Effect of Horse Mango (*Mangifera foetida*) Pulp on Quality and Consumer Acceptance of Sherbet Ice Cream

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Article info

Abstract

This objective of this research was to develop the local fruit of Thailand, horse mango (*Mangifera foetida*) into sherbet ice cream. Horse mango sherbet ice cream with 3 difference level of horse mango pulp (20, 40 and 60%) were study with physical quality, chemical quality microbiological quality and consumer acceptance. The results showed, yellowness color increasing related to quantity of horse mango pulp; so the 60% horse mango pulp content sherbet ice cream is the brightest yellow. Overrun value of 20, 40 and 60% horse mango pulp sherbet ice cream were 20.19 ± 0.91, 20.18 ± 0.32, 19.91 ± 0.37 respectively, it's statistically not significant ($p > 0.05$). The texture in each of the 3 levels of pulp was different, and increasing the horse mango pulp meant the firmness decreased. The melting rate was increased when increasing horse mango pulp. Energy, carbohydrate, protein, ash and retinol variation all increased when the level of of horse mango pulp increased. Microbiological quality followed Ministry of Public Health standards. Additionally, a higher concentration of fruit pulp increased the value of panelist's sensory score for color, odor, texture and overall acceptance.

Introduction

Horse mango (*Mangifera foetida*) is a native plant of south of Thailand and commonly found in tropical area as Malaysia, Indonesia, Myanmar and Singapore. Common name are malmut, limus, bachang and machang. This fruit in the family Anacardiaceae is in the same genus as mango so the shape similar to mango but mature have a strong exotic odor. Horse mango tree produce fruits during January to April while immature the skin is green color and change to yellow or golden yellow when mature. Horse mango is reported to typically contain that edible portion of 100 g flesh, it contains 78.5 g water, 0.8 g protein, 17.9 g carbohydrates, 16 mg calcium, 19 mg phosphorus, 0.09 mg thiamine, 255 µg carotenes, and 47.4 mg vitamin C. (Tyug et al., 2010). The raw fruit, because of acidic taste is used to make spicy salad, yellow curry or replaces as lime acid ingredient in shrimp paste dip, while ripened fruit was eaten flesh and less commonly to make dessert.

Ice cream is a product maintained at uniform consistency and prepared by pasteurization,

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homogenization, aeration and freezing. The main ingredients of ice cream are usually fat, nonfat dry milk, sweeteners, stabilizers, emulsifiers, water and flavoring agents (Badem & Alpkent, 2018) and it is a favorite dessert in Thailand, recognized worldwide and enjoyed by consumers of all ages. According to Food Intelligent Center, Thailand (2017) statistics; 13,850 million baht of ice cream were sold in 2017 and estimated ice cream market in Thailand will grow in the following years.

Nowadays healthy eating is a worldwide trend, the consumer looking forward to healthier material, one way is to add healthy ingredients with natural functions, such as fruit and vegetables.

Sherbet ice cream is one type of ice cream, main ingredients are water, sugar, fruit and/or fruit extracts, cream and a stabilizer. Sherbet ice cream has become a good choice of people who lookout for health, athletics, and weight control because this product contains both the nutritional value of fruit and the refreshing taste of frozen dessert.

For this reason, in this study, horse mango sherbet ice cream was produced and assess physical, chemical, biological and consumer acceptance to investigate the possibility of development about functional dessert from horse mango.

Materials and methods

1. Horse mango preparation

Horse mango was collected from Trang, Nakhon Sri Thammarat and Phatthalung provinces, ripening at room temperature. Healthy and undamaged horse mango were chosen for the preparation of the pulp. Ripe specimens were selected when they had 20% yellow peel, yellow flesh, correct odour and having a diameter of 8-10 centimeter as shown in Fig.1. They were cleaned with water to remove dirt and insects, peeled and washed again to eliminate the mango sap. They were then cut into small enough pieces for a blender to work, and blended for 2 minutes until smooth and finally filtered by 60 mesh sieves to become horse mango pulp as shown in Fig.2. Total soluble solid of horse mango pulp was used hand refractometer (Optika Model : HR-130, Italy), TSS value was 4°Brix. The pH value was 4, it was used a digital pH meter (Mettler toledo Model: Seven Compact pH meter, S210-Bio, Switzerland).

2. Preparation Horse mango to sherbet ice cream

Study maximized Horse mango pulp quantity to horse mango sherbet ice cream with 3 different level are 20%

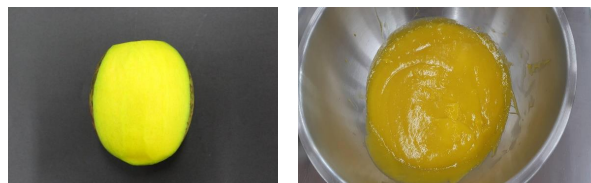**Fig. 1** Characteristic of horse mango from unripe to ripe

Fig. 2 preparation the horse mango to horse mango pulp

40% and 60%, as shown in Table 1. The process and details of horse mango pulp sherbet was presented in Fig. 3.

Table 1 Ingredient of sherbet ice cream from 3 formulas in different horse mango pulp

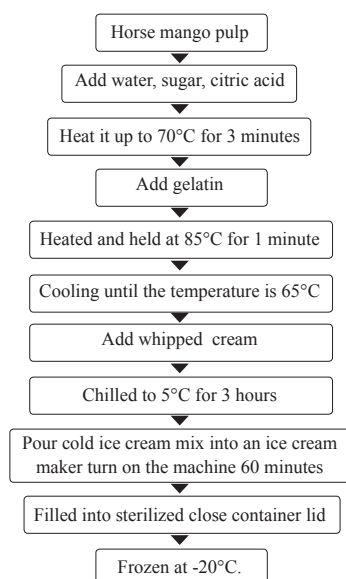| Ingredient	Quantity of horse mango pulp (%)		
	20	40	60
Horse mango pulp	20.0	40.0	60.0
Water	57.4	37.4	17.4
Sugar	15.7	15.7	15.7
Citric acid	0.1	0.1	0.1
Gelatin	0.1	0.1	0.1
Whip cream	6.7	6.7	6.7

Remark: Modify from Manfah & Nivet (2015)

Fig. 3 The process of horse mango sherbet

3. Selection formula of horse mango sherbet ice cream

Horse mango sherbet ice cream 3 formulas was selected by sensory characteristic evaluation. The test used a 9 point hedonic scale (1 = disliked very much and 9 = liked very much) (Rawendra & Dwi, 2020). The sensory panel was composed of 50 untrained subjects whom were selected randomly from students, staffs and lecturers at Suan Dusit University, Trang Center. Horse mango sherbet ice cream was evaluated in the following aspects; color, odor, flavor, texture and overall acceptability. The judges evaluated the 3 formula of mango sherbet ice cream in the same session. The sample of horse mango sherbet ice cream were served at temperature -10°C in white cups coded with a 3 digit number. The panelists were evaluated individually in a random order, drinking to clean the mouth before and between evaluations of formula (Januario et al., 2018). All formula were statistically analyzed, and studied for their physical, chemical and microbiological characteristics. Then the formulas that received the highest scores were taken to a consumer acceptance test.

4. Quality of horse mango sherbet ice cream

4.1 Physical quality

4.1.1 Determined of color value using Hunter Lab Color Flex (Model A60-1012-312, Hunter Associates Laboratory Inc., USA). The measurements were show as L*(lightness), a*(redness) and b*(yellowness).

4.1.2 Determined of overrun of the ice cream were calculated using the equation by Muse & Hartel (2004)

$$\text{Overrun} = \frac{\text{Weight of mix} - \text{Weight of ice cream}}{\text{Weight of ice cream}} \times 100$$

The overrun was shown the increase volume caused the corporation of air into the ice cream mixture during ice cream making.

4.1.3 Texture analysis (firmness), the texture of ice cream was determined by texture analyzer (Model: TA-XTPlus). The firmness test using the 1 cm. diameter cylinder probe with target value 5.5 cm, speed test was 2 mm./s., load cell of 1 kN.

4.1.4 The melting test was carry out according to the procedure suggested by Garcia et al. (1995.) The samples were cooled to -20°C for 24 hours. 100 grams of each sample was placed individually on wire mesh attached to cylinder, with the cylinder, mesh, all equipment and the surrounding temperature all at 25°C. The ice cream that dripped through the cylinder was weighed.

4.2 Chemical quality

Proximate compound of mango sherbet ice cream including moisture, fat, protein, carbohydrate and ash were analyzed according to AOAC (2005) official method.

4.3 Microbiological Quality

Microbiological analysis of mango sherbet ice cream were total plate count and yeast and mold by FDA, BAM (Maturin & Peeler, 2001)

4.4 Consumer acceptance test

The horse mango sherbet ice cream which received high score from sensory test was tested for consumer acceptance test using the 5 points hedonic scale. The sensory test evaluated appearance, color, odor, flavor, texture and overall acceptability. The 100 untrained individual panelists were selected randomly at Huay Yod district, Trang province.

5. Statical analysis

The statical analysis was used SPSS software (SPSS Version 17; SPSS Inc., Chicago, USA). Analyzed data by ANOVA and using Duncan's New Multiple Range Test for identify difference of mango sherbet ice cream treatments at the 95% confidence level ($p < 0.05$).

Results and discussion

1. Physical quality

1.1 Color

The color of horse mango sherbet ice cream with 3 different pulp at; 20%, 40%, and 60% showed that the sherbet ice cream are yellow because of the characteristics of the Horse mango pulp as shown in Fig.4. The color measurement data is present in Table 2 regarding color values, lightness (L*) of horse mango pulp 20% and 40% were significantly different at $p < 0.05$ from 60%. The redness (a*) value of all 3 formulars decreased with a higher amount of mango horse pulp and were not significantly different at $p \geq 0.05$. While yellowness (b*) value of all formulars increase and were significantly different at $p < 0.05$. This result was similar to the result of Rattanathanalerk et al. (2005) study effect of thermal processing on the quality loss of pineapple juice, the resulted showed that pineapple juice changed color because of non-enzymatic browning and pigment destruction more than enzymatic browning since enzymes are damaged at 50°C. Hyoung & Gary (2003) studied effect of thermal pasteurization on Valencia orange juice color and pigments reported that total carotenoid pigment content loss was significant ($p < 0.05$) after thermal

pasteurization at 90°C for 30 s. Color change after orange juice pasteurization, led to juice color becoming lighter. According to Petruzzi et al. (2017) suggested that heating processing led to a degradation of color.

Table 2 Color quality of difference level of horse mango pulp sherbet ice cream

Color	Horse mango sherbet ice cream		
	Horse mango pulp 20% (w/w)	Horse mango pulp 40% (w/w)	Horse mango pulp 60% (w/w)
L*	71.06 ± 1.69^a	71.04 ± 1.01^a	67.40 ± 0.60^b
a*[ns]	-1.14 ± 0.26	-1.16 ± 0.38	-1.19 ± 0.28
b*	19.87 ± 1.45^c	27.51 ± 1.24^b	36.99 ± 1.03^a

Remark: a, b, c superscripts with different letters in the same row are significantly different ($p < 0.05$) and ns is not significantly different ($p \geq 0.05$), all value are mean ± S.D. for three samples.
L* : Brightness a* Redness b* Yellowness

Fig. 4 Characteristic of horse mango sherbet ice cream 20% 40% and 60% respectively

1.2 Overrun value, melting rate and texture

The calculated overrun was shown in Table 3. All of horse mango sherbet ice creams had overruns between 19.91-20.19%, it's shown that increase of horse mango pulp no effect to overrun so all formular of difference level of horse mango pulp in sherbet ice cream were not significantly different ($p > 0.05$). In part of texture measurement, while increasing proportion of horse mango pulp the texture is softer as shown in Table 3. The force used to deform of ice cream with horse mango pulp 20% 40% 60% are 231.33 ± 6.77, 141.88 ± 15.47 and 71.55 ± 6.57 g force, respectively. All 3 levels of sherbet ice cream texture were significant ($p < 0.05$).

Table 3 Overrun and texture quality of horse mango sherbet ice cream

Quality	Horse mango sherbet ice cream		
	Horse mango pulp 20%	Horse mango pulp 40%	Horse mango pulp 60%
Overrun[ns]	20.19 ± 0.91	20.18 ± 0.32	19.91 ± 0.37
Texture: firmness (g Force)	231.33 ± 6.77^a	141.88 ± 15.47^b	71.55 ± 6.57^c

Remark: a, b, c superscripts with different letters in the same row are different ($p < 0.05$), all value are mean ± S.D. for three samples.
ns shown that there is no statistically significant differences ($p \geq 0.05$)

The melting rate, Melting rate is one of the most important characteristics of ice cream, this parameter was shown to be the amount of time it took ice cream to become a liquid of smooth consistency. In this case, the melting test was carry out at room temperature of 25 ± 2°C with the the humidity at 60%. The melting rate showed in Fig. 5. The result showed that first 10 minutes the ice cream of all 3 formulas no turned to liquid. They started to soft at 15-20 minutes, turned to liquid 10% after 25 minutes. and continue dissolve until complete dissolve at 60 minutes. And the horse mango sherbet ice cream with 60% pulp turned into liquid faster than other formula.
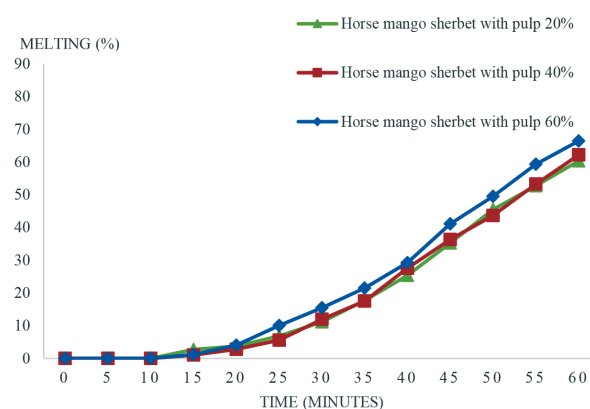

Fig. 5 Melting rate of the horse mango sherbet ice cream

This results were in agreement with Sofjan & Hartel (2004) who reported that the ice cream that has a low overrun value were melt faster, while ice cream with high overrun have a better resistance to melting properties. This is because the heat transfer rate is reduced with greater air volume. This is because higher viscose ingredient will limit the mobility of water molecules due to the space between the particles in the mixture is getting narrower. The space between the narrow particles will cause the air entering the mixture during the agitation process to be less, resulting in lower overrun value.

2. Chemical quality

In this study, the chemical analysis carried out was energy, carbohydrate, fat, protein, ash, retinal and water content are presented in table 4. All 3 levels of sherbet ice cream in part of energy, carbohydrate, retinol and water content were significant ($p < 0.05$). Fat, protein and ash found that the horse mango pulp 40% and 60% were not significantly different at $p \geq 0.05$ but were significant ($p < 0.05$) with horse mango pulp 20%. It can

be seen that increase of horse mango pulp was found to cause an increase in all chemical composition.

Table 4 Chemical composition of horse mango sherbet ice cream

Component	Horse mango sherbet ice cream (100 g)		
	horse mango pulp 20%	horse mango pulp 40%	horse mango pulp 60%
Energy (kcal)	109.02 ± 0.70[c]	123.90 ± 0.16[b]	128.04 ± 0.51[a]
Carbohydrate (g)	19.90 ± 0.06[c]	23.00 ± 0.12[b]	23.80 ± 0.17[a]
Fat (g)	3.10 ± 0.10[b]	3.30 ± 0.06[a]	3.40 ± 0.10[a]
Protein (g)	0.38 ± 0.02[b]	0.55 ± 0.03[a]	0.56 ± 0.02[a]
Ash (g)	0.16 ± 0.01[b]	0.32 ± 0.02[a]	0.52 ± 0.02[a]
Retinol (mg)	0.02 ± 0.01[b]	0.04 ± 0.01[b]	0.06 ± 0.03[a]
Water content (%)	76.50 ± 0.06[a]	72.90 ± 0.01[b]	71.70 ± 0.06[c]

Remark: a, b, c superscripts with different letters in the same row are different ($p < 0.05$), all value are mean ± S.D. for three samples.

3. Microbial content

The microbial content of horse mango sherbet ice cream was show in Table 5. The result show that horse mango sherbet of all 3 formulars are in accordance with the Notification of the Ministry of Public Health No.354 B.E.2556 (Thailand Public Health, 2013) issue ice cream which determined total plate count does not exceed 6×10^5 colony, not found yeast and mold per 1 cm^3 and the number of *E.coli* should be zero per 100 g of ice cream. The result of microbiological value was not exceeding the standard due to the process was sterilize and freeze.

Table 5 Microbial content of horse mango sherbet ice cream

Microbiological	Horse mango sherbet ice cream		
	horse mango pulp 20%	horse mango pulp 40%	horse mango pulp 60%
Total plate count (CFU/ml)	< 10	< 10	< 10
Yeast and mold (CFU/ml)	Not detected	Not detected	Not detected
Escherichia coli (100 ml)	Not detected	Not detected	Not detected

4. Sensory test

Sensory assessment of ice cream consists of sense of color, odor, horse mango flavor, texture and overall acceptance. The 50 panelists present the score show as Table 6, the horse mango sherbet ice cream with 60% pulp received highest score all attributes of ice cream except horse mango flavor got lowest score. Hence increasing the horse mango pulp effected to liking score of horse mango sherbet ice cream but decrease in flavor. Panelist's opinion that horse mango sherbet flavor is too strong at a high concentration, so the panelists prefer horse mango ice cream with a lower concentration.

Table 6 Sensory test of horse mango sherbet ice cream in difference level of mango pulp

Sensory attribute	Horse mango sherbet ice cream		
	horse mango pulp 20%	horse mango pulp 40%	horse mango pulp 60%
Color	6.32 ± 1.49[b]	7.50 ± 1.11[a]	7.88 ± 1.04[a]
Odor	6.62 ± 1.18[b]	7.18 ± 1.37[a]	7.50 ± 1.23[a]
Horse mango flavor	7.42 ± 1.34[a]	7.14 ± 1.28[ab]	6.86 ± 1.64[b]
Texture	6.56 ± 1.54[b]	7.36 ± 1.32[a]	7.64 ± 1.24[a]
Overall liking	6.76 ± 1.36[b]	7.48 ± 1.07[a]	7.50 ± 0.91[a]

Remark: a, b superscripts with different letters in the same row are different ($p < 0.05$), all value are mean ± S.D. for three samples.

5. Consumer acceptance test

The horse mango sherbet ice cream for 60% pulp was sensory test for 100 untrained individuals (62 men and 38 women). Most of panelists were aged under 20 years old, most of them are students (59%), most of them had education levels below bachelor degree (60%) and average income per month less than or equal to 10,000 Baht (65%). Consumer behavior showed 80% of consumer decision the ice cream with flavor first, frequency of eating ice cream 1-2 times/week (59%) and buy ice cream product at convenient store (46%).

The consumer acceptance test on 4 aspects are color, odor, texture and overall acceptance as shown in Fig.6. The result showed the color scoring was 4.18, which was high; odor scoring was 4.00 which was high; textural scoring was 4.05, which was high and overall acceptance was 4.00, which was high. The consumer decision buys this ice cream if release to market (76%).
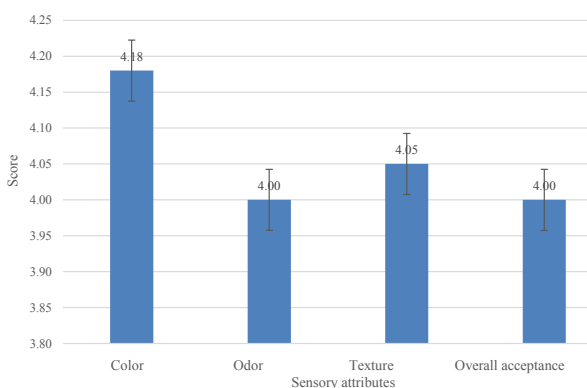

Fig. 6 Acceptance score of horse mango sherbet ice cream

Conclusion

This study showed that increasing horse mango pulp related to increase of yellowness, not difference for

overrun, decrease for hardness and high melting rate. Chemical quality, increase horse mango pulp show all composition (energy, carbohydrate, protein, ash and retinol) were increasing. Microbiological quality follow to notification of the ministry of public health, Thailand and the addition of fruit pulp with higher concentration increase the value of panelist's sensory score for color, odor, texture and overall acceptance. So, the 60% horse mango pulp suitable to be sherbet ice cream.

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