% MD	9.05	4.76	4.29	nd	nd	nd	N/A
10 % MD	7.23	3.94	3.29	nd	nd	nd	N/A
15% MD	5.66	2.96	2.70	nd	nd	nd	0.11

Remarks: nd means not detectable, N/A means no analysis of the sample

Topography of date powder was also investigated and reported in Fig. 5 and 10. The surface topography and composition of the date juice powder at 5% w/v MD at x50SE showed that the product powder had highest surface area. Comparing with 10%w/v MD, which showed as a pack powder. This indicated that maltodextrin increased porosity and density to the date juice powder, while 15% w/v MD showed the structure as crystalline structure.



Figure 5. Physicochemical properties of 5% maltodextrin act on the surface topography and composition of the date juice powder. (x50SE)



Figure 6. Physicochemical properties of 5% maltodextrin act on the surface topography and composition of the date juice powder. (x150SE)

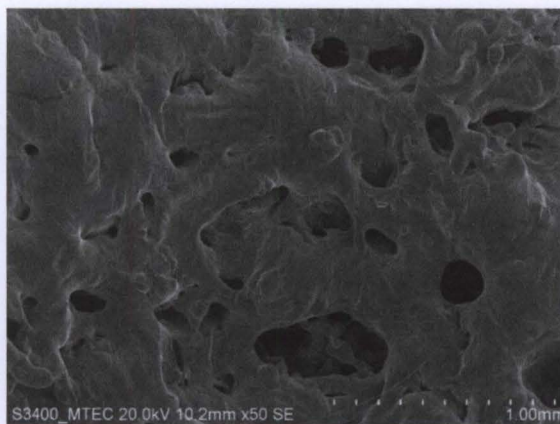


Figure 7. Physicochemical properties of 10% maltodextrin act on the surface topography and composition of the date juice powder. (x50SE)



Figure 8. Physicochemical properties of 10% maltodextrin act on the surface topography and composition of the date juice powder. (x150SE)

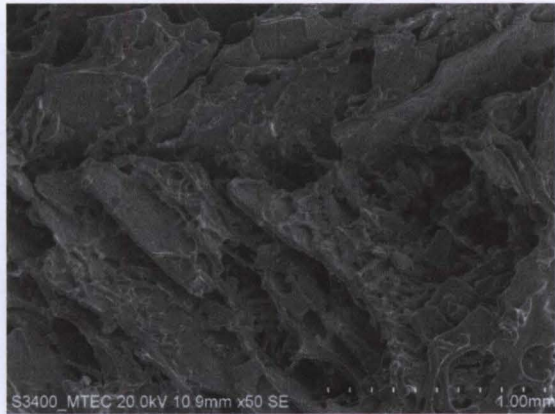


Figure 9.Physicochemical properties of 15% maltodextrin act on the surface topography and composition of the date juice powder. (x50SE)



Figure 10.Physicochemical properties of 15% maltodextrin act on the surface topography and composition of the date juice powder. (x150SE)

3. Consumer survey results of a product.

The consumer behavior, perception, and opinion towards date palm juice and date powder was investigated. Product concept to the potential market has been conducted by 108 respondents. From Fig 11-14, 60.19% were female and 39.81% were male. The 63.9% never tried the date product in any form. From 68% of 60.19% of female ever tried date product comparing with male from 39.81%, only 58% ever tried product from date.

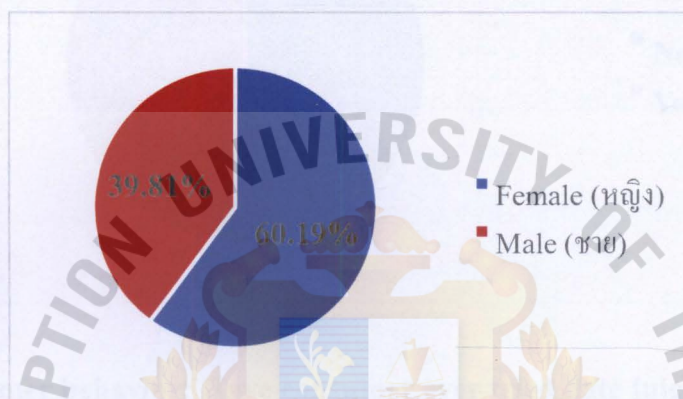


Figure 11. Pie chart of Demographic data on gender (n=108 responses)



Figure 12. Demographic data on Consumer behavior: Consumer ever tried products from date palms? (n = 108 responses)

However only 36.23% of them have ever tried date juice made from fresh date fruit.

(Fig 13.) The main reasons are they do not know about the product, and do not have a chance to try with equally for 25%, the product hard to find for 17% and not familiar with the date palm for 13%. (Figure14.)

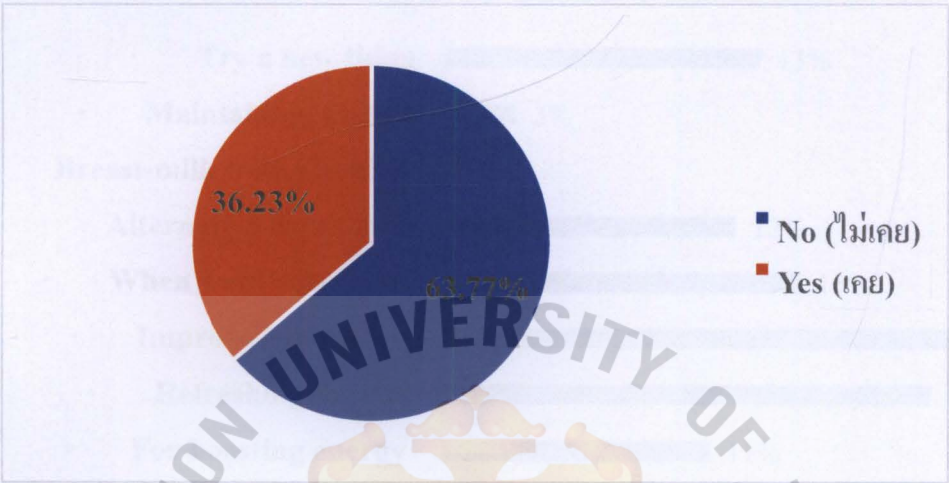


Figure 13.Consumer behavior: Have consumer ever tried date juice made from fresh date fruit? (n = 69 responses)

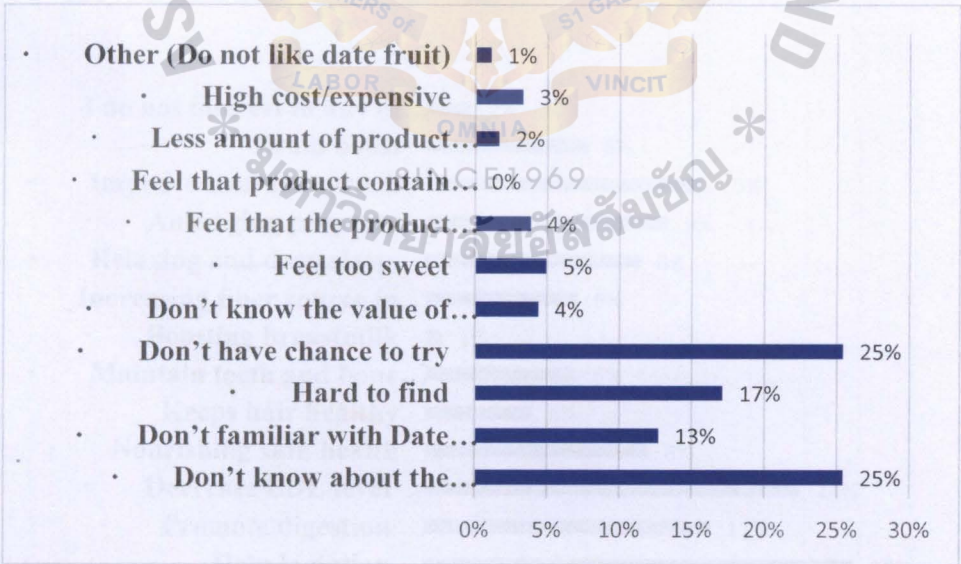


Figure 14.Consumer behavior: The reason why consumer not consume date juice?

On consumer preference, consumer expected the product to refresh the day 21%, when they want the relaxation 15% and to improve their health in terms of Improve healthiness 23%, in terms of helping lactation 16%, decreasing LDL cholesterol 14%, and improve immune system 10% (Fig. 15)

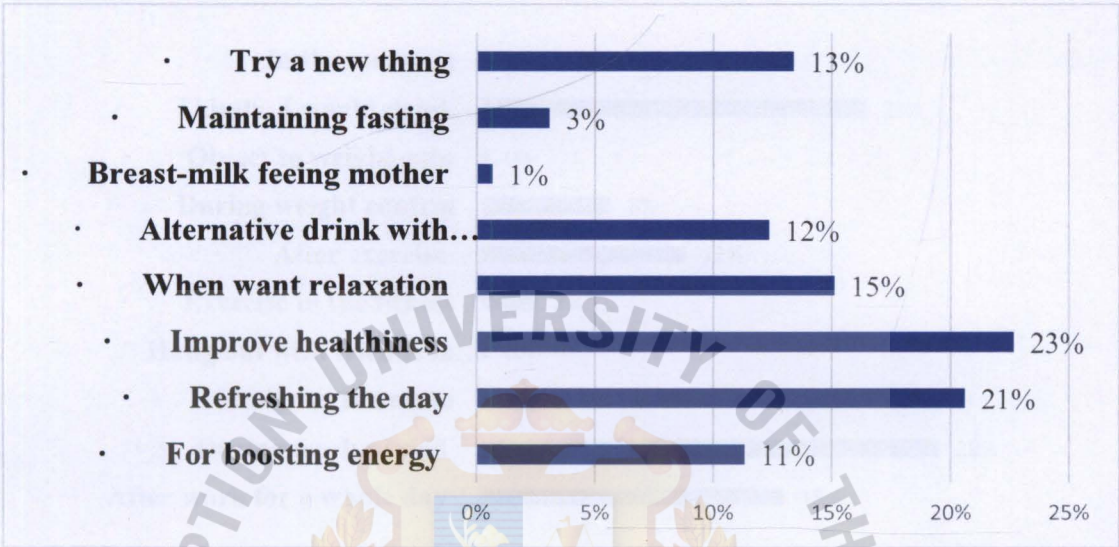


Figure 15.Consumer preference: Consumer requirement about the function of product that consumer prefer.

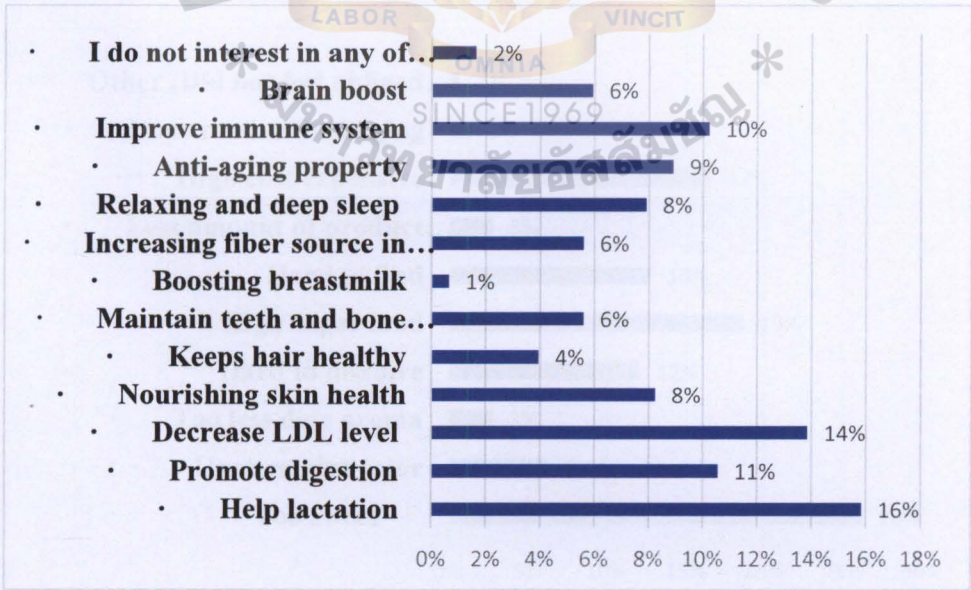


Figure 16.Expectation on health benefits that this product would suits consumer the three most. (n = 108 responses)

The moment or situation that consumer prefers to consume the most and suited to the product was drinking during work period 28%, after work for a whole day 18%, and drink when thirsty preferred to drink with ice23%. The most consumer concern about the date juice product was too sweet 26%, high sugar load 19% and expensive product 17% (Fig. 16-18).

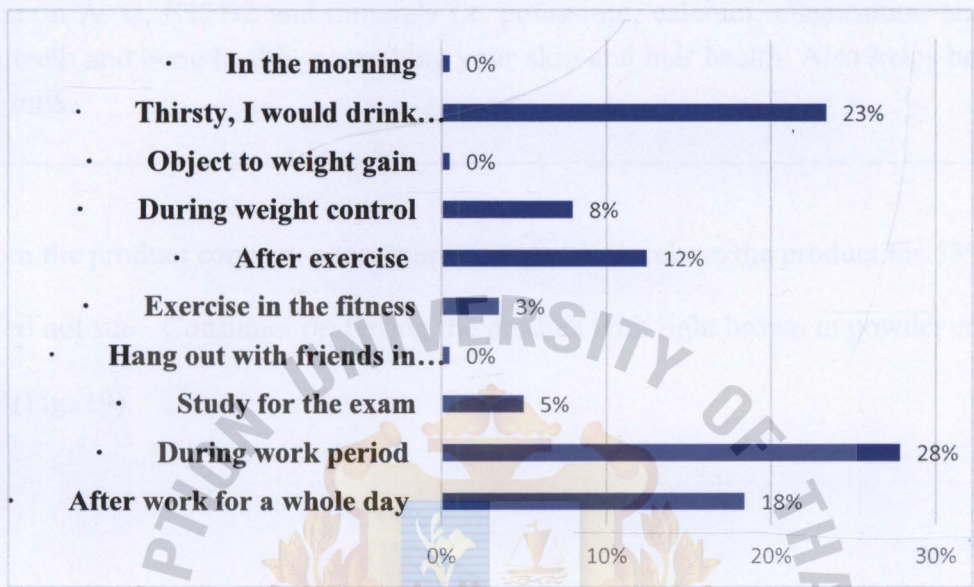


Figure 17.The moment or situation that is the best suited to drink this product drink. (n = 108 responses)

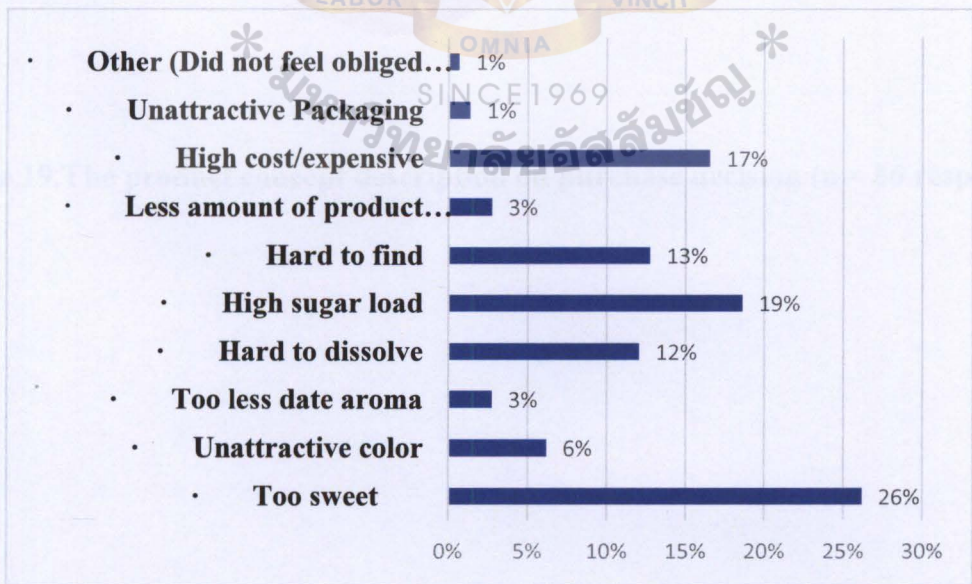


Figure 18.What are the concerns about the consuming the product. (n = 108 responses)

Product Concept: Instant date powder: A Juice for A New You!

An instant date powder made from Barhee dates by freeze-drying process. The product will come up as a tea bag, just dissolve the date juice powder in room temperature or hot water, will get ready-to-drink healthy date juice, serve as a real fresh-squeezed. An alternative juice for people who looking for the healthy drink. Product is free from sugar, sweetened by natural, low GI, with fully date flavored from its nature with 100% natural ingredients. High fiber, vitamin A, C, B1, B2 and minerals i.e. potassium, calcium, magnesium, and iron. Maintain teeth and bone health, nourishing your skin and hair health. Also helps boosting mothers' milk.

From the product concept, consumer interested to purchase the product for 53% while 44% decided not sure. Consumer preferring the product with light brown in powder and its juice color (Fig. 19).

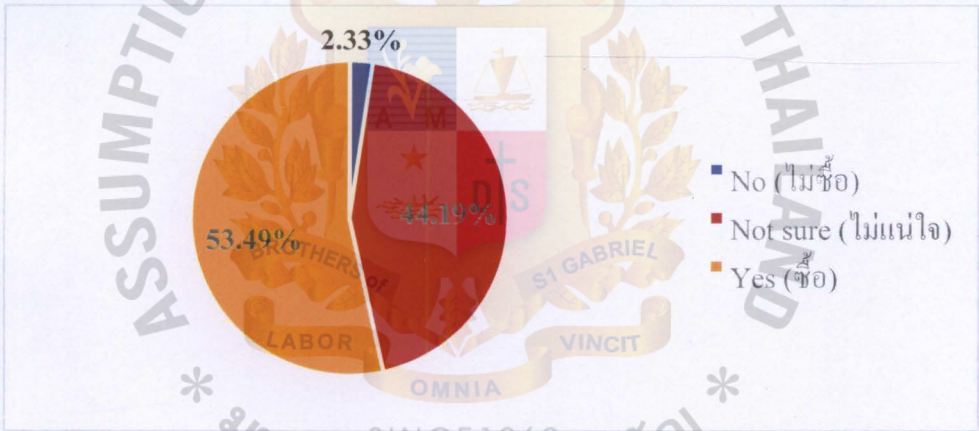


Figure 19.The product concept description on purchase decision (n = 86 responses)

Conclusion

Premature fruit drop, Barhee or Barhi variety was used in date juice powder production. Freeze dry can successfully form a dried powder with % moisture content less than 5%. Maltodextrin concentrations impact to color, %solubility, compressibility flow description, %moisture content, % yield and water activity content of dried juice powder. The addition of maltodextrin (DE19) help improving date juice powder quality.

Consumer survey had been conducted, only 36% have ever tried date juice made from fresh date fruit. The main reasons are do not know about the product, do not chance to try, and hard to find. From the product concept, consumer interested to purchase the product for 53% while 44% decided not sure. They preferred the product with light brown in powder and its juice color.



References

- (n.d.). Retrieved from himedialabs: <http://www.himedialabs.com/TD/HTBC003.pdf>
- Abdolhossein Moghbel and Hamideh Abbaspour Iranian. (2013). *Pharmaceutical Research. Study of Compressibility Properties of Yogurt Powder in*, 231-237.
- AOAC official method 2011.25. (n.d.). Retrieved from Megazyme: <https://www.megazyme.com/media/pdf/8b/34/e0/37b-insoluble-soluble-and-total-dietary-fiber-in-foods.pdf>
- Asgar Farahnakya, b. N. (2016). *Food and Bioproducts Processing. Physicochemical and sorption isotherm properties of date syrup powder: Antiplasticizing effect of maltodextrin*, 133-141.
- Asgar Farahnakya, b,*, Nasim Mansoorib, Mahsa Majzooobia, b, Fojan Badiica. (133–141). *Food and Bioproducts Processing. Physicochemical and sorption isotherm properties of date syrup powder: Antiplasticizing effect of maltodextrin* Asgar, 2016 .
- Chumchong, W. (2017, 05 12). *Date palm suitable for commercial planting in Thailand*. Retrieved from palangkaset: <https://www.palangkaset.com/เมืองไม่ผล/สายพันธุ์อินทผลัม-ปลูก-1/>
- Date palm*. (2019, October 4). Retrieved from wikipedia: https://en.wikipedia.org/wiki/Date_palm
- Date Palm Market* . (n.d.). Retrieved from globenewswire: <https://www.globenewswire.com/news-release/2019/07/15/1882397/0/en/Date-Palm-Market-to-Grow-at-5-2-CAGR-to-reach-13-482-48-kilo-tons-by-2025-Insights-on-Types-Conventional-Organic-Export-and-Product-Pricing-Statistics-and-Trends-Adroit-Market-Rese.html>
- Farahnaky, N. M. (2016). *Physicochemical and sorption isotherm properties of date syrup powder: Antiplasticizing effect of maltodextrin. Food and Bioproducts Processing*, 133-141.
- Freeze-drying*. (2019, October 6). Retrieved from wikipedia: <https://en.wikipedia.org/wiki/Freeze-drying>
- GlobeNewswire* . (n.d.). Retrieved from globenewswire: <https://www.globenewswire.com/news-release/2019/07/15/1882397/0/en/Date-Palm-Market-to-Grow-at-5-2-CAGR-to-reach-13-482-48-kilo-tons-by-2025-Insights-on-Types-Conventional-Organic-Export-and-Product-Pricing-Statistics-and-Trends-Adroit-Market-Rese.html>
- GOLD COATINGS FOR SCANNING ELECTRON MICROSCOPY*. (2017, December 14). Retrieved from mgsrefining: <https://www.mgsrefining.com/blog/2017/12/14/gold-coatings-for-scanning-electron-microscopy/>
- Kohlus, M. S. (2015). *Food processing and food preservation. Preparation of High-Grade Powders from Honey-Glucose Syrup Formulations by Vacuum Foam-Drying Method*.

Lean, B. M. (n.d.). *Fox and Cameron's Food Science, Nutrition & Health*.

Maltodextrin. (n.d.). Retrieved from sugar-and-sweetener-guide: <http://www.sugar-and-sweetener-guide.com/maltodextrin.html>

Maltodextrin. (2019, 8 26). Retrieved from wikipedia: <https://en.wikipedia.org/wiki/Maltodextrin>

Marisa Garriga1, M. A. (n.d.). Retrieved from fundacioniai.org: <http://fundacioniai.org/actas/Actas3/Actas3.19.pdf>

Marshall, W. A.-s. (2009). The fruit of the date palm: its possible use as the best food for the future? *International Journal of Food Sciences and Nutrition* , 247-259.

Med., J. A. (n.d.). *Diet rich in date palm fruits*. Retrieved from ncbi: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4484046/>

Natalia Castro, Vanessa Durrieu, Christine Raynaud, Antoine Rouilly. (2016). Carbohydrate Polymers. *Influence of DE-value on the physicochemical properties of*, 464-473.

Radzi, W. I. (2013). Evaluation on the Benefits of Date Palm (*Phoenix dactylifera*) to the Brain. *Alternative and Integrative Medicine*.

Reem A. Al-Alawi, J. H.-M.-N.-S. (2017). Plant metabolism and chemodiversity. *Date Palm Tree (Phoenix dactylifera L.): Natural Products and Therapeutic Options*.

Shahbandeh, M. (2020, Feb 21). *Global date palm industry value 2014-2023*. Retrieved from statista.com: <https://www.statista.com/statistics/960213/date-palm-market-value-worldwide/>

Suad, Jiwan, Jameela, Amani. (2002). Food chemistry . *Chemical composition and quality of date syrup as affected by pectinase/cellulase treatment*, 215-220 .969

Wet, A. Z. (n.d.). *BOTANICAL AND SYSTEMATIC DESCRIPTION OF THE DATE PALM*. Retrieved from fao: <http://www.fao.org/3/y4360e/y4360e05.htm>



Appendix A: Example of Statistical analysis

Sensory evaluation on liking score (SAS 9.4 English)

title 'Date juice RCBD';

data likingscore;

input Consumer Sample\$ Color Aroma Flavor Sweetness Thickness

@@;

cards;

1	A	7	7	7	7	8
1	B	8	5	6	5	5
1	C	5	5	4	3	7
2	B	6	4	4	6	6
2	C	6	4	4	4	4
2	A	6	5	5	7	7
3	C	4	3	2	2	4
3	A	7	6	8	7	8
3	B	8	8	5	5	6
4	A	6	7	7	5	4
4	B	6	6	6	5	7
4	C	7	6	6	4	6
5	B	8	8	9	7	7
5	C	6	7	6	4	7
5	A	8	7	7	8	9
6	C	7	5	5	6	7
6	A	7	7	8	8	8
6	B	8	8	9	6	7
7	A	9	9	9	9	8
7	B	7	7	7	4	8
7	C	6	5	5	8	6
8	B	8	6	7	8	7
8	C	9	8	8	6	6
8	A	7	7	7	6	5
9	C	7	7	6	4	4
9	A	8	8	7	7	7
9	B	9	8	9	7	8
10	A	8	8	9	9	6
10	B	7	7	8	7	6
10	C	8	6	6	5	5
11	B	8	7	7	8	8
11	C	7	6	7	7	5
11	A	5	5	6	6	6
12	C	6	5	6	7	7
12	A	6	7	7	8	8
12	B	5	7	8	8	6
13	A	7	7	7	7	5
13	B	7	7	8	7	8
13	C	8	6	6	7	7
14	B	6	6	6	8	8
14	C	4	4	5	4	5
14	A	7	7	8	6	9
15	C	6	8	7	4	9
15	A	6	6	4	4	7
15	B	7	4	4	7	5
16	A	7	7	5	6	8

16	B	7	6	6	3	9
16	C	4	4	5	5	6
17	B	7	4	6	5	6
17	C	8	7	6	7	7
17	A	7	8	6	8	8
18	C	8	6	5	6	5
18	A	6	8	5	6	8
18	B	7	6	7	7	7
19	A	7	7	8	8	6
19	B	7	7	6	6	6
19	C	5	7	5	5	6
20	B	8	9	8	5	6
20	C	6	6	7	7	6
20	A	4	7	6	7	7
21	C	6	5	4	5	5
21	A	8	8	8	8	7
21	B	5	8	5	5	5
22	A	3	5	2	3	8
22	B	3	1	2	1	5
22	C	3	4	1	2	1

```
;
proc glm data = likingscore;
class Consumer Sample;
model Color Aroma Flavor Sweetness Thickness = Consumer Sample;
means Sample;
means Sample/duncan;
run;
```

1. Physiochemical properties of reconstitute on Color parameter L*, b* and a*

```
title 'Rehydrate date juice
CRD';
data colorparameter;
input Sample$ L a b @@;
cards;
```

A	45.4	3.29	46.42
A	45.34	3.28	46.25
A	45.34	3.27	46.2
B	50.37	0.14	41.51
B	50.37	0.13	41.5
B	50.38	0.12	41.45
C	40.8	8.06	49.79
C	40.81	8.06	49.82
C	40.81	8.07	49.84

```
;
proc glm data
=colorparameter;
class Sample;
model L a b = Sample;
means Sample;
means Sample/duncan;
run;
```

Appendix B: Sensory ballot

Analysis of rehydrate Date juice (น้ำอินทผลาลัม)

Introduction: Please test the sample from left to the right and scoring the samples based on the following preference test of 9-point hedonic scale. (ชิมตัวอย่างจาก ซ้าย ไป ขวา และให้คะแนนความชอบตามเกณฑ์ด้านล่าง)

1= Dislike extremely(ไม่ชอบอย่างยิ่ง) 4=Dislike slightly(ไม่ชอบเล็กน้อย) 7=Like moderately(ชอบปานกลาง)

2=Dislike very much (ไม่ชอบมาก) 5=Neither like or nor dislike (ไม่ได้ชอบ และ ไม่ชอบ) 8=Like very much(ชอบมาก)

3= Dislike moderately(ไม่ชอบปานกลาง) 6= Like slightly(ชอบเล็กน้อย) 9=like extremely(ชอบอย่างยิ่ง)

Attribute	Sample number		
Color (สี)			
Aroma of date juice (กลิ่นของอินทผลาลัม)			
Flavor of date juice (กลิ่นรสของอินทผลาลัม)			
Overall Flavor (กลิ่นรสโดยรวมจากการชิม)			
Sweetness (ความหวาน)			
Thickness (ความหนืด)			
Overall liking			

Which sample do you prefer the most (กรุณาเลือกตัวอย่างที่ชอบมากที่สุด)?_____.

Appendix C: Questionnaire

Consumer behavior, perception, and opinion towards date palm juice and date palm product.

แบบสอบถาม : พฤติกรรมการรับรู้และความคิดเห็นของผู้บริโภคคือน้ำอินทผลัมและผลิตภัณฑ์จากอินทผลัม

Introduction: This questionnaire is a part of Special Project of the student from School of Biotechnology, Assumption University. Your cooperation for this questionnaire is extremely essential to this research in the aspect of consumer's view in term of important attributes, consumer behavior, attitudes, and acceptance. I would like to ask for your cooperation in answering all questions. All of information provided will be beneficial to the development process and kept confidentially.

แบบสอบถามชุดนี้เป็นส่วนหนึ่งของปริญญานิพนธ์ของนักศึกษาคณะเทคโนโลยีชีวภาพ มหาวิทยาลัยอัสสัมชัญ ข้อมูลของท่านจะเป็นประโยชน์อย่างยิ่งต่อการทำวิจัยครั้งนี้โดยเฉพาะในด้านของความคิดเห็นของผู้บริโภคเช่นพฤติกรรมผู้บริโภคความคิดเห็นต่อผลิตภัณฑ์รวมไปถึงการยอมรับผลิตภัณฑ์ ดังนั้นจึงใคร่ขอความร่วมมือในการตอบคำถามในแบบสอบถามชุดนี้ ข้อมูลทั้งหมดที่ท่านตอบมาจะถูกเก็บเป็นความลับ

Part I: Consumer behavior (ข้อมูลพฤติกรรมของผู้บริโภค)

1. Please check, the products that you have ever tried. (กรุณาเลือกผลิตภัณฑ์ที่คุณเคยลอง)

Check all that apply. (ตอบได้มากกว่า 1 ข้อ)

- ☐ Flower tea (ชาดอกไม้พร้อมซอง)
- ☐ Herbal tea (ชาสมุนไพรพร้อมซอง)
- ☐ Fruit tea (ชาผลไม้)
- ☐ Green tea, black tea and white tea (ชาเขียว, ชาขาว หรือ ชาดำพร้อมซอง)
- ☐ Instant fruit juice powder (น้ำผลไม้ผงสำเร็จรูป)
- ☐ Date juice powder (น้ำอินทผลัมแบบผง)
- ☐ Instant ginger juice powder (น้ำขิงผงสำเร็จรูป)
- ☐ No (ไม่เคย)
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____

2. Have you ever tried products from date palms?

(คุณเคยลองทานผลิตภัณฑ์จากอินทผลัมหรือไม่)

- ☐ Yes (เคย)
- ☐ No (ไม่เคย) Skip to Question no. 11

3. Please check product(s) from "Date palms" that you ever tried.

(ผลิตภัณฑ์จากอินทผลัมที่คุณเคยทาน) Check all that apply. (ตอบได้มากกว่า 1 ข้อ)

- ☐ Fresh date (อินทผลัมสด)
- ☐ Dried date (อินทผลัมแห้ง)
- ☐ Date juice (น้ำอินทผลัม)
- ☐ Date syrup (น้ำเชื่อมอินทผลัม)
- ☐ Date jam (แยมอินทผลัม)
- ☐ Date soda (น้ำอินทผลัมอัดแก๊ส)
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____

4. Have you ever tried date juice made from FRESH DATES FRUIT? (คุณค้มน้ำอินทผลัมจากผลอินทผลัมสดหรือไม่)

- ☐ Yes (เคย)
- ☐ No (ไม่เคย) (Skip to

5. How often do you drink date juice within the last 6 months? (คุณค้มน้ำอินทผลัมบ่อยขนาดไหนภายใน 6 เดือนที่ผ่านมา)

- ☐ Everyday (ทุกวัน)
- ☐ 3-4 times a week (3-4 ครั้งต่อสัปดาห์)
- ☐ Once a week (หนึ่งครั้งต่อสัปดาห์)
- ☐ 2-3 times per month (2-3 ครั้งต่อเดือน)
- ☐ Once a month (เดือนละครั้ง)
- ☐ Do not consume within the last 6 months(มากกว่า6เดือน)
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____

6. Do you personally purchase Date juice yourself? (คุณเป็นผู้ซื้อผลิตภัณฑ์น้ำอินทผลัมค้มน้ำหรือไม่)

- ☐ Yes (ใช่)
- ☐ No, someone else bought it for me (ปกติคนอื่นเป็นคนซื้อมาให้ ไม่เคยซื้อเอง)
- ☐ No, I haven't purchase. I made it myself. (ฉันไม่เคยซื้อ แต่ทำทานด้วยตนเอง)

7. Which is/are brands of date juice do you normally drink? (ปกติฉัน/เขา/เธอ/พวกเขา/มันดื่มอะไรที่
เลือกซื้อ)

Check all that apply. (ตอบได้มากกว่า 1 ข้อ)

☐ Mumin (มุมิน)



☐ Andalus (แอนด์อาลุส)



☐ INONE (อินวัน)



☐ Unbranded or homemade date juice (skip to question no.10)

☐ Unrecognized the brand (จำชื่อไม่ได้)

☐ Other(please specify) (อื่นๆ โปรดระบุ): _____

8. Where do you usually buy? (คุณมักจะซื้อที่ไหน)

Check all that apply. (ตอบได้มากกว่า 1 ข้อ)

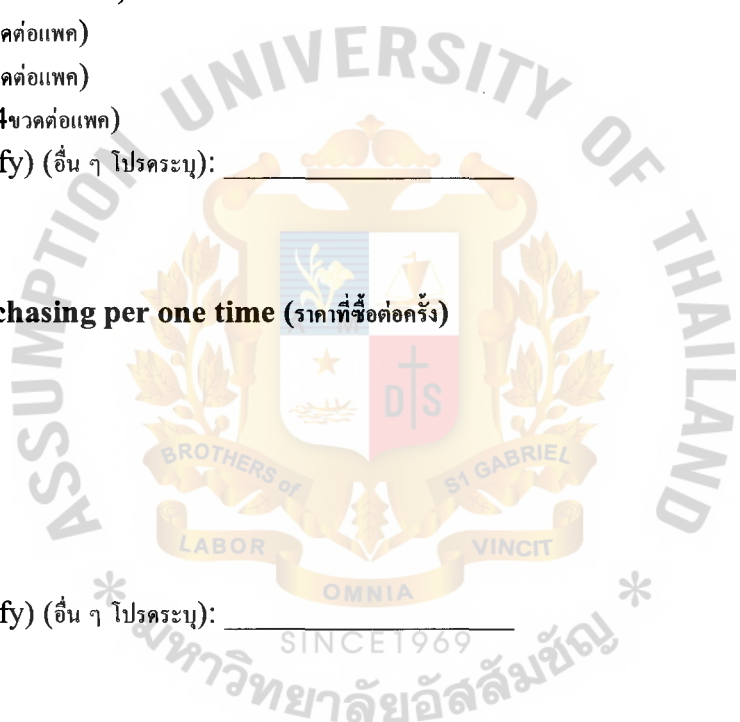
- ☐ Supermarket (ซูเปอร์มาร์เก็ต) (e.g. (ตัวอย่าง) Tops, MaxValue)
- ☐ Convenience stores (ร้านสะดวกซื้อ) (e.g. (ตัวอย่าง) 7-11, Family Mart, 108 Shop)
- ☐ Grocery (ร้านโชห่วย)
- ☐ Health shop/Specialty (ร้านขายของเพื่อสุขภาพ) (e.g. (ตัวอย่าง) Golden Place, Lemon Farm)
- ☐ Online ordering i.e. Line, Instagram, Facebook page, website
- ☐ Online store i.e. Lazada, Shopee, Alibaba
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____

9. Purchasing size (ขนาด/ปริมาณที่ซื้อ)

- ☐ 1 bottle 250ml (1ขวด 250มิลลิลิตร)
- ☐ 3 bottle / pack (3ขวดต่อแพค)
- ☐ 6 bottle / pack (6ขวดต่อแพค)
- ☐ 24 bottle / pack (24ขวดต่อแพค)
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____

10. Price of purchasing per one time (ราคาที่ซื้อต่อครั้ง)

- ☐ 35-60 baht
- ☐ 61-100 baht
- ☐ 101-200 baht
- ☐ 201-300 baht
- ☐ 301-400 baht
- ☐ 401-500baht
- ☐ >500 baht
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____



11. Please check, the reason why you do not consume date juice? (เหตุผล ที่ไม่/ไม่เคยดื่มน้ำอินท
ผาลัม) Check all that apply. (ตอบได้มากกว่า 1 ข้อ)

- ☐ Don't know about the product before (ไม่เคยรู้จักผลิตภัณฑ์นี้มาก่อน)
- ☐ Don't familiar with Date palm (ไม่คุ้นเคยกับอินทผาลัม)
- ☐ Hard to find (หาซื้อยาก)
- ☐ Don't have chance to try (ไม่มีโอกาสได้ลอง)
- ☐ Don't know the value of the product (ไม่รู้ถึงคุณประโยชน์)
- ☐ Feel too sweet (รู้สึกว่ามันหวานเกินไป)
- ☐ Feel that the product contain high sugar (รู้สึกว่าผลิตภัณฑ์มีน้ำตาลสูง)
- ☐ Feel that product contain high calories (รู้สึกว่าผลิตภัณฑ์ให้พลังงานสูง)
- ☐ Less amount of product per bottle/not worth with price (ปริมาณน้อยเกินไปต่อขวด/ไม่เหมาะสมกับราคา)
- ☐ High cost/expensive (ราคาสูง)
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____

12. What is the things that need improvement? (สิ่งที่อยากให้ปรับปรุงแก้ไขเพิ่มเติม ถ้ามี)

.....

.....

.....

.....

Part II: Consumer preference (ความพึงพอใจของผู้บริโภค)

Product Concept: Instant date powder: A Juice for A New You !

An instant date powder made from Barhee dates by freeze-drying process. The product will come up as a tea bag, just dissolve the date juice powder in room temperature or hot water, will get ready-to-drink healthy date juice, serve as a real fresh-squeezed. An alternative juice for people who looking for the healthy drink. Product is free from sugar, sweetened by natural, low GI, with fully date flavored from its nature with 100% natural ingredients. High fiber, vitamin A, C, B1, B2 and minerals i.e. potassium, calcium, magnesium, and iron. Maintain teeth and bone health, nourishing your skin and hair health. Also helps boosting mothers' milk.

แนวคิดผลิตภัณฑ์ : อินทผลัมผงสำเร็จรูปพร้อมดื่ม เครื่องดื่มสำหรับคุณคนใหม่ !

อินทผลัมผงสำเร็จรูปพร้อมดื่มจากน้ำผลอินทผลัมสด คุณภาพเหมือนสดใหม่ ผลิตโดยกระบวนการอบแห้งแช่เยือกแข็งแบบสูญญากาศ ผลิตภัณฑ์อยู่ในรูปแบบของถุงชาพร้อมชง เพียงแค่ใส่อินทผลัมผงลงในน้ำอุณหภูมิห้องหรือน้ำร้อน น้ำอินทผลัมพร้อมดื่มก็พร้อมเสิร์ฟ เหมือนได้ดื่มน้ำอินทผลัมสด เป็นเครื่องดื่มทางเลือกสำหรับผู้มองหาเครื่องดื่มเพื่อสุขภาพ ผลิตภัณฑ์ปราศจากน้ำตาล หวานหอมจากธรรมชาติ 100% มีค่าดัชนีน้ำตาลต่ำ ใยอาหารสูง อุดมด้วยคุณค่าสารอาหาร วิตามิน A, C, B1, B2 และเกลือแร่ เช่น โพแทสเซียม แมกนีเซียม แคลเซียม และธาตุเหล็ก ช่วยให้กระดูกและฟันแข็งแรง ช่วยบำรุงเส้นผมและผิว อีกทั้งเพิ่มน้ำนมในคุณแม่ที่กำลังให้นมบุตร

1. From the product concept description above, do you think this product is interested you to purchase or not? (จากแนวคิดผลิตภัณฑ์ข้างต้น ท่านคิดว่าผลิตภัณฑ์ดังกล่าวน่าสนใจจะซื้อหรือไม่)

- ☐ Yes (ใช่) ☐ No (ไม่ซื้อ) ☐ Not sure (ไม่แน่ใจ)

2. What do you prefer about the color and appearance of the finished product on date juice powder? (อยากให้ผลิตภัณฑ์ชาอินทผลัมผงมีสี หรือลักษณะปรากฏอย่างไร)

- ☐ Light brown color powder (ผงสีน้ำตาลอ่อน)
☐ Dark brown color powder (ผงสีน้ำตาลเข้ม)
☐ Glossy black color powder (ผงสีดำมันวาว)
☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____

3. What do you prefer about the color and appearance of the reconstituted date juice? (อยากให้เกิดลักษณะน้ำอินทผลาล์มที่ละลายน้ำแล้วมีสี หรือลักษณะปรากฏอย่างไร)

- ☐ Light brown color juice (น้ำมีสีน้ำตาลอ่อน)
- ☐ Dark brown color juice (น้ำมีสีน้ำตาลเข้ม)
- ☐ Bright golden yellow juice (น้ำมีสีเหลืองสวย)
- ☐ Transparent/clear juice (น้ำมีความใส)
- ☐ Opaque juice (น้ำมีความขุ่น/ทึบแสง)
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____

4. What factors would you consider as an important attribute in an instant date tea powder? (ปัจจัยใดที่คุณคิดว่าเป็นคุณลักษณะที่สำคัญในชาอินทผลาล์มผงสำเร็จรูป?)

Statement	Extremely disagree (ไม่เห็นด้วยอย่างมาก)	Somewhat disagree (ไม่เห็นด้วยเล็กน้อย)	Neither disagree / agree (เฉยๆ)	Somewhat agree (เห็นด้วยเล็กน้อย)	Extremely Agree (เห็นด้วยอย่างมาก)
1. Good date aroma (กลิ่นหอมของอินทผลาล์ม)					
2. Less Sweetness (หวานน้อย)					
3. High nutrient (คุณค่าสารอาหาร)					
4. Natural sweetener (ความหวานจากธรรมชาติ)					
5. Refreshing (ทำให้สดชื่น)					
6. Convenient to prepare (ง่่าย)					
7. Easy to dissolve (ละลายง่่าย)					
8. Packaging (บรรจุภัณฑ์)					

5. What are factors that you will consider if you purchase this product? (ปัจจัยใดที่ทำให้คุณตัดสินใจเลือกซื้อผลิตภัณฑ์นี้)*Check for Top 3 (เลือกเพียง3อันดับแรก)

- ☐ Suitable Price (ราคาสมเหตุสมผล)
- ☐ Taste/Flavor (รสชาติ/กลิ่นรส)
- ☐ Craving (อยากดื่ม)
- ☐ Natural sweetener (ความหวานจากธรรมชาติ)
- ☐ Healthier choice of sweets drink (เครื่องดื่มทางเลือกที่ดีต่อสุขภาพ)
- ☐ New product (ผลิตภัณฑ์ใหม่)
- ☐ Promotion (โปรโมชั่น)
- ☐ Ingredient (ส่วนประกอบ)
- ☐ Shop location (ตำแหน่งร้านค้า)
- ☐ Brand (ชื่อ)
- ☐ Health benefit (ประโยชน์ต่อสุขภาพ)
- ☐ Packaging (บรรจุภัณฑ์)
- ☐ Other(please specify) (อื่นๆ โปรดระบุ): _____

6. If product has 10 bags (about 200 g), how much you will be willing to pay? (ถ้าผลิตภัณฑ์ 10 ซอง ก้อนละ 200 กรัม ราคาเท่าไรที่คุณจะจ่ายสำหรับผลิตภัณฑ์นี้)

- ☐ 60-100 baht
- ☐ 101-150 baht
- ☐ 200-250 baht
- ☐ > 250 baht

If this product is launched to the market in the selected packaging and price, what quality do you looking for? (หากมีผลิตภัณฑ์ดังกล่าวออกสู่จำหน่ายในราคาและลักษณะบรรจุภัณฑ์ที่ท่านได้เลือก คุณภาพแบบใดที่คุณมองหาจากผลิตภัณฑ์)

7. How would this drink suit your needs the THREE most? (เครื่องดื่มนี้จะเหมาะกับความต้องการของคุณมากที่สุดอย่างไรใน 3 อันดับแรก?)

- ☐ For boosting energy (เพื่อเพิ่มพลังงาน)
- ☐ Refreshing the day (ช่วยให้สดชื่นตลอดทั้งวัน)
- ☐ Improve healthiness (ส่งเสริมสุขภาพ)
- ☐ When want relaxation (เมื่อต้องการ การผ่อนคลาย)
- ☐ Alternative drink with healthier sugar (เป็นผลิตภัณฑ์ทางเลือกที่ดีของน้ำตาลสุขภาพ)
- ☐ Breast-milk feeding mother (ให้น้ำนมแม่ หลังคลอดบุตร)
- ☐ Maintaining fasting (ดื่มก่อนและหลังการอดอาหาร)
- ☐ Try a new thing (อยากทดลองผลิตภัณฑ์ใหม่)
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____



8. Expectation on health benefits that this drink would suits you the THREE most.
(คุณสมบัติที่มองหาที่เครื่องดื่มนี้เหมาะกับคุณที่สุด 3 อันดับแรก?)

- ☐ Help laxation (ช่วยระบบขับถ่าย)
- ☐ Promote digestion (ช่วยระบบย่อย)
- ☐ Decrease LDL level (ช่วยลดระดับไขมันส่วนเกิน)
- ☐ Nourishing skin health (บำรุงผิว)
- ☐ Keeps hair healthy (บำรุงให้เส้นผมหนานุ่ม)
- ☐ Maintain teeth and bone health (รักษาความแข็งแรงให้กระดูกและฟัน)
- ☐ Help in natural labour (ช่วยให้คลอดง่าย)
- ☐ Boosting breastmilk (กระตุ้นน้ำนมแม่)
- ☐ increasing fiber source in meal (เพิ่มเส้นใยในมื้ออาหาร)
- ☐ relaxing and deep sleep (ช่วยในการนอนหลับ)
- ☐ Anti-aging property (ชะลอวัย)
- ☐ Improve immune system (เสริมภูมิคุ้มกันในร่างกาย)
- ☐ Brain boost (อาหารสมอง)
- ☐ I do not interest in any of these (ไม่มีความสนใจในเรื่องดังกล่าว)
- ☐ Other(please specify) (อื่นๆ โปรดระบุ): _____

9. The moment or situation that is the best suited to drink this drink. (ช่วงเวลาหรือสถานการณ์ที่เหมาะสม ที่สุดที่จะดื่มเครื่องดื่มชนิดนี้)

- ☐ After work for a whole day (หลังจากงานมาทั้งวัน)
- ☐ During work period (ระหว่างการทำงาน)
- ☐ Study for the exam (ช่วงเตรียมตัวสอบ)
- ☐ Hang out with friends in the party (ใช้เวลาอยู่กับเพื่อนในงานเลี้ยง)
- ☐ Exercise in the fitness (ช่วงออกกำลังกายในฟิตเนส)
- ☐ After exercise (หลังจากการออกกำลังกาย)
- ☐ During weight control (เมื่อลดน้ำหนัก)
- ☐ Object to weight gain (เมื่อต้องการเพิ่มน้ำหนัก)
- ☐ Thirsty, I would drink with ice (เมื่อกระหายน้ำ ทานเย็นๆ กับน้ำแข็ง)
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____

10. The mood of this drink that you expect the Three most. (ความรู้สึกที่คุณต้องการ เมื่อดื่มผลิตภัณฑ์นี้มากที่สุด 3 อันดับแรก)

- ☐ Energetic (กระฉับกระเฉง)
- ☐ Relaxing (ผ่อนคลาย)
- ☐ refreshing (สดชื่น)
- ☐ calm (สงบ)
- ☐ Thirst quenching (ดับกระหาย)
- ☐ full (อิ่ม)
- ☐ awake (ทำให้ตื่น)
- ☐ Easy to drink (ดื่มง่าย ลื่นคอ)

11. What are your concerns when consuming this product (อะไรคือปัญหาที่คุณต้องการหลีกเลี่ยงจากการบริโภคน้ำอินทผลัมจากผงขงมากที่สุด 3 อันดับแรก)

- ☐ Too sweet (หวานเกินไป)
- ☐ Unattractive color (สีไม่ดึงดูด/ไม่น่าดื่ม)
- ☐ Too less date aroma (กลิ่นอินทผลัมน้อยเกินไป)
- ☐ Hard to dissolve (ละลายยาก)
- ☐ High sugar load (ให้ปริมาณน้ำตาลสูง)
- ☐ Hard to find (หาซื้อยาก)
- ☐ Less amount of product per bottle/not worth with price (ปริมาณน้อยเกินไปต่อขวด/ไม่เหมาะสมกับราคา)
- ☐ High cost/expensive (ราคาสูง)
- ☐ Unattractive Packaging (บรรจุภัณฑ์ไม่สวย ไม่น่าดึงดูด)
- ☐ Other(please specify) (อื่น ๆ โปรดระบุ): _____

Part III: General Information (ข้อมูลทั่วไป)

1. Gender (เพศ)

- ☐ Male (ชาย)
- ☐ Female (หญิง)

2. What range is your age? (คุณมีอายุอยู่ในช่วงไหน)

- ☐ 15-20 ปี
- ☐ 21-26 ปี
- ☐ 27-32 ปี
- ☐ 33-38 ปี
- ☐ 39-44 ปี
- ☐ 45-50
- ☐ > 50 ปี

3. Nationality (เชื้อชาติ)

- ☐ Thai (ไทย)
- ☐ Non-Thai (คนต่างชาติ) please specify (ระบุ) : _____

4. Religion (ศาสนา)

- ☐ Buddhism (พุทธ)
- ☐ Christianity (คริสต์)
- ☐ Islam (อิสลาม)
- ☐ Hinduism (ฮินดู)
- ☐ No religion (ไม่มีศาสนา)
- ☐ Other (please specify) (อื่นๆ โปรดระบุ): _____

5. Highest level of education (ระดับการศึกษาสูงสุด)

- ☐ High School or Less (ระดับมัธยมศึกษาหรือต่ำกว่า)
- ☐ Vocational degree (ปวช. และ ปวส.)
- ☐ Bachelor's degree (ระดับปริญญาตรี)
- ☐ Higher than Bachelor's degree (สูงกว่าปริญญาตรี)
- ☐ Others (อื่นๆ)

6. Occupation (อาชีพ)

- ☐ Student/College student (นักเรียน/นักศึกษา)
- ☐ Government employee/State Enterprises (ข้าราชการ/รัฐวิสาหกิจ)
- ☐ Employee (ลูกจ้าง)
- ☐ Business owner (ธุรกิจส่วนตัว)
- ☐ Others (อื่นๆ)

7. Monthly income (รายได้ต่อเดือน)

- ☐ Less than 10,000 baht (ต่ำกว่า 10,000 บาท)
- ☐ 10,000-20,000 baht
- ☐ 20,001-30,000 baht
- ☐ 30,001-40,000 baht
- ☐ More than 40,000 baht (มากกว่า 40,000 บาท)

Thank you for your kindly participation (ขอบคุณที่ให้ความร่วมมือ)



Appendix D : Table of consumer survey results

Table 1: Demographic data (n = 108 responses)

Question	Frequency (-)	Percentage (%)
1. Gender		
• Male	43	39.8
• Female	65	60.2
2. Age		
• 15-20 years old	11	10.2
• 21-26	39	36.1
• 27-32	3	2.8
• 33-38	1	0.9
• 39-44	6	5.6
• 45-50	44	40.7
• >50	4	3.7
3. Nationality		
• Thai	103	95.4
• Non-Thai	5	4.6
4. Religion		
• Buddhism	89	82.4
• Christianity	12	11.1
• Islam	2	1.9
• Hinduism	1	0.9
• No religion	4	3.7
5. Highest level of education		
• High school or less	4	3.7
• Vocational degree	6	5.6
• Bachelor's degree	75	69.4
• Higher than bachelor's degree	23	21.3

Question	Frequency (-)	Percentage (%)
6. Occupation		
• Student/ college student	39	36.1
• Government employee/ state enterprises	18	16.7
• Employee	27	25
• Business owner	21	19.4
• Freelance	1	0.9
• Unemployed	2	1.8
7. Monthly income		
• Less than 10,000 baht	29	26.9
• 10,000-20,000 baht	22	20.4
• 20,001-30,000 baht	17	15.7
• 30,001-40,000 baht	16	14.8
• More than 40,000 baht	24	22.2

Appendix Table 2: Consumer behavior

Question	Frequency (-)	Percentage (%)
1.Please check, the products that you have ever tried. (n = 108 responses)		
• Flower tea	42	38.9
• Herbal tea	61	59.5
• Fruit tea	45	41.7
• Green tea, black tea, and white tea	71	65.7
• Instant fruit juice powder	29	26.9
• Date juice powder	4	3.7
• Instant ginger juice powder	50	46.3
• No (ไม่กิน)	13	12
• Eating date plainly	1	0.9
• Coffee	1	0.9
2.Have you ever tried products from date palms? (n = 108 responses)		
• Yes	69	63.9
• No	39	36.1
3. Please check product(s) from "Date palms" that you ever tried. (n = 69 responses)		
• Fresh date	30	43.5
• Dried date	54	78.3
• Date juice	24	34.8
• Date syrup	18	26
• Date jam	6	8.7
• Date soda	1	1.4
4. Have you ever tried date juice made from fresh date fruit? (n = 69 responses)		
• Yes	25	36.2
• No	44	63.8

Question	Frequency (-)	Percentage (%)
5. How often do you drink date juice within the last 6 months? (n = 25 responses)		
• Everyday	0	0
• 3-4 times a week	1	4
• Once a week	2	8
• 2-3 times per month	3	12
• Once a month	1	4
• Do not consume within the last 6 months	18	72
6. Do you personally purchase Date juice yourself? (n = 25 responses)		
• Yes	3	12
• No, someone else bought it for me	19	76
• No, I haven't purchase. I made it myself.	3	12
7. Which is/are brands of date juice do you normally drink? (n = 3 responses)		
• Mumin	0	0
• Andalus	2	66.7
• INONE	0	0
• Unbranded or homemade date juice	2	66.7
• Unrecognized the brand	0	0
8. Where do you usually buy? (n = 3 responses)		
• Supermarket	3	100
• Convenience stores	0	0
• Grocery	0	0
• Health shop/Specialty	1	33.3
• Online ordering	0	0
• Online store	0	0
9. Purchasing size(n = 3 responses)		
• 1 bottle 250ml	1	33.3
• 3 bottle / pack	2	66.7
• 6 bottle / pack	0	0
• 24 bottle / pack	0	0

Question	Frequency (-)	Percentage (%)
10. Price of purchasing per one time (n = 3 responses)		
• 35-60 baht	0	0
• 61-100 baht	1	33.3
• 101-200 baht	1	33.3
• 201-300 baht	1	33.3
• 301-400 baht	0	0
• 401-500baht	0	0
• >500 baht	0	0
11. Please check, the reason why you do not consume date juice? (n = 83 responses)		
• Don't know about the product before	46	55.4
• Don't familiar with Date palm	23	27.7
• Hard to find	31	37.3
• Don't have chance to try	46	55.4
• Don't know the value of the product	8	9.6
• Feel too sweet	9	10.8
• Feel that the product contain high sugar	7	8.4
• Feel that product contain high calories	0	0
• Less amount of product per bottle/not worth with price	3	3.6
• High cost/expensive	6	7.2
• Other (Do not like date fruit)	2	2.4

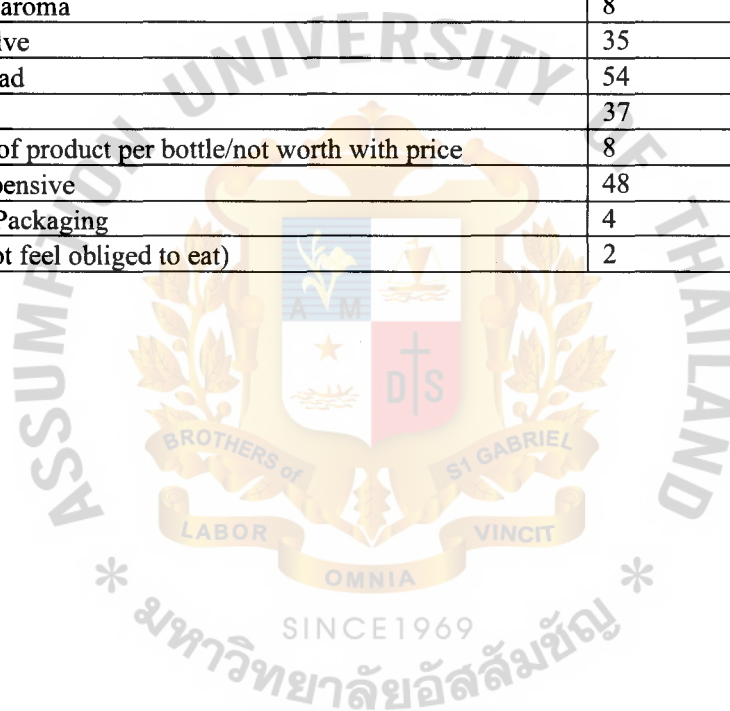
Appendix Table 3: Consumer preference

Question	Frequency (-)	Percentage (%)
1.From the product concept description above, do you think this product is interested you to purchase or not? (n = 86 responses)		
• Yes	46	53.5
• No	2	2.3
• Not sure	38	44.2
2. What do you prefer about the color and appearance of the finished product on date juice powder? (n = 86 responses)		
• Light brown color powder	60	69.8
• Dark brown color powder	23	26.7
• Glossy black color powder	1	1.2
• Other (whatever)	1	1.2
• Other (natural color)	1	1.2
3. What do you prefer about the color and appearance of the reconstituted date juice? (n = 86 responses)		
• Light brown color juice	54	62.8
• Dark brown color juice	13	15.1
• Bright golden color juice	17	19.8
• Transparent/clear juice	8	9.3
• Opaque juice	3	3.5
• Other (Natural color)	2	2.4
4. What factors would you consider as an important attribute in an instant date tea powder? (n = 86 responses)		

Question	Frequency (-)	Percentage (%)
5. What are factors that you will consider if you purchase this product? (n = 86 responses)		
• Suitable Price	54	62.8
• Taste/Flavor	53	61.6
• Craving	16	18.6
• Natural sweetener	13	15.1
• Healthier choice of sweets drink	42	48.8
• New product	5	5.8
• Promotion	3	3.5
• Ingredient	5	5.8
• Shop location	2	2.3
• Brand	0	0
• Health benefit	47	54.7
• Packaging	5	5.8
6. If product has 10 bags (about 200 g), how much you will be willing to pay? (n = 86 responses)		
• 60-100 baht	23	26.7
• 101-150 baht	37	43
• 151-200 baht	18	20.9
• 200-250 baht	6	7
• >250 baht	2	2.3
7. How would this drink suit your needs the three most? (n = 108 responses)		
• For boosting energy	33	30.6
• Refreshing the day	60	55.6
• Improve healthiness	66	61.1
• When want relaxation	44	40.7
• Alternative drink with healthier sugar	36	33.3
• Breast-milk feeding mother	2	1.9
• Maintaining fasting	9	8.3
• Try a new thing	39	36.1
• Other (Replacement pop drink)	1	0.9
• Other (Yummy)	1	0.9

Question	Frequency (-)	Percentage (%)
8. Expectation on health benefits that this drink would suits you the three most. (n = 108 responses)		
• Help laxation	48	44.4
• Promote digestion	32	29.6
• Decrease LDL level	42	38.9
• Nourishing skin health	25	23.1
• Keeps hair healthy	12	11.1
• Maintain teeth and bone health	17	15.7
• Help in natural labor	1	0.9
• Boosting breastmilk	2	1.9
• Increasing fiber source in meal	17	15.8
• Relaxing and deep sleep	24	22.2
• Anti-aging property	27	25
• Improve immune system	31	28.7
• Brain boost	18	16.7
• I do not interest in any of these	5	4.6
• Other (refreshes)	1	0.9
• Other (full fill the hunger)	1	0.9
9. The moment or situation that is the best suited to drink this drink. (n = 108 responses)		
• After work for a whole day	37	34.3
• During work period	56	51.9
• Study for the exam	10	9.3
• Hang out with friends in the party	1	0.9
• Exercise in the fitness	7	6.5
• After exercise	25	23.1
• During weight control	16	14.8
• Object to weight gain	1	0.9
• Thirsty, I would drink with ice	47	43.5
• In the morning	1	0.9

Question	Frequency (-)	Percentage (%)
10. The mood of this drink that you expect the three most (n = 108 responses)		
• Energetic	35	32.4
• Relaxing	67	62
• Refreshing	92	85.2
• Calm	6	5.6
• Thirst quenching	43	39.8
• Full	9	8.3
• Awake	13	12
• Easy to drink	28	25.9
12. What are your concerns when consuming this product. (n = 108 responses)		
• Too sweet	76	70.4
• Unattractive color	18	16.7
• Too less date aroma	8	7.4
• Hard to dissolve	35	32.4
• High sugar load	54	50
• Hard to find	37	34.3
• Less amount of product per bottle/not worth with price	8	7.4
• High cost/expensive	48	44.4
• Unattractive Packaging	4	3.7
• Other (Did not feel obliged to eat)	2	1.9



Appendix E: Cost estimation

Cost of date juice powder (Calculate according to formulation 15%wv maltodextrin)

Ingredients	Price quantity	Unit used	Unit cost
1.Premature fruit drop, Barhee variety date	150baht/1 kg	1kg	150 baht
2.Water	15 baht/L	2L	30 baht
3.Maltodexgtrin (DE19)	100 baht/1kg	450g	45 baht
Total cost of ingredients			225baht/47 serving size
Coat per unit (one serving size)			4.78baht per one serving (16g of powder)

Note: 1L of Date juice with 15% MD can product 22.5% yield of Date powder or (254g/1L). 3L of date juice with15%w/v maltodextrin can product dried powder around 762 g. (47 serving size) Reconstituted date juice (Date juice powder16g /100mlwater).



