

Product Development of Karanda Fruit (*Carissa Carandas* Linn.): Sorbets and Yogurt Ice-Cream

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Abstract: Product development of Karanda Sorbets and yogurt ice-cream. The objectives of this study are to determine the appropriate amount of Karanda fruits for making Sorbets and yogurt ice-cream to examine the quality of Karanda Sorbets and yogurt ice-cream) to study about the consumer's behaviors towards Karanda Sorbets and yogurt ice-cream. The results are as stated below. In terms of Karanda sorbet preparation, the most appropriate quantity of Karanda fruit juice is 30%. The physical properties of Karanda Sorbets contain the brightness level at 34.32, red color level at 41.26 and yellow color level at 21.18. The soluble solids contain: 30 Brix, overrun statistics at 25.72, melting rate at 47.32 and pH balance at 2.40. Upon studying the chemical qualities of Karanda sorbet, it is evident that in every 100 g, there are 91.8 Kcal of energy, 77.1 g of humidity, 0.15 g of fat, <0.20 g of protein, 22.6 g of carbohydrates, 0.11 g of fiber and 0.12 g of ash. Alternatively in the aspect of Karanda yogurt ice-cream, the most appropriate quantity of Karanda fruit added to the ingredients is 10%. The physical properties of Karanda yoghurt ice-cream are as follow: brightness level at 52.32; red color level at 32.26; yellow color level at 21.18; viscosity level at 364.798 cps; overrun statistics at 75.85; melting rate at 89.90 and pH balance at 5.67. In terms of the chemical qualities of Karanda yogurt ice-cream, each 100 g provides 214 Kcal of energy, 64.0 g of humidity, 14.6 g of fat, 3.14 g of protein, 17.5 g of carbohydrates, 0.76 g of fiber and 0.74 g of ash. Consumer satisfaction towards Karanda Sorbets and yogurt ice-cream is at 100%.

Key words: Karanda fruit, sorbet, yogurt ice-cream, satisfaction, consumer, protein

INTRODUCTION

The community of Bang Nok Kwaek Sub-District, Bang Kon Tee District, Samut Songkhram Province is located in the central region of Thailand and is abundant with natural resources. Unfortunately in the economic aspect, the region is experiencing a sluggish growth. In terms of agricultural industry, fishery provides the highest income to the community, followed by farming and simple agricultural processing ([http://th.wikipedia.org/wiki/samut songkhram](http://th.wikipedia.org/wiki/samut_songkhram)). In addition, Samut Songkhram is also a site for agricultural tourism which has becoming increasingly popular amongst both domestic and international tourists. The region provides an authentic experience for visitors through the traditional food and lifestyles of the community along Maeklong River. Upon conducting a field research and survey, it is apparent that Bang Nok

Kwaek Sub-District is well-known for Karanda plantation which is primarily sold as a seedling for home decoration. Meanwhile, its fruits are sold to tourists who love to eat sour fruits. Karanda trees typically provide the highest yield during May-July. In addition, Karanda fruits have significant antioxidant properties, comprising of anthocyanin, phenolic compounds and vitamin C. Karanda is believed to provide an array of health benefits such as treating scurvy, sore throat, fever, mouth ulcers and stomach ulcers (Rais *et al.*, 2015; Sungkhapong *et al.*, 2016). Based on the research conducted by Pongpien (2009) regarding the antioxidant properties of purple-hued indigenous plants, it was found that Karanda has 93.01% of the antioxidants.

Accordingly, the researcher has an idea of processing Karanda fruits in Bang Nok Kwaek Sub District which would consequently add value to the fruits,

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increase the variety of products and develop local products in a sustainable way in accordance with the community's wisdom. Moreover such development would further lead to the development of human resources, resulting in the production of high quality products that correspond to the market demand (Ayuningrat *et al.*, 2016; Intan, 2016). Indeed, these elements serve as one of the mechanisms for promoting local products to be recognized and spread across the country as well as abroad. Ultimately, the community would have a solid foundation and stand on their own feet. As such this research has the objectives to:

- Determine the appropriate quantity of Karanda for the preparation of Sorbets and yogurt ice-cream
- Examine the quality of Karanda Sorbets and yogurt ice-cream
- Study about consumer's behaviors towards Karanda Sorbets and yogurt ice-cream

Literature review: Karanda has a scientific name called *Carissa carandas* L. which belongs to Apocynaceae family. Other names less commonly used include karaunda, Karanda or karamda. It is considered as a scandent shrub or a perennial plant which can grow up to 5 m in height. Its resin is white in color with only one embryonic leaf or as referred to as cotyledon. The leaf shape is either oblong or ovate with 1.5-4 cm in width and 3-7 cm in length. The leaf apex can be either obtuse or retuse. Meanwhile, the flowers are of the inflorescence type with a length of between 3.5 and 5.5 cm. The petals are white or pink in color with an interconnected hollow at a length of between 16 and 21.5 mm; the flower shape is of a hypocrateric form. Its fruits are oval shape with 12-17 mm in width, 15-23 mm in length and red or pink in color as illustrated in Fig. 1. Karanda produces multiple fruits in a cluster. Young fruits generally have a light pink color that slowly darken and turn into the red color. Once fully ripen, the fruits will become purple and have many antioxidant properties including anthocyanin, phenolic compounds and vitamin C.

Medical Department of the National Cancer Institute of Thailand had published an article on the topic of "Vegetables-Fruits for Cancer Treatment" which concluded that the pigments in three types of plants (chlorophyll green color, carotenoid orange, yellow and red color and anthocyanin bluish purple and red color) including orange-lemon, shallot-garlic and herbs have the properties for treating various types of cancer. For instance, orange-lemon is not only abundant in vitamin C but it also contains other antioxidant properties that can treat inflammation and cancer as well as prevent

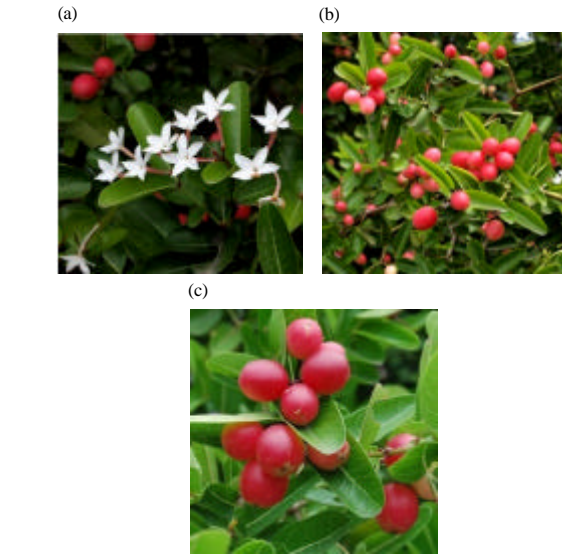


Fig. 1: a-c) Characteristics of karanda

coagulation. Its antioxidants prevent free radicals (free radical is a molecule with a single unpaired electron that is highly reactive; if presence in a human body, free radicals can damage other molecules and DNA) and inhibit the growth of cancerous cells and tumor. In addition, it promotes detoxification, reduces cholesterol and stimulates enzyme inhibitors (Paeng, 2012).

Chakri Kaewchundee, Rakkiad Saenprasert and Tinn Phromchoti conducted a study on the effect of harvesting period on the quality of Karanda fruits (*Carissa carandas*) by examining 9 physical and chemical characteristics. The results indicated that the harvesting period has an effect on the quality of fruits in terms of: weight, size, color, brightness level of the shell, Total Soluble Solids (TSS), Total Acidity (TA), the ratio of TSS: TA and the amount of vitamin C. The most appropriate harvesting period of Karanda is 65 days after the flowering stage which provides the highest quality of fruits in terms of both physical and chemical properties.

Pewlong *et al.* (2014) investigated the activities of antioxidants by examining the total amount of anthocyanin and phenolic compounds in karanda. The results indicated that Karanda fruits contain: 4.67 mg of phenolic compounds which is equivalent to Gallic acid per g; 54.80 mg of anthocyanin per L; 2.42 mg of DPPH antioxidants which is equivalent to Ascorbic acid per g and 37.81 micromoles of antioxidants which is equivalent to phosphorous sulfate per g.

Upon consideration of the above information, the researcher is interested in processing Karanda fruits into Sorbets and yogurt ice-cream. Regarding its various

health benefits as well as its colorful characteristics and sour taste, Karanda is ideal for processing into ice-cream products which can be consumed by people of all ages and genders.

MATERIALS AND METHODS

The study on appropriate quantity of Karanda fruits for making Sorbets and yogurt ice-cream

Preparation and production process of Karanda Sorbets

Preparation of Karanda fruit juice: Rinse Karanda fruit with clean water for two times. Then, cut the fruit in half and remove the seeds. The 600 g of Karanda flesh are extracted using an electric juicer for two times, obtaining 300 g of Karanda juice at a pH level of 2.40.

Production process of Karanda Sorbets: Weigh the ingredients and the quantity of Karanda juice. Set the stove on a medium heat for 5 min while mixing the ingredients with water, Karanda juice and sugar until the sugar is melted. Cool the Karanda syrup in a refrigerator for 1 h. After that add lemon juice into the syrup and mix them together. Pour the mixture into an ice-cream blender for 15 min until the mixture is solidified. Refrigerate the solid mixture in a temperature of 18° celsius for 30 min. The study on the appropriate quantity of Karanda juice was conducted using three different levels of quantities: 20, 30 and 40% of the total ingredients.

Preparation and production process of Karanda yogurt ice-cream

Preparation of Karanda flesh: Defrost the frozen Karanda at a room temperature for 30 min. Cut the Karanda in half, remove the seeds and then blend the fruit.

Production process of Karanda yogurt ice-cream: Weigh the ingredients necessary for making yogurt ice-cream by separating the ingredients into 2 parts: part 1 (300 g) and part 2 (150 g). Mix fresh milk with glucose syrup in a stove, set the heat level at 5 for 5 min. Once the ingredients begin to melt, add stabilizer powder into the mixture and rest for 30 min. Whip the whipping cream at a medium speed of 3 for 3 min. Once it becomes fluffy, add water and yogurt from part 1 (300 g). Continue to whip the mixture for 2 min. Whip the cream cheese at a low speed of 2 for 2 min. Once the mixture becomes smooth, add yogurt from Part 2 (150 g). Continue to whip the mixture for 1 min. Then, mix all the ingredients together including the blended Karanda flesh. Refrigerate the mixture at a temperature of 4° celsius for 24 h. Pour the mixture into an ice-cream blender for 10 min. Fill 100 g of the mixture into each cup and close the lid. Refrigerate at the temperature of 18° celsius for 2 h before serving.

The study on the appropriate quantity of Karanda for making ice-cream yogurt was conducted using three different levels of quantities: 10, 20 and 30% of the total ingredients.

The quality of Karanda products was assessed in terms of senses with a Randomized Complete Block Design (RCBD) (Sinsomboontong, 2003). The sample group of 70 people, comprising of professors and students from Rajamangala University of Technology Phra Nakhon were asked to provide a score for their level of satisfaction based on the 9-Hedonic scale. The participants assessed the product quality in terms of color, smell, flavor, texture (smoothness) and overall satisfaction.

The obtained data were Analyzed Using a Statistical Analysis of Variance (ANOVA) and the averages were compared using Duncan's Multiple Range Test (DMRT) at a confidence level of 95%.

The study on the quality of Karanda Sorbets and yogurt ice-cream: Assessment of the physical properties of Karanda Sorbets and yogurt ice-cream.

Viscosity measurement: The viscosity of Karanda ice-cream which had been incubated at a temperature of between 4 and 8°C in a 600 mL beaker was assessed using brookfield viscometer with #3 spindle at a speed of 100 rpm. The values were recorded after a 30 min spin.

Overrun measurement: The ice-cream overrun was determined by weighing the mixed ice-cream contained in a plastic cup. Once the ice-cream was blended until solidified it was poured into a plastic cup until full. The obtained ice-cream was used in an overrun calculation.

Color measurement: Color was measured using spectre Magic NX.

Melt-down rate measurement: The melt-down rate of the ice-cream was measured at a controlled temperature (25°C). Prior to the analysis, the ice-cream must be incubated at a temperature of 20°C for 24 h.

Level of pH measurement: The level of pH was evaluated using a pH meter satorius AQ, PB-10 model.

Refractive index measurement: The refractive index was measured using a hand refractometer, Ni (0-32°Brix), MNL 1125 model. Evaluation of chemical properties of Karanda Sorbets and yogurt ice-cream:

- Moisture level (%): measured according to AOAC technique in 2005

- Ash level (%): measured according to AOAC technique in 2005
- Fat level (%): measured using Roese-Gottlieb method, based on AOAC technique in 2005
- Protein level (%): measured using formal titration, based on AOAC technique in 2005
- Fiber level (%): measured according to AOAC technique in 2005
- Total carbohydrate (%): measured according to AOAC technique in 2005
- Energy measured using the method of analysis for Nutrition Labeling in 2002

The study on consumer's behaviors towards Karanda Sorbets and yogurt ice-cream:

The study was conducted on a total of 150 consumers, comprising of individuals in Dusit District, Bangkok. The sample group was selected on a random basis and the questionnaire was standardized according to a rating scale based on a point Likert scale. The participants were provided with questions relating to the senses that include: color, smell, taste, texture (smoothness) and overall satisfaction.

RESULTS AND DISCUSSION

From Table 1, it is evident that the participants were satisfied with Karanda Sorbets at 30% concentration in terms of the color, smell, taste, texture and overall satisfaction all at a moderate level with the averages of 7.41, 7.19, 7.20 and 7.39, respectively. Upon evaluation, the results were significantly different at a confidence level of 95% due to the dark red color, sweet and sour fragrance, sour taste and smooth texture of the product. Meanwhile, for Karanda Sorbets at 20 and 40% concentration, the color, smell, taste, texture and overall satisfaction were rated in a low to moderate level. The primary reasons are that Karanda Sorbets at 20%

concentration have a weak sour taste while Karanda Sorbets at 40% concentration have bitter and sour tastes due to the high concentration of anthocyanin.

From Table 2, it indicated that the majority of participants preferred Karanda Sorbets at 30% concentration with the results as follow: brightness level is $L^*34.32$; redness level is $a^*41.26$; yellowness level is $b^*21.18$; refractive index is at 30°Brix; overrun value is 25.72%; melt-down rate is 47.32%, under a room temperature for the duration of 30 min; the level of pH is 2.40. Therefore, the product appears as red with the sweet fragrance from sugar and sour taste from the lemon juice. In addition, it also has a smooth and fine texture. Meanwhile, the physical properties of Karanda Sorbets at 20 and 40% concentration are slightly different due to the difference in Karanda juice concentration. A high concentration of Karanda juice increases the brightness (L^*) and redness (a^*) levels while the yellowness level (b^*) remains unchanged. Nonetheless, the overrun value depends on the viscosity. A high viscosity will hinder the movement of the rotating blade in the blending process which results in less air being blended into the sorbet. The melt-down rate at 30 min in a room temperature, increases the melting resistance while the pH value remains unchanged.

From Table 3, it can be inferred that the majority of participants preferred Karanda yogurt ice-cream at 10% concentration in terms of the color, smell, taste, texture and overall satisfaction all at a moderate level with averages of 7.24, 7.77, 7.17 and 7.67, respectively. Meanwhile, for Karanda yogurt ice-cream at 20% concentration, the participants are most satisfied with the color at a moderate level and average of 7.54. Upon the analysis of variance and statistical difference it is apparent that the color, smell, taste, texture and overall satisfaction have a significant difference at a confidence level of 95%. The main reasons for such differences are that the Karanda

Table 1: Results of the quality of senses for each concentration of Karanda juice

Karanda juice (%)	Properties				
	Color	Smell	Taste	Texture	Overall satisfaction
20	7.33 ^b ±1.11	6.80 ^b ±1.04	7.01 ^b ±1.01	6.84 ^b ±0.93	7.12 ^b ±0.98
30	7.41 ^a ±0.96	7.19 ^a ±0.99	7.20 ^a ±1.02	7.20 ^a ±1.15	7.39 ^a ±1.01
40	7.27 ^b ±0.90	6.91 ^b ±1.00	6.89 ^b ±1.00	6.81 ^b ±0.97	7.03 ^b ±1.04

^{a, b} The variables that are significantly different at a confidence level of 95%

Table 2: Physical properties of Karanda Sorbets at 3 different levels

Karanda juice (%)	Color index			Refractive index	Overrun value	Melt-down rate	Level of pH
	L*	a*	b*	Brix	%	%	pH
20	40.46	38.68	22.72	30	26.32	45.62	2.37
30	34.32	41.26	21.18	30	25.72	47.32	2.40
40	31.56	44.94	20.48	30	24.75	49.28	2.42

L* The brightness level, a* The redness level, b* The yellowness value

Table 3: Results of quality of senses for Karanda yogurt ice-cream at 3 different levels

Karanda juice (%)	Properties				
	Color	Smell	Taste	Texture	Overall satisfaction
10	7.41 ^a ±1.27	7.24 ^a ±1.22	7.77 ^a ±1.16	7.17 ^a ±1.21	7.67 ^a ±1.11
20	7.54 ^a ±1.08	6.97 ^b ±1.41	7.24 ^b ±1.50	7.01 ^a ±1.51	7.42 ^a ±1.23
30	6.72 ^b ±1.50	6.51 ^b ±1.45	6.48 ^c ±1.40	6.17 ^b ±1.38	6.48 ^b ±1.33

^{a, b, c}The variables that are significantly different at a confidence level of 95%

Table 4: Physical properties of Karanda yogurt ice-cream at 3 different levels

Karanda juice (%)	Color index			Viscosity index	Refractive index	Overrun value	Melt-down rate	Level of pH
	L*	a*	b*	Cps.	*Brix	%	%	pH
10	52.32	32.26	21.18	364.798	26	75.85	89.90	5.67
20	51.32	35.68	23.72	369.524	26	77.72	91.32	5.40
30	50.56	39.57	25.48	373.015	26	79.89	93.12	5.32

L* The brightness level, a* The redness level, b* The yellowness value

yogurt ice-cream at 10% concentration have a smooth texture of the ice-cream and the chewiness of Karanda flesh in the ice-cream. On the contrary, Karanda yogurt ice-cream at 20 and 30% concentration have a smooth texture, yet both have too much of the Karanda flesh blended in the ice-cream, resulting in excessive stickiness.

From Table 4, it is apparent that Karanda yogurt ice cream at 10% concentration is most accepted amongst the participants with the results as follow: brightness level is L*52.32; redness level is a*32.26; yellowness level is b*21.18; viscosity index is 364.798 cps; refractive index is 26°Brix; overrun value is 75.85%; melt-down rate in 30 min at room temperature is 89.90% and pH value is at 5.67. Upon blending the Karanda flesh into the ice-cream, the viscosity level increases due to the water content in the flesh.

Moreover, adding Karanda flesh into the yogurt ice-cream increases the color index, due to the red color of the flesh. Therefore with the addition of Karanda flesh, the resulting ice-cream becomes light pink with high level of moisture. The melt-down rate of the ice-cream ranges from 89.90-92.53%. Regardless, the melt-down rate depends on the transfer of heat from the environment into the ice-cream which causes the ice crystals to be melted. The melt-down rate will be initially low and will exponentially increase overtime (Muse and Hartel, 2004).

From Table 5, it can be concluded that a 100 g of Karanda Sorbets provides: 91.8 Kcal; 22.6 g of carbohydrates; >0.20 g of protein; 0.15 g of fats; 77.1% of moisture content; 0.11 g of fiber; 0.12 g of ash and pH level of 2.40. Meanwhile, a 100 g of Karanda yogurt ice-cream provides: 229 Kcal of energy; 17.0 g of carbohydrates; 3.24 g of protein; 16.4 g of fats; 64.0% of moisture content; 0.76 g of fiber; 0.74 g of ash and pH level of 5.67. Both types of Karanda products do not contain any vitamin C. This may be due to the fact that vitamin C are used in respiration and the molecules are

Table 5: The nutritional value of Karanda Sorbets and yogurt ice-cream, based on the quantity of 100 g

Chemical composition	Amount per serving: 100 g	
	Karanda Sorbets	Karanda yogurt ice-cream
Energy (Kcal)	91.8	214
Carbohydrates (g)	22.6	17.5
Protein (g)	<0.20	3.14
Fats (g)	0.15	14.6
Moisture (g)	77.1	64.0
Fiber (g)	0.11	0.76
Ash (g)	0.12	0.74
Vitamin C (g)	Non detected	Non detected
Level of pH (pH)	2.40	5.67

Table 6: Results of consumer's acceptance towards Karanda Sorbets and yogurt ice-cream

Details	No. of participants	Percentage
Do you accept Karanda Sorbets and yogurt ice-cream?		
Yes	150	100
No	0	0
Total	150	100

attached to carbon dioxide in the chemical synthesis of new compounds during the ripening process (Dechawongsatien, 1993). Additionally, Karanda is abundant in anthocyanin which consists of purple-red pigments that act as an antioxidant. Its antioxidant property is a thousand times more effective than that of vitamin C. Likewise, it provides various health benefits including reducing the blood sugar level, preventing heart diseases and cancer, promoting immune system, healing wounds and enhance activities of red blood cells.

According to Table 6, it can be observed that all of the 150 participants (100%) accepted Karanda Sorbets and yogurt ice-cream due to the sweet and sour taste as well as the attractive fragrance. The majority of participants accepted the products due to the perfect combination of the sweet and sour taste.

CONCLUSION

The appropriate quantity of Karanda juice for making Sorbets is 30% and the appropriate quantity of Karanda

flesh in the yogurt ice-cream is 10%. In terms of the chemical properties of the two products, it is found that a 100 g of Karanda Sorbets provide 91.8 Kcal of energy, 22.6 g of carbohydrates, <0.20 g of protein, 0.15 g of fats, 77.1% of moisture content, 0.11 g of fiber, 0.12 g of ash and pH value of 2.40. Alternatively, a 100 g of Karanda yogurt ice-cream provide 229 Kcal of energy, 17.0 g of carbohydrates, 3.24 g of protein, 16.4 g of fats, 64.0% of moisture content, 0.76 g of fiber, 0.74 g of ash and pH level of 5.67. In terms of consumer's acceptance towards the products, 100% of the participants accepted Karanda Sorbets and yogurt ice-cream.

SUGGESTIONS

There should be a study on the shelf life of Karanda Sorbets and yogurt ice-cream. There should be more studies on the development of Karanda products in food and beverages in order to create new products and choices for consumer. In addition, this would also serve as a pathway for government agencies to promote the agriculture economy.

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