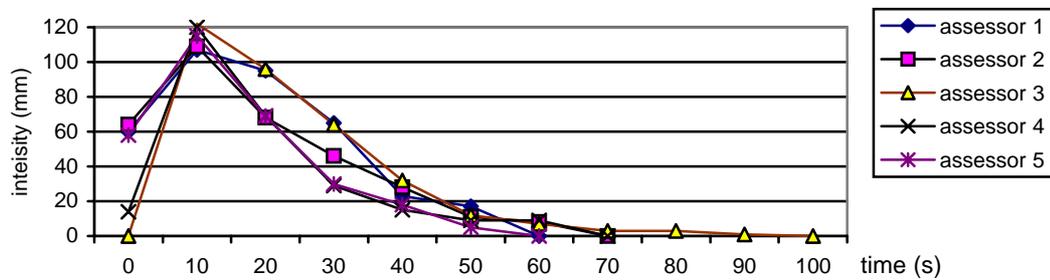
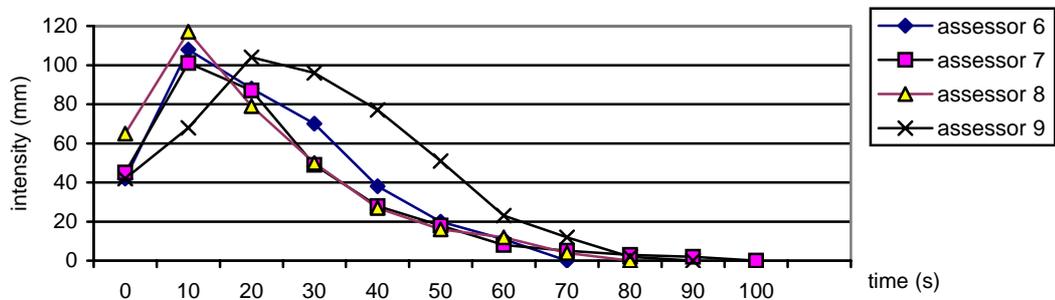


c. increasing to maximum intensity of astringency in 10s followed by fast decreasing at a rate of 42/s (example, assessor 1,2,5,6,7,8)



(a)



(b)

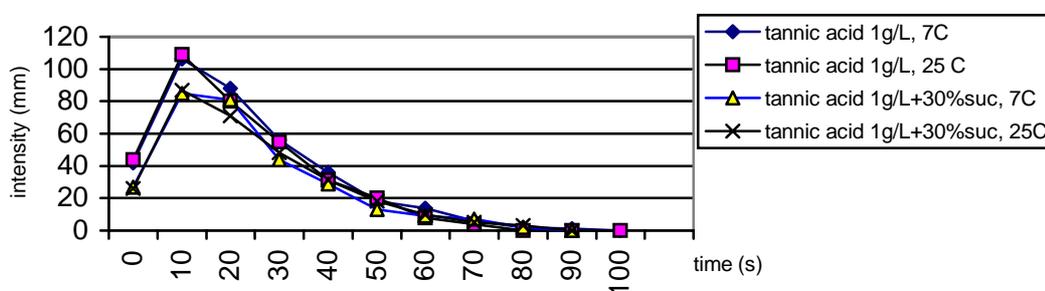
**Figure 7** Time-intensity curves for a single assessment of tannic acid solution 1 g/l for each of 9 assessors. Increasing time-intensity scores are indicative of increasing astringency.

Time-intensity characteristic of tannic acid solution was determined at concentration of 1 g/l., average results of 9 assessors are shown in [Table 12](#) and [Figure 8](#). The astringency was perceived as nearly the same both at 7 and 25 °C. The maximum intensity of tannic acid solution were more than 106 mm. The maximum intensity was observed at within 10s after swallowing, some residual astringency was detected even after 100s after swallowing.

**Table 12** Time-intensity course in astringent solutions ,the results of tannic acid solution ( 1 g/l ) obtained with use of paper ballot 150 mm line scale.

Time interval recorded	Tannic acid 1g/l		Tannic acid 1g/l +sucrose 300g/l	
	at 7 °C (mm)	at 25 °C (mm)	at 7 °C (mm)	at 25 °C (mm)
0 s (In the mouth)	42	44	27	26
After 10 s	106	109	85	87
After 20 s	88	80	81	71
After 30 s	56	55	44	48
After 40 s	36	31	29	30
After 50 s	18	20	13	17
After 60 s	14	8	9	10
After 70 s	6	4	7	5
After 80 s	2	2	2	3
After 90 s	1	0	0	0
After 100 s	0	0		
I max(mm of scale)	106 <sup>a</sup>	109 <sup>a</sup>	85 <sup>b</sup>	87 <sup>b</sup>
T max (s)	10 <sup>ns</sup>	10 <sup>ns</sup>	10 <sup>ns</sup>	10 <sup>ns</sup>
T total (s)	100 <sup>a</sup>	90 <sup>b</sup>	90 <sup>b</sup>	90 <sup>b</sup>

Note: means with different superscripts within in the same row were significantly different ( $p \leq 0.05$ ).



**Figure 8** Time-intensity characteristics of tannic acid solution at 7 and 25 °C.

Results obtained using a solution of tannic acid 1 g/l added 30% of sucrose are average of 27 responses by the same person as in assessing the tannic acid solution. The maximum intensity was lower than in case of only one tannic acid solution significantly. The maximum value was reached at 10s after swallowing, some residual astringency remaining even after 90s after swallowing. Sucrose was found to suppress the astringency feeling in human mouth may be due to the masking effect on the receptor of tongue.

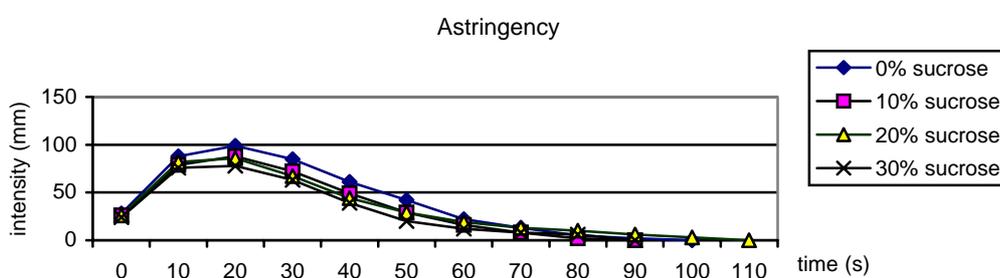
### Sweetness

As the level of sucrose was raised, all astringency TI parameters decreased significantly as illustrated in [Figure 9](#) and [Table 13](#) [ I max :  $F(3,320) = 10.674$ ,  $P < 0.0001$ ; T max :  $F(3,320) = 4.153$ ,  $P < 0.0001$ ; T total :  $F(3,320) = 7.809$ ,

**Table 13** Time-intensity characteristics of dry Mafai Jeen with 0, 10, 20, and 30% sucrose.

Treatment	Maximum Intensity (mm)	Reduction rate of astringent (mm)	Time to maximum (s)	Time of disappearance of astringency (s)
0% sucrose	109 <sup>a</sup>	-	21 <sup>a</sup>	71 <sup>a</sup>
10% sucrose	97 <sup>b</sup>	-12	19 <sup>ab</sup>	64 <sup>b</sup>
20% sucrose	95 <sup>bc</sup>	-2	17 <sup>b</sup>	63 <sup>b</sup>
30% sucrose	89 <sup>c</sup>	-6	17 <sup>b</sup>	60 <sup>b</sup>

Note: means with different superscripts within in the same row were significantly different ( $p \leq 0.05$ )

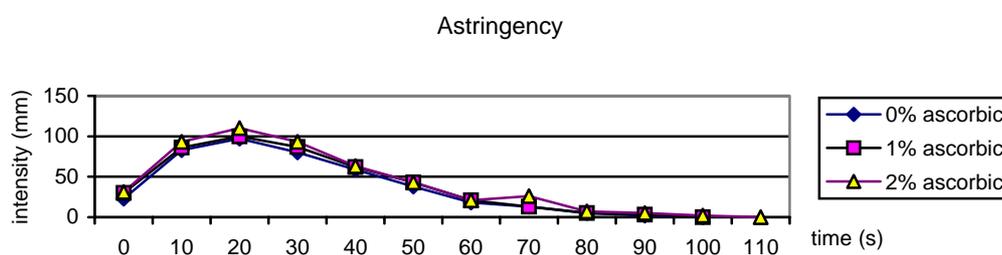


**Figure 9** Time-intensity characteristics of dry Mafai Jeen with 0, 10, 20, and 30% sucrose.

$P < 0.0001$ ]. Both astringency time to maximum and time of disappearance decreased significantly with increasing sucrose concentration. Significant negative correlations were found between astringency and sweetness.

### Sourness

As illustrated in [Figure 10](#) and [Table 14](#), Time-intensity characteristics of dry Mafai Jeen with 0, 1, and 2% of ascorbic acid. As the ascorbic acid concentration was raised, all astringency TI parameters increased significantly.

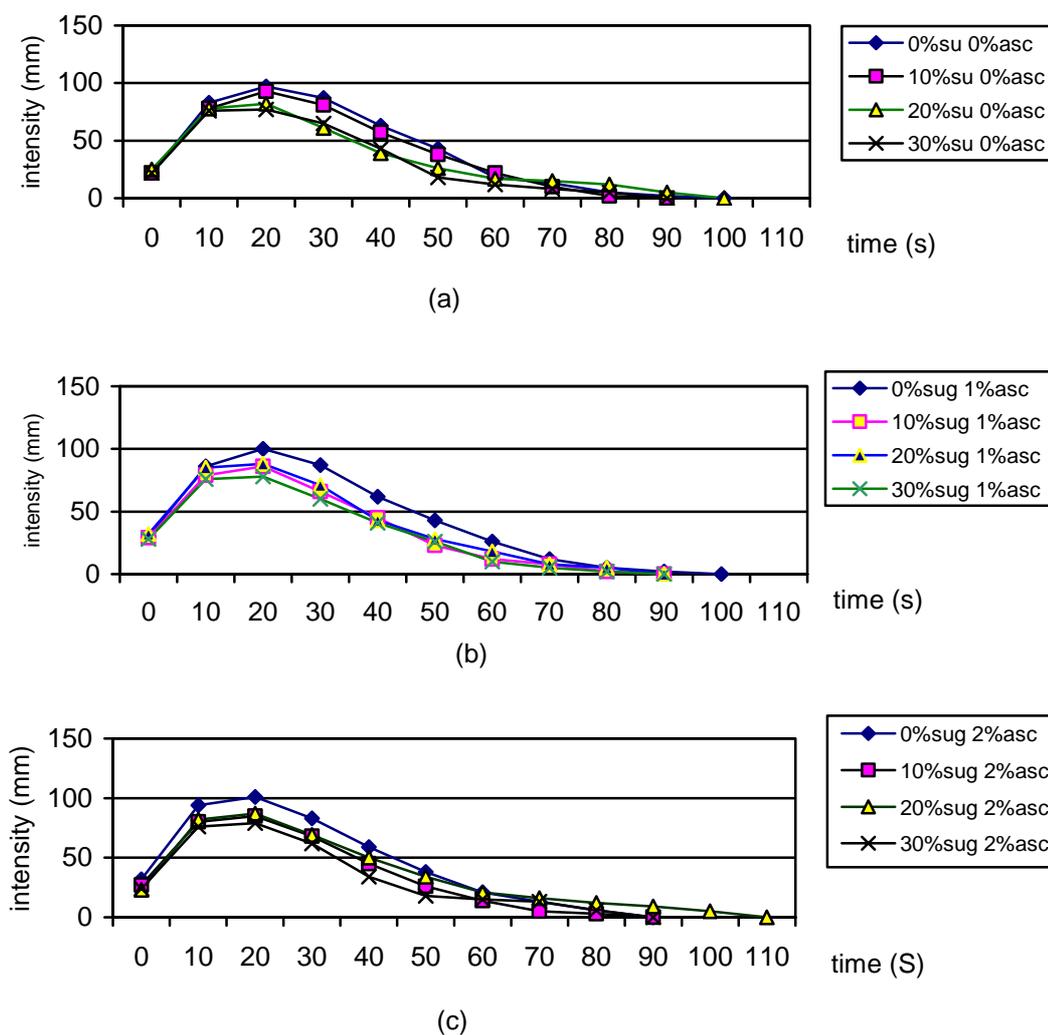


**Figure 10** Time-intensity characteristics of dry Mafai Jeen with 0, 1, and 2% of ascorbic acid.

**Table 14** Time-intensity characteristics of dry Mafai Jeen with 0, 1, and 2% of ascorbic acid.

Treatment	Maximum intensity (mm)	Increased rate of astringent (mm)	Time to maximum (s)	Time of disappearance of astringency (s)
0% Ascorbic acid	97 <sup>b</sup>	-	20 <sup>a</sup>	66 <sup>b</sup>
1% Ascorbic acid	102 <sup>b</sup>	+5	18 <sup>b</sup>	68 <sup>b</sup>
2% Ascorbic acid	111 <sup>a</sup>	+9	18 <sup>b</sup>	73 <sup>a</sup>

Note: means with different superscripts within in the same row were significantly different ( $p \leq 0.05$ ).



**Figure 11** Time-intensity characteristics of dried Mafai Jeen at 0, 1, 2% ascorbic acid and 0, 10, 20, 30, 40% sucrose.

Dried Mafai Jeen contains significant amount of the sucrose (%) and ascorbic acid (%). Therefore, we studied the effect of this addition of sucrose and ascorbic acid on the intensity of astringent taste. The effect of the ingredients and their combinations on the maximum astringency ( $I_{max}$ ), the time to reach the maximum ( $T_{max}$ ), and the rate of disappearance of astringency are shown in [Figure 11](#) and [Table 15](#). It showed significant differences between the samples of difference composition of dried Mafai Jeen, when increasing sucrose, the astringency decreased significantly.

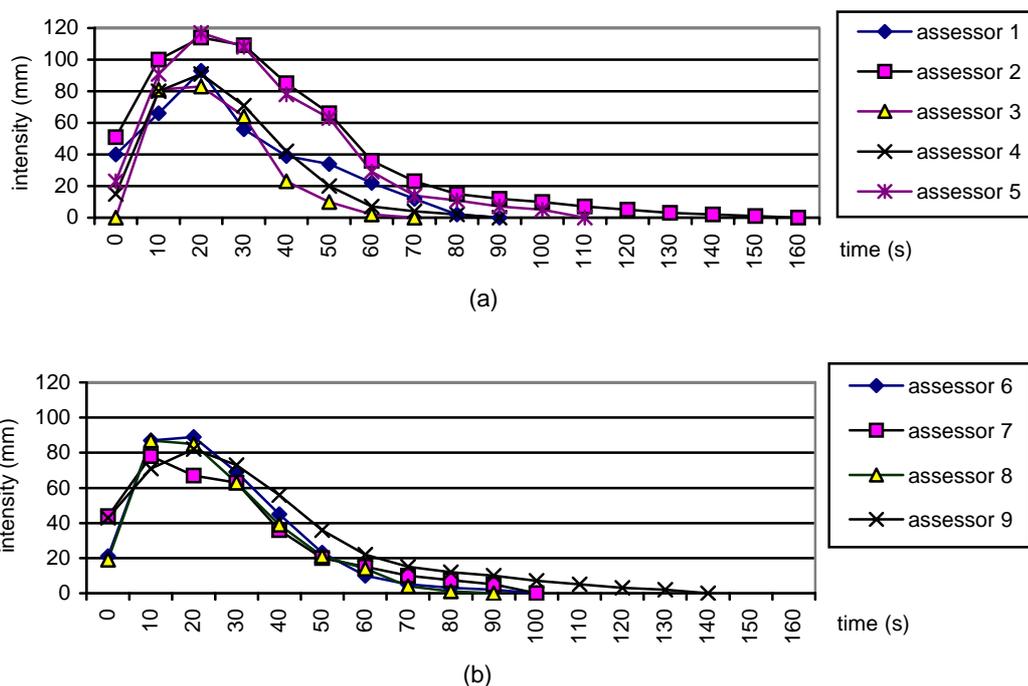
**Table 15** Time-intensity of dried Mafai Jeen modified by additions of taste active substances.

Treatment	Maximum intensity (mm)	Intensity change (mm)	Time to maximum (s)	Time of disappearance of astringency (s)
0% sucrose, 0% ascorbic	106 <sup>abc</sup>	0	22 <sup>a</sup>	69 <sup>abc</sup>
10% sucrose, 0% ascorbic	99 <sup>bcd</sup>	-7	22 <sup>a</sup>	69 <sup>abc</sup>
20% sucrose, 0% ascorbic	94 <sup>bcd</sup>	-5	18 <sup>ab</sup>	62 <sup>bcd</sup>
30% sucrose, 0% ascorbic	90 <sup>d</sup>	-4	18 <sup>ab</sup>	64 <sup>bcd</sup>
0% sucrose, 1% ascorbic	107 <sup>ab</sup>	0	22 <sup>a</sup>	73 <sup>a</sup>
10% sucrose, 1% ascorbic	96 <sup>bcd</sup>	-11	17 <sup>b</sup>	60 <sup>cd</sup>
20% sucrose, 1% ascorbic	97 <sup>bcd</sup>	+1	17 <sup>b</sup>	61 <sup>cd</sup>
30% sucrose, 1% ascorbic	92 <sup>cd</sup>	-5	17 <sup>b</sup>	58 <sup>d</sup>
0% sucrose, 2% ascorbic	115 <sup>a</sup>	0	19 <sup>ab</sup>	70 <sup>ab</sup>
10% sucrose, 2% ascorbic	97 <sup>bcd</sup>	-18	18 <sup>ab</sup>	62 <sup>bcd</sup>
20% sucrose, 2% ascorbic	96 <sup>bcd</sup>	-1	18 <sup>ab</sup>	65 <sup>abcd</sup>
30% sucrose, 2% ascorbic	84 <sup>d</sup>	-12	16 <sup>b</sup>	58 <sup>d</sup>
Fresh fruit	109 <sup>a</sup>		19 <sup>ab</sup>	77 <sup>a</sup>

Note: means with different superscripts within in the same row were significantly different ( $p \leq 0.05$ ).

**Figure 12;** illustrated the average curves for each assessor from dried Mafai Jeen. The data were averaged over approximately 36 individual curves. The shapes of the curves were 3 types:-

- 1) Assessor 2 and 5 evaluated astringency as high score and take long time to disappearance.
- 2) Assessor 7 found the time to maximum reaching fastest.
- 3) The curves of assessor 1, 3, 4, 6, 8, 9 were in the middle.



**Figure 12** Average curves for each assessor from dried Mafai Jeen. Each curve is averaged over approximately 36 individual curves. Increasing time-intensity scores are indicative of increasing astringency.

#### **4. To Develop Mafai Jeen Candy with Shelf Life Study**

##### 4.1 Plant Material Qualities

The chemical analysis on fresh fruit of Mafai Jeen showed that the measured pH value was 3.3 (Table 16). Therefore Mafai Jeen is considered to be a high acid food. It has acidity of 0.77%. The total soluble solid was also high at 14.5 °Bx, with 6.12% total sugar and 4.06% reducing sugar. The Mafai Jeen fruit is juicy and contained 71.91% moisture. It has light green and light yellow shade, color read as  $L^*$   $a^*$   $b^*$  were 38.95, 2.61, and 17.94, respectively.

Table 16 The qualities of fresh Mafai Jeen fruits for this experiments.

Qualities attribute	Mean values
pH	3.30 ±0.07
Total soluble solid (°Bx)	14.50 ±1.40
Reducing sugar (%)	4.06 ±0.06
Total sugar (%)	6.12 ±0.08
Acidity (%)	0.77 ±0.01
Moisture (%)	71.91 ±1.83
Color <i>L</i> *	38.95 ±1.65
<i>a</i> *	2.61 ±0.17
<i>b</i> *	17.94 ±0.87

## 4.2 Development of Mafai Jeen Candy

### 4.2.1 Focus Group Discussion

The responses and conclusion for all question discussed in the focus group sessions were summarized as followed.

#### 1) Consumers' perceptions of a healthy food.

The participant had different understanding about the perception of a healthy food. Some believed that a healthy food was a “varied and well balanced diet”; others believed that a healthy food was a “lot of fruits and vegetables”. There was a strong agreement among respondents that a “healthy food” is foods as natural as possible without pesticides used in the production of a food.

2) If you were asked to make a suggestion to develop the Mafai Jeen fruit products, what would be your most suggested product?

During discussion, the products of the other fruit candy, tablets, and beverage were presented. Two-third of participants in all three groups mentioned fruit candy as the most suggested and all focus groups commented about the importance of improving accountability as the product should contain natural color or no artificial flavors, the least sucrose content, smooth mouth feel, and moderately sour taste. Convenience packed that are individually wrapped were preferred by most to minimize losses.

Some participants in all focus groups suggested to develop Mafai Jeen fruit tablet, Mafai Jeen fruit drink, Mafai Jeen tea,

One participant expressed an interest in exploring the possibility of allowing essential oils to be ingredient-based for hard candy.

3) Of all the new product we discussed, which one is most important attribute to you?

The product should be made from natural ingredient was most mentioned by participants in all focus groups.

The nutritional and healthy benefits of product were frequently mentioned.

4) Is there anything we should have talked about but didn't?

Some participants mentioned regulations. They would like the regulations to be clearer. They expressed a need for an explanation for the nutritional and healthy benefits to be provided on the product packaging.

A FGDs among of 3 sessions indicated that healthy natural Mafai Jeen candy product was required. The product should contain no synthetic color or

artificial flavors, the least sucrose content, smooth mouth feel, and moderately sour taste.

#### 4.2.2 The Sucrose and Glucose Syrup Concentration in the Recipe

The effect of glucose syrup and sucrose concentration on hardness, moisture,  $a_w$ , and color value were shown in Table 17. Glucose syrup concentration had no effect ( $p>0.05$ ) on % moisture but reduced ( $p<0.05$ ) hardness,  $a_w$ , color  $L^*$  value, and increased color  $b^*$  value. Sucrose concentration had no effect ( $p>0.05$ ) on color  $a^*$  value, but reduced ( $p<0.05$ ) hardness, moisture, color  $L^*$  value, and color  $b^*$  value. A significant ( $p<0.05$ ) interaction between glucose syrup and sucrose concentration was also observed for hardness and color  $L^*$  value. Hardness values decreased while sucrose increased, the hardness value of Mafai Jeen fruit candy were 11.68-18.36. No significant interaction ( $p>0.05$ ) was observed for moisture,  $a_w$ , color  $a^*$  value, and color  $b^*$  value.

The effect of glucose syrup and sucrose concentration on sensory attribute; color, taste, sweet, texture, and overall acceptance were shown in Table 18. Glucose syrup concentration had no effect ( $p>0.05$ ) on color, but significant different ( $p<0.05$ ) on taste, sweetness, texture, and overall acceptance. The mean scores of 5% glucose syrup showed the highest acceptance for all sensory attributes. Sucrose concentration had significant different ( $p<0.05$ ) on color, taste, sweetness, texture, and overall acceptance. The mean scores of 35% sucrose shown the highest acceptance for all sensory attributes. No significant interaction ( $p>0.05$ ) was observed for all sensory attributes.

In conclusion, the 35% of sucrose and 5% of glucose syrup were consider to used for furthered experiment in the next topic due to highest score in sensory acceptance test.

**Table 17** Effect of glucose syrup and sucrose concentration on hardness, moisture,  $a_w$ , and color value of Mafai Jeen candy.

Treatment	Hardness	Moisture (%)	$a_w$	Color value		
				$L^*$	$a^*$	$b^*$
A: Glucose syrup (%)						
0	17.39 <sup>a</sup>	6.44 <sup>ns</sup>	.590 <sup>a</sup>	52.42 <sup>a</sup>	1.77 <sup>b</sup>	22.80 <sup>b</sup>
5	13.84 <sup>b</sup>	6.47 <sup>ns</sup>	.567 <sup>b</sup>	51.25 <sup>ab</sup>	1.33 <sup>b</sup>	22.44 <sup>b</sup>
10	12.73 <sup>c</sup>	6.39 <sup>ns</sup>	.578 <sup>ab</sup>	49.88 <sup>b</sup>	3.37 <sup>a</sup>	27.41 <sup>a</sup>
Significant level	0.000	ns	0.031	0.033	0.003	0.000
B: Sucrose (%)						
20	18.36 <sup>a</sup>	7.22 <sup>a</sup>	.603 <sup>a</sup>	53.70 <sup>a</sup>	2.11 <sup>ns</sup>	27.19 <sup>a</sup>
25	16.36 <sup>b</sup>	6.95 <sup>a</sup>	.593 <sup>ab</sup>	52.15 <sup>ab</sup>	2.27 <sup>ns</sup>	25.72 <sup>b</sup>
30	13.83 <sup>c</sup>	6.51 <sup>ab</sup>	.553 <sup>c</sup>	51.72 <sup>ab</sup>	2.40 <sup>ns</sup>	24.35 <sup>c</sup>
35	13.03 <sup>cd</sup>	5.81 <sup>b</sup>	.566 <sup>bc</sup>	50.40 <sup>b</sup>	2.09 <sup>ns</sup>	22.70 <sup>d</sup>
40	11.68 <sup>d</sup>	5.69 <sup>b</sup>	.572 <sup>bc</sup>	47.91 <sup>c</sup>	1.92 <sup>ns</sup>	21.14 <sup>e</sup>
Significant level	0.000	0.014	0.013	0.004	ns	0.000
Interaction A x B						
Significant level	0.000	ns	ns	0.017	ns	ns
Glucose syrup / sucrose (%)						
0 / 20	21.01	7.71	0.628	55.28	2.49	24.94
0 / 25	19.77	6.39	0.608	53.57	2.21	24.79
0 / 30	17.35	6.82	0.583	52.85	1.82	22.82
0 / 35	14.98	5.77	0.561	51.34	1.41	21.26
0 / 40	13.85	5.53	0.573	49.06	0.94	20.23
5 / 20	17.92	7.49	0.591	52.04	1.62	26.73
5 / 25	14.83	7.11	0.584	51.30	1.53	23.72
5 / 30	12.46	6.13	0.541	52.67	1.45	22.29
5 / 35	13.08	5.68	0.566	51.92	1.22	20.91
5 / 40	10.94	5.94	0.553	48.35	0.87	18.58
10 / 20	16.15	6.46	0.605	53.90	2.22	29.92
10 / 25	14.49	7.35	0.589	51.59	3.09	28.65
10 / 30	11.70	6.58	0.535	49.65	3.94	27.95
10 / 35	11.05	5.99	0.571	47.95	3.65	25.94
10 / 40	10.27	5.61	0.592	46.34	3.97	24.62

abc, means followed by the different letter within a column are significantly different ( $p \leq 0.05$ ).

ns, not different (no significant;  $p > 0.05$ ).

**Table 18** Effect of glucose syrup and sucrose concentration on sensory attribute; color, taste, sweet, texture, and overall acceptance of Mafai Jeen candy.

Treatment	Color	Taste	Sweetness	Texture	Overall acceptance
<b>A: Glucose syrup (%)</b>					
0	6.19 <sup>ns</sup>	5.14 <sup>b</sup>	4.95 <sup>c</sup>	4.81 <sup>c</sup>	4.86 <sup>b</sup>
5	6.34 <sup>ns</sup>	6.38 <sup>a</sup>	6.51 <sup>a</sup>	6.69 <sup>a</sup>	6.59 <sup>a</sup>
10	6.13 <sup>ns</sup>	5.67 <sup>ab</sup>	5.45 <sup>b</sup>	5.35 <sup>b</sup>	5.17 <sup>b</sup>
Significant level	ns	0.016	0.000	0.000	0.000
<b>B: Sucrose (%)</b>					
20	6.09 <sup>b</sup>	4.92 <sup>b</sup>	4.72 <sup>b</sup>	4.71 <sup>d</sup>	4.80 <sup>c</sup>
25	5.87 <sup>ab</sup>	5.18 <sup>b</sup>	5.18 <sup>b</sup>	5.23 <sup>cd</sup>	5.01 <sup>c</sup>
30	6.32 <sup>ab</sup>	5.68 <sup>ab</sup>	5.38 <sup>b</sup>	5.63 <sup>bc</sup>	5.62 <sup>b</sup>
35	6.48 <sup>a</sup>	6.48 <sup>a</sup>	6.57 <sup>a</sup>	6.51 <sup>a</sup>	6.25 <sup>a</sup>
40	6.33 <sup>ab</sup>	6.38 <sup>a</sup>	6.32 <sup>a</sup>	6.02 <sup>ab</sup>	6.04 <sup>ab</sup>
Significant level	0.041	0.021	0.001	0.002	0.001
<b>Interaction A x B</b>					
	ns	ns	ns	ns	ns
<b>Glucose syrup / sucrose (%)</b>					
0 / 20	5.93	4.11	4.36	4.02	4.09
0 / 25	6.14	4.36	4.56	4.13	4.31
0 / 30	6.30	5.06	4.69	4.95	5.13
0 / 35	6.15	6.19	5.38	5.76	5.45
0 / 40	6.43	5.98	5.75	5.21	5.36
5 / 20	6.31	5.19	5.44	5.29	5.54
5 / 25	5.82	5.77	6.21	6.54	6.07
5 / 30	6.91	6.02	6.03	6.48	6.40
5 / 35	6.82	7.54	7.49	7.66	7.61
5 / 40	6.44	7.41	7.38	7.52	7.34
10 / 20	6.03	5.47	4.36	4.84	4.77
10 / 25	5.65	5.42	4.79	5.03	4.63
10 / 30	6.35	5.98	5.42	5.46	5.33
10 / 35	6.49	5.71	6.85	6.10	5.70
10 / 40	6.13	5.77	5.83	5.34	5.42

abc, means followed by the different letter within a column are significantly different ( $p \leq 0.05$ ).

ns, not different (no significant;  $p > 0.05$ ).

#### 4.2.3 The Thickening Agent for Mafai Jeen Fruit Candy

The texture of Mafai Jeen fruit candy product was an important factor for the consumer acceptance of Mafai Jeen fruit candy, so the thickening agent has been used for improved the texture acceptance. Three type of thickening agent; maltodextrin DE 10, pectin (150grade), and CMC (PM 7) were used in this study. The rank sum of preference test of Mafai Jeen fruit candy for 15 samples, various concentration of 0.5%, 1.0%, 1.5%, 2.0%, and 2.5% (w/w Mafai Jeen puree) were shown in [Table 19](#).

Table 19 The rank sum of preference for three thickening agent added in Mafai Jeen fruit candy.

Thickening agent	Concentration (%)				
	0.5	1.0	1.5	2.0	2.5
Maltodextrin DE 10	121 <sup>c</sup>	132 <sup>c</sup>	87 <sup>bc</sup>	42 <sup>a</sup>	67 <sup>b</sup>
Pectin(150grade)	129 <sup>c</sup>	116 <sup>c</sup>	47 <sup>a</sup>	79 <sup>b</sup>	80 <sup>b</sup>
CMC(PM 7)	70 <sup>b</sup>	45 <sup>a</sup>	91 <sup>bc</sup>	118 <sup>c</sup>	126 <sup>c</sup>

Rank sums that do not have a common superscript are significantly different(  $p < 0.05$  )

A Friedman's test and Fisher's analog of  $LSD_{rank}$  test indicated and existence of difference in five samples of Mafai Jeen fruit candy. The rank sum of preference for maltodextrin DE10 from the most preference to least preference were 2.0, 2.5, 1.5, 0.5, and 1.0%, respectively. The rank sum of preference for pectin (150 grade) from the most preference to least preference were 1.5, 2.0, 2.5, 1.0, and 0.5%, respectively. And the rank sum of preference for CMC (PM7) from the most preference to least preference were 1.0, 0.5, 1.5, 2.0, and 2.5%, respectively. So, the first rank in this study; 2.0% maltodextrin, 1.5% pectin, and 1.0% CMC were used to study the sensory descriptive analysis in further experiment.

#### 4.2.4 Descriptive Sensory Analysis of Mafai Jeen Fruit Candy

The model used for the analysis of the descriptive sensory evaluation was a randomized block design, in which panelists were considered as blocks. ANOVA was executed using the SPSS version 10.01. Table 20 shows the means, standard deviations and Pr>F values for the intensities of each of the attributes evaluated in each of the three Mafai Jeen fruit candy.

The glossy, pickled lemon aroma, dried preserved mandarin peel aroma, pungent aroma, sweet, sour, bitter, astringent, hardness, cohesiveness, crumble, sandy, chewiness, roughness, bitter in residual, astringent in residual and toothpack showed significant difference in their intensities among the three Mafai Jeen fruit candy. Caramel aroma ( $p=0.236$ ), pickled lemon flavor (0.122), and dried preserved mandarin peel flavor (0.102) were not significant different among the three samples.

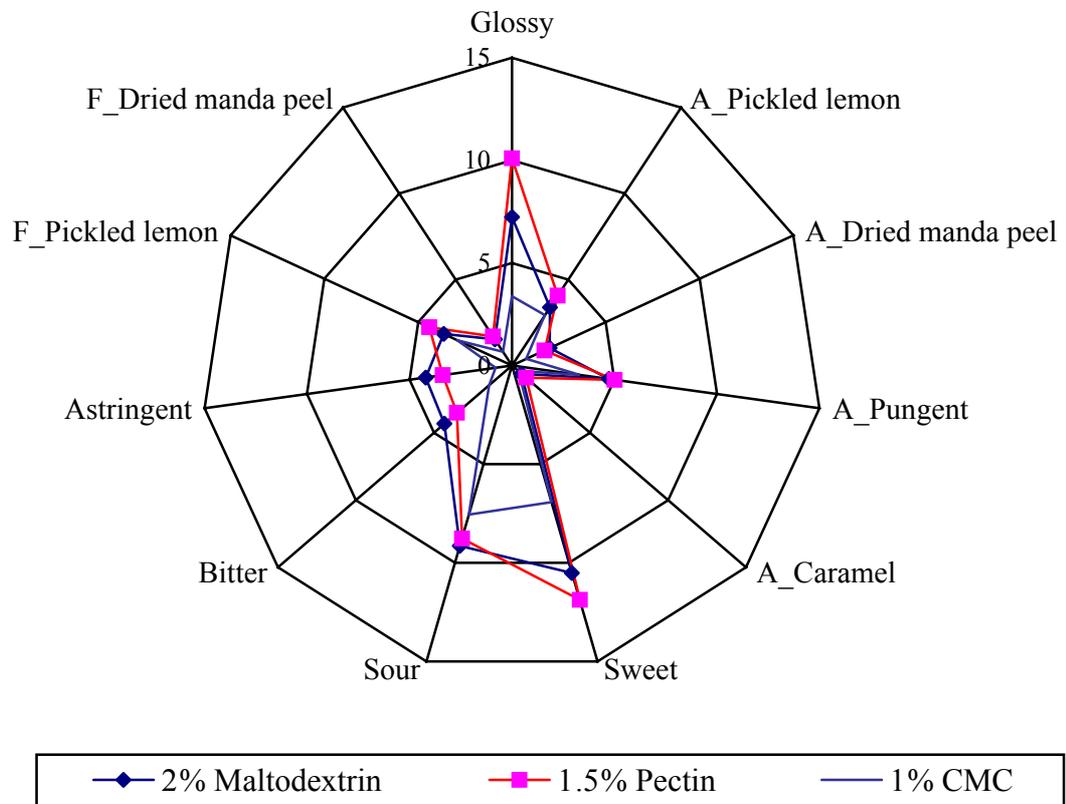
The Duncan's post-hoc test indicated that glossy, sweet taste, astringent taste, crumble, chewiness, bitter in residual, and toothpack were different among the 2% maltodextrin, 1.5% pectin, and 1% CMC added in Mafai Jeen fruit candy. Pickled lemon aroma, dried preserved mandarin peel aroma, pungent aroma, sour taste, bitter taste, sandy, roughness, and astringent in residual had different intensities in 1% CMC added in Mafai Jeen fruit candy lower scores compared with the 2% maltodextrin and 1.5% pectin. Hardness and cohesiveness had different intensities in 1% CMC added in Mafai Jeen fruit candy higher scores compared with the 2% maltodextrin and 1.5% pectin. Caramel aroma, pickled lemon flavor, and dried preserved mandarin peel were not different among the three Mafai Jeen fruit candy.

Mafai Jeen fruit candy mixed with 2% maltodextrin had highest intensities scores in dried preserved mandarin peel aroma, sour taste, bitter taste, astringent taste, crumble, sandy, roughness, bitter in residual, and astringent in residual. 1.5% pectin had highest intensities scores in glossy, pickled lemon aroma, pungent aroma, caramel aroma, sweet taste, pickled lemon flavor, and dried preserved mandarin peel flavor. 1% CMC had highest intensities scores in hardness cohesiveness, chewiness and toothpack (Table 20, Figure 13 and Figure 14).

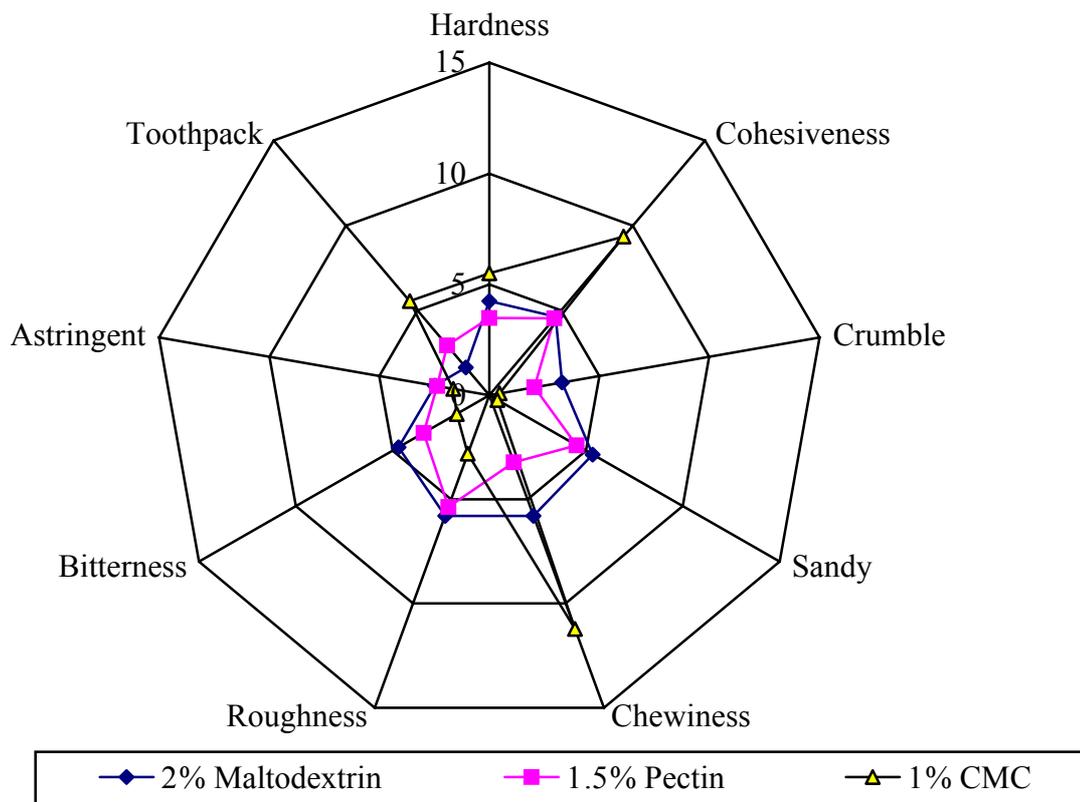
**Table 20** Means, standard deviations and analysis of variance for three Mafai Jeen fruit candy<sup>a</sup>.

Attribute	Mafai Jeen fruit candy			Pr>F
	2% Maltodextrin	1.5% Pectin	1% CMC	
<b>Appearance</b>				
Glossy	7.32 <sup>b</sup> ± 1.45	10.09 <sup>a</sup> ± 2.94	3.38 <sup>c</sup> ± 1.21	0.000
<b>Odor/aroma</b>				
Pickled lemon	3.38 <sup>ab</sup> ± 1.22	4.05 <sup>a</sup> ± 1.76	2.92 <sup>b</sup> ± 0.77	0.019
Dried preserved mandarin peel	2.00 <sup>a</sup> ± 0.81	1.72 <sup>a</sup> ± 1.21	0.76 <sup>b</sup> ± 0.41	0.000
Pungent	4.72 <sup>a</sup> ± 1.83	5.00 <sup>a</sup> ± 1.67	3.28 <sup>b</sup> ± 1.49	0.002
Caramel	0.60 <sup>a</sup> ± 0.68	0.90 <sup>a</sup> ± 0.78	0.40 <sup>a</sup> ± 0.43	0.236
<b>Taste</b>				
Sweet	10.50 <sup>b</sup> ± 1.54	11.87 <sup>a</sup> ± 1.34	6.92 <sup>c</sup> ± 0.52	0.000
Sour	9.14 <sup>a</sup> ± 2.09	8.77 <sup>a</sup> ± 1.24	5.76 <sup>b</sup> ± 1.52	0.000
Bitter	4.32 <sup>a</sup> ± 2.01	3.51 <sup>a</sup> ± 1.47	1.46 <sup>b</sup> ± 0.85	0.000
Astringent	4.22 <sup>a</sup> ± 1.45	3.37 <sup>b</sup> ± 0.94	0.80 <sup>c</sup> ± 0.67	0.000
<b>Flavor</b>				
Pickled lemon	3.64 <sup>a</sup> ± 1.43	4.42 <sup>a</sup> ± 1.95	2.92 <sup>a</sup> ± 1.65	0.122
Dried preserved mandarin peel	1.52 <sup>a</sup> ± 0.85	1.68 <sup>a</sup> ± 1.30	0.80 <sup>a</sup> ± 0.31	0.102
<b>Texture</b>				
Hardness	4.24 <sup>b</sup> ± 0.98	3.48 <sup>b</sup> ± 1.79	5.50 <sup>a</sup> ± 1.13	0.000
Cohesiveness	4.62 <sup>b</sup> ± 1.11	4.54 <sup>b</sup> ± 1.25	9.34 <sup>a</sup> ± 1.13	0.000
Crumble	3.30 <sup>a</sup> ± 1.71	2.04 <sup>b</sup> ± 1.71	0.46 <sup>c</sup> ± 0.54	0.000
Sandy	5.34 <sup>a</sup> ± 0.94	4.51 <sup>a</sup> ± 2.14	0.42 <sup>b</sup> ± 0.37	0.000
Chewiness	5.78 <sup>b</sup> ± 1.39	3.21 <sup>c</sup> ± 1.97	11.22 <sup>a</sup> ± 1.32	0.000
Roughness	5.78 <sup>a</sup> ± 1.08	5.35 <sup>a</sup> ± 1.52	2.80 <sup>b</sup> ± 1.57	0.000
<b>Residual</b>				
Bitter	4.70 <sup>a</sup> ± 1.08	3.40 <sup>b</sup> ± 1.74	1.68 <sup>c</sup> ± 0.59	0.000
Astringent	2.48 <sup>a</sup> ± 1.05	2.37 <sup>a</sup> ± 1.07	1.64 <sup>b</sup> ± 0.89	0.000
Toothpack	1.64 <sup>c</sup> ± 0.70	2.94 <sup>b</sup> ± 1.68	5.54 <sup>a</sup> ± 2.19	0.000

<sup>a</sup> Means in each row having different superscripts are significantly different ( $P \leq 0.05$ )



**Figure 13** Spider web diagram of average scores obtained by descriptive analysis of Mafai Jeeen fruit candy, in appearance, aroma (A), taste, and flavor (F).



**Figure 14** Spider web diagram of average scores obtained by descriptive analysis of Mafai Jeen fruit candy, in texture.

#### 4.2.5 Consumer Test

##### a. Consumer Demographics and Product Information

Demographic information of 135 consumers was shown in [Table 21](#). The majority of the participating consumers was in the age range of 25-44 years old (58.5%); followed by consumers in the range of 45-54 years old (17.8%). The lowest percentage of participants (7.4%) was 55 years old or older. Of the total, 50.4% of subjects were female and 49.6% were male. Their education level was divided into bachelor (50.4%), graduate level (23.0%), Diploma (14.8%), less than high school (7.4%), and high school (4.4%). A greater proportion of them were employed full-time (76.3%), followed by student (14.8%), unemployed (5.9%), and employ part-time (3.0%).

Table 21 Demographic and socioeconomic information.

	Male, %	Female, %	Total, %
<i>Age</i>			
18-24 years	10.4	5.9	16.3
25-34 years	8.9	23.7	32.6
35-44 years	17.0	8.9	25.9
45-54 years	11.9	5.9	17.8
55-64 years	1.5	3.0	4.4
Over 64 years	0.0	3.0	3.0
<i>Gender</i>	49.6	50.4	100.0
<i>Education</i>			
Less than high school	-	7.4	7.4
High school	-	4.4	4.4
Diploma	4.4	10.4	14.8
Bachelor	29.6	20.7	50.4
Graduate (M.S., M.A., Ph. D.)	15.6	7.4	23.0
<i>Work status</i>			
Employed full-time	40.7	35.6	76.3
Employ part-time	-	3.0	3.0
Unemployed	-	5.9	5.9
Student	8.9	5.9	14.8
<i>Income/month</i>			
< 10,000 ₪	8.9	17.8	26.7
10,000-19,999 ₪	10.4	13.3	23.7
20,000-29,999 ₪	5.9	7.4	13.3
30,000-39,999 ₪	3.0	4.4	7.4
40,000-49,999 ₪	4.4	3.0	7.4
Over 50,000 ₪	17.0	4.4	21.5

About 63.7% of the consumers had incomes less than ₱30,000/ month, and 36.5% had income of ₱30,000/month or higher.

Table 22 gives product information about Mafai Jeen fruit candy collected from consumers. About 57.0% of consumers ate fruit candy more than twice a month, again, female consumers responded in a higher percentage (40.7%) when compared to males (16.3%), and 43% were ate once a month or less than once a month. Taste, texture, and color were important quality attribute that consumers want in fruit candy products. The most of consumer (48.9%) prefer the sweet/sour equally taste. One hundred percent of them said they were aware of fruit herb/ health benefits. In addition, 100% of the consumers declared that they also to purchase candy containing fruit herb. A large number of consumers (57%) have known a Mafai Jeen fruit products in the market.

#### b. Consumer Acceptability

Table 23 reports the mean scores and ANOVA results for the acceptability of appearance, overall taste, aroma, sweetness, sourness, texture, and overall liking of three Mafai Jeen fruit candy; 2% maltodextrin, 1.5% pectin, and 1.0% CMC added. The analysis of variance and a post-hoc test indicated an existence of differences in acceptability of all attributes. Acceptability of appearance for 1.5% pectin is highest with a score of 6.35, while the lowest score was observed for 2.0% maltodextrin (5.01). 1.5% pectin got 6.65 score in overall taste which was higher than that of the 2% maltodextrin. 1.5% pectin and 1.0% CMC in Mafai Jeen fruit candy were not different in acceptability of their sourness (6.29 and 6.10), while 2% maltodextrin (with a mean score of 4.80) was different when compared to the two. 1.5% pectin in Mafai Jeen fruit candy was most accepted when consumers evaluated aroma, sweetness, sourness and attributes with hedonic scores of 6.25, 6.50, 6.29 and 7.20, respectively. Gel structured of pectin tab more aroma compound than the other thickening agent. 2.0% maltodextrin in Mafai Jeen fruit candy was least accepted with the scores for taste, aroma, specific flavor, and sweetness attributes of 4.5, 4.5, 4.6

Table 22 Consumer product information about Mafai Jeen fruit candy.

Question	Gender		
	Male, %	Female, %	Total, %
<i>How often do you eat fruits candy?</i>			
More than once a week	3.7	8.9	12.6
Once a week	4.4	20.7	25.1
Twice a month	8.2	11.1	19.3
Once a month	23.0	8.9	31.9
Very rarely	10.4	0.7	11.1
<i>What is the most important quality attribute that you want in fruit candy products?</i>			
Color/appearance	20.7	8.9	29.6
Texture/mouthfeel	5.9	11.8	17.7
Taste	21.6	17.8	39.4
Nutrition	-	5.9	5.9
Aroma/odor	1.5	5.9	7.4
<i>Which taste do you prefer most for fruit candy product? (check one)</i>			
Sweeter and less sour	15.6	8.9	24.4
More sour and less sweet	7.4	19.3	26.7
Sweet/sour equally	26.7	22.2	48.9
<i>Are you aware of fruit herb/ health benefits?</i>			
YES	49.6	50.4	100
NO			
<i>Would you consider buying fruit herb candy?</i>			
YES	49.6	50.4	100
NO			
<i>Have you heard of or seen Mafai Jeen fruit products in the market?</i>			
YES	33.3	23.7	57.0
NO	16.3	26.7	43.0

and 5.2, respectively. In conclusion, the addition 1.5% pectin to the Mafai Jeen fruit candy gave the most accepted when participants estimated overall liking, with a score of 6.32, followed by the 1.0% CMC with a score of 5.90. The 2.0% maltodextrin in Mafai Jeen fruit candy had again the lowest score, with 4.63 (5= neither like nor dislike), indicating significant lower in acceptability when compared with the other two samples (1.5% pectin and 1.0% CMC).

**Table 23** Means, standard deviations and analysis of acceptability attributes of the three Mafai Jeen fruit candy.

Attributes	Mafai Jeen fruit candy			Pr > F
	2% maltodextrin	1.5% pectin	1.0% CMC	
Appearance	5.01 <sup>c</sup> ±0.71	6.35 <sup>a</sup> ±0.96	5.42 <sup>b</sup> ±1.01	<0.0001
Overall taste	5.20 <sup>b</sup> ±0.84	6.65 <sup>a</sup> ±1.67	6.20 <sup>ab</sup> ±1.11	<0.0001
Aroma	4.48 <sup>c</sup> ±1.24	6.25 <sup>a</sup> ±1.53	5.66 <sup>b</sup> ±1.41	<0.0001
Sweetness	4.60 <sup>c</sup> ±1.14	6.50 <sup>a</sup> ±1.74	6.10 <sup>b</sup> ±1.17	<0.0001
Sourness	4.80 <sup>b</sup> ±1.10	6.29 <sup>a</sup> ±1.49	6.10 <sup>a</sup> ±1.07	<0.0001
Texture	4.00 <sup>c</sup> ±1.01	7.20 <sup>a</sup> ±1.74	5.69 <sup>b</sup> ±1.58	<0.0001
Overall Liking	4.63 <sup>b</sup> ±0.89	6.32 <sup>a</sup> ±1.20	5.90 <sup>a</sup> ±0.92	<0.0001

Means in each row having different superscripts are significantly different (Pr ≤ 0.05).

### c. Purchase Intent- McNemar Test

The McNemar test was performed using descriptive statistics/crosstabs (SPSS version 10.0.1). It was used to establish any potential association between purchase intent of the Mafai Jeen candy before and after the consumers being informed that the product may offer health benefits. [Table 24-26](#) described counts number and frequencies of purchase intent responses before and after knowing that the product contained health benefits.

**Table 24** Purchase intent responses for 2.0% maltodextrin DE 10 added in Mafai Jeen candy before and after knowing that the product was enriched with health-promoting.

Purchase intent (Question 1)	Purchase intent after knowing health benefits (Question 2)		
	YES	NO	TOTAL
YES	30 (22.2%)	2 (1.5%)	32 (23.7%)
NO	24 (17.8%)	79 (58.5%)	103 (76.3%)
TOTAL	54 (40.0%)	81 (60.0%)	135 (100.0%)

**Table 25** Purchase intent responses for 1.5% pectin (150grade) added in Mafai Jeen candy before and after knowing that the product was enriched with health-promoting.

Purchase intent (Question 1)	Purchase intent after knowing health benefits (Question 2)		
	YES	NO	TOTAL
YES	66 (48.9%)	7 (5.2%)	73 (54.1%)
NO	35 (25.9%)	27 (20.0%)	62 (45.9%)
TOTAL	101 (74.8%)	34 (25.2%)	135 (100.0%)

**Table 26** Purchase intent responses for 1.0% CMC(PM 7) added in Mafai Jeen candy before and after knowing that the product was enriched with health-promoting.

Purchase intent (Question 1)	Purchase intent after knowing health benefits (Question 2)		
	YES	NO	TOTAL
YES	58 (43.0%)	6 (4.4%)	64 (47.4%)
NO	32 (23.7%)	39 (28.8%)	71 (52.6%)
TOTAL	90 (66.7%)	45 (33.3%)	135 (100.0%)

Table 27 showed details about McNemar test results. It can be seen that a significant difference existed between the two responses, with a chi square ( $\chi^2$ ) values of 50.488 (for the evaluation of the 2.0% maltodextrin added), 20.519 (for the evaluation of the 1.5% pectin added), and 31.43 (for the evaluation of the 1.0% CMC added), which are greater than the critical  $\chi^2$  df 1 of 3.84, with  $\text{Pr} > \chi^2 < 0.0001$  for the three cases (with an alpha = 0.05). The decision of buying the Mafai Jeen fruit candy was influenced by the fact that consumers had been informed about the health benefits of the product. The difference of proportions ( $p_{+1} - p_{1+}$ ) between purchase intent after ( $p_{+1}$ ) and before ( $p_{1+}$ ) knowing that the product was enriched with health benefits was calculated for each of the evaluation of the three Mafai Jeen fruit candy. For example, the proportion of consumers that answered yes to purchase intent of the Mafai Jeen candy added 2.0% maltodextrin before knowing the health benefits of the product is 0.24 (i.e., applying equation (7),  $p_{1+}=32/135$ ) see Table 28.

Table 27 McNemar test results of three Mafai Jeen fruit candy with different thickening agent.

Mafai Jeen fruit candy	95% Confidence intervals for difference of proportions	Statistic $\chi^2$	$\text{Pr} > \chi^2$
2.0% maltodextrin	(0.11, 0.21)	50.488	<0.0001
1.5% pectin	(0.17, 0.25)	20.519	<0.0001
1.0% CMC	(0.16, 0.24)	31.430	<0.0001

The proportion of consumers that answered yes to purchase intent of the Mafai Jeen candy added 2.0% maltodextrin after they had been informed about the health benefits of the product is 0.40 (i.e., applying equation (7),  $p_{+1}=54/135$ ). Then the difference of proportions ( $p_{+1} - p_{1+}$ ) between consumers that said yes to purchase intent of the Mafai Jeen candy added 2.0% maltodextrin after had been informed that the product was enriched with health benefits ( $p_{+1}$ ), and consumers who said yes to purchase intent of the Mafai Jeen candy added 2.0% maltodextrin before knowing the health benefits of the product ( $p_{1+}$ ) is 0.16 (i.e., 0.40-0.24).

**Table 28** The proportion of consumer answered yes to purchase before and after informed about the health benefits of the products.

	$p_{1+}$ (before)	$p_{+1}$ (after)	$p_{+1} - p_{1+}$
2.0% maltodextrin	32/135 = 0.24	54/135 = 0.40	0.16
1.5% pectin	73/135 = 0.54	101/135 = 0.75	0.21
1.0% CMC	64/135 = 0.47	90/135 = 0.67	0.20

The 95% confidence intervals for the difference of proportions were calculated in order to obtain a better understanding of the association between the two questions' responses (i.e., applying equation 8). The 95% confidence interval for the difference of proportion of purchase intent of the Mafai Jeen candy added 2.0% maltodextrin was 0.11, 0.21 (i.e.,  $0.16 \pm 0.05$ ). The confidence interval explained that, for the Mafai Jeen candy added 2.0% maltodextrin, the probability that consumers would buy it after they had been informed about the health benefits of the product was 0.11 to 0.21 times higher than the probability that consumers would buy it before they had been informed about the health benefits.

The 95% confidence interval for the difference of proportion of purchase intent of the Mafai Jeen candy added 1.5% pectin was 0.17, 0.25 (i.e.,  $0.21 \pm 0.04$ ). The probability of buying the Mafai Jeen candy added 1.5% pectin after participants had been informed that the product was enriched with health benefits was from 0.17 to 0.25 higher than the probability of buying the product before consumer had known that it contained health benefits.

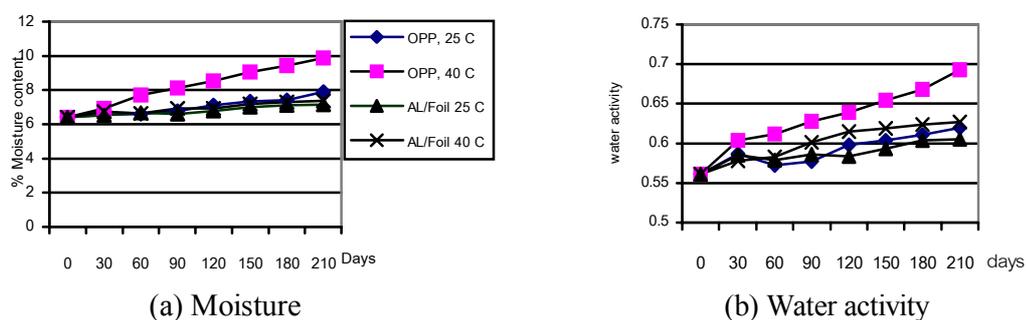
The 95% confidence interval for the difference of proportion of purchase intent of the Mafai Jeen candy added 1.0%, CMC was 0.16, 0.24 (i.e.,  $0.20 \pm 0.04$ ). The probability of buying the Mafai Jeen candy added 1.0%, CMC after participants had been informed that the candy was enriched with health benefits was 0.16 to 0.24 higher than the probability of buying the product before consumers had been informed about the health benefits of the product. There was a positive increase

in the probability of buying the Mafai Jeen fruit candy after consumers had been informed that the product was enriched with health promoting ingredients. Therefore, there was a positive increase in the purchase intent after consumers had been informed the Mafai Jeen fruit candy was enriched with health benefits. Walker (2002) studied the difference in the purchase intent of low-fat sugar-free orange sherbets before and after consumers had been informed that the product contained health promoting soy protein. Pavon (2003) studied the difference in the buying intention of flavored milk candy before and after consumers had been informed about the health benefits of the products. In both studies, the fact that the product could promote health benefits positively increased the purchase intent of them.

### 4.3 To Study on Shelf Life of Developed Product

#### 4.3.1 Moisture Content and Water Activity

The graphical representation in [Figure 15 \(a\)](#) shown no significant difference in effect of both packaging on the % moisture content values for the first 60 days of storage for 25 °C. The differences that were observed after 90 days due to OPP pouch having higher % moisture content value than AL/Foil. In the case of samples treated on 40 °C had significant difference % moisture content value on

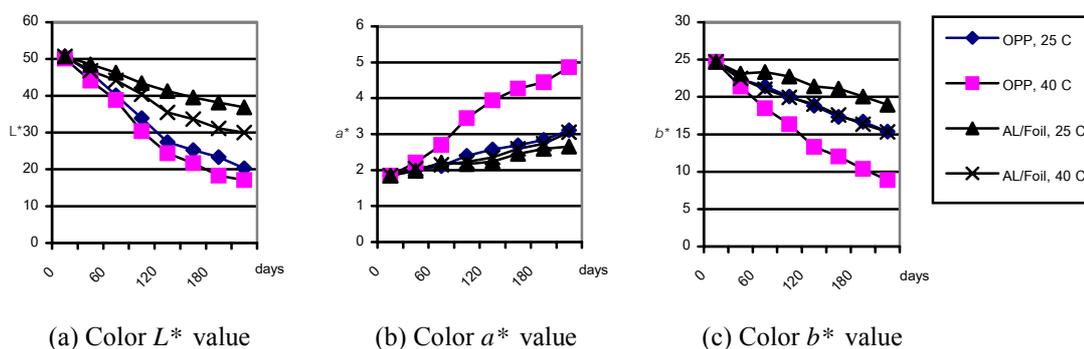


**Figure 15** Moisture contents (a) and water activity (b) of Mafai Jeen fruit candy stored at various time condition in oriented polypropylene (OPP) and aluminum laminated foil (AL/Foil) pouches

both packaging. The result shown OPP pouch having higher % moisture content value than AL/Foil. Change in water activity was shown in Figure 15 (b). The water activity of Mafai Jeen fruit candy packed in AL/Foil, 25 °C was less increased compared to the other treatment. After 30 days storage, the water activity of the OPP pouch with 40 °C sample distinctly increased.

#### 4.3.2 Color Assessment

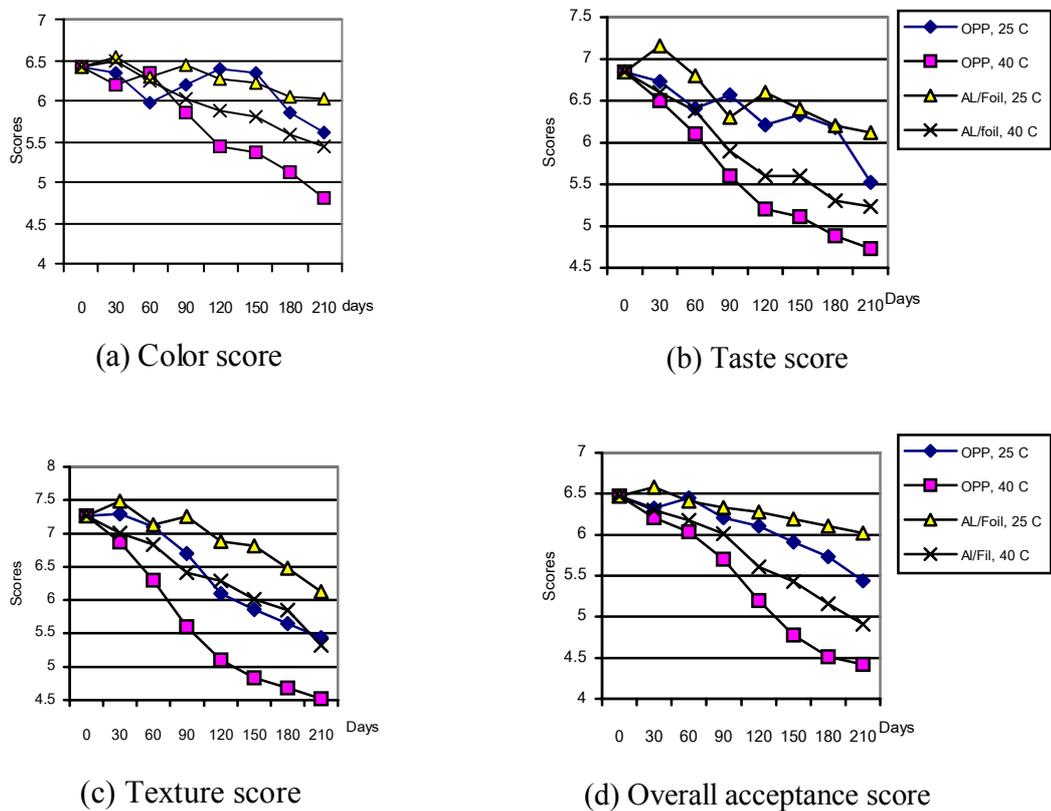
The graphical representation (Figure 16 (a)) of the difference in lightness values of Mafai Jeen fruit candy showed that OPP pouch samples were darker than the AL/Foil pouch during storage at both 25 °C and 40 °C. The graphical representation in Figure 16 (b) shown that the color  $a^*$  value for the treatments of OPP and AL/Foil pouches increased constantly with increase in storage time. The AL/Foil, 25 °C treated samples had less increase in redness compared to the other treated samples. There was a decrease in color  $b^*$  values for all the treatments; the graphical representation in Figure 16 (c) shown that the AL/Foil pouch at 25 °C retained more degree of yellowness in the Mafai Jeen fruit candy than the other treated samples. Therefore, AL/Foil pouch stored at 25 °C gave a better result in color  $L^*$   $a^*$   $b^*$  values after storage until 210 days.



**Figure 16** Color  $L^*$  value (a), color  $a^*$  value (b), and color  $b^*$  value (c) of Mafai Jeen fruit candy stored at various time condition in oriented polypropylene (OPP) and aluminum laminated foil (AL/Foil) pouches.

### 43.3. Sensory analysis

The effect of storage on color acceptance were rated similarly by the consumer (Figure 17 (a)) for 25 °C, slightly decreased for AL/Foil 40 °C and score lower 5 at 210 days for OPP 40 °C. The effect on taste acceptance were rated decreasing in taste acceptance with increasing storage time and temperature (Figure 17 (b)). Sample at zero days were rated 6.84 (like moderately) on taste acceptance and decreased with increasing storage time and temperature, sample storage in OPP 40 °C was rate lower 5 after 180 days. Texture acceptance is one important criteria in consumer acceptance of fruit candy. The changes of texture acceptance of Mafai Jeen



**Figure 17** Mean hedonic rating (9-point scale, 1=dislike extremely, 9=like extremely) on color score (a), taste score (b), texture score (c), and overall acceptance score (d) of Mafai Jeen fruit candy stored at various time condition in oriented polypropylene (OPP) and aluminum laminated foil (AL/Foil) pouches.

fruit candy for various storage condition was shown in [Figure 17 \(c\)](#) the sample stored at OPP, 40 °C for 150 days significantly decreased with storage time and the score lower 5, while sample stores at AL/Foil, 25 °C for 210 days showed only a small decrease and acceptance score more than 6.

The changes of hedonic ratings for overall acceptance of Mafai Jeen fruit candy at varied storage conditions were shown in [Figure 17 \(d\)](#). The sample stored at 40 °C with OPP and AL/Foil pouches after 120 days significantly decreased with storage time and score lower 5 at 180 and 210 days for OPP 40 °C and AL/Foil pouches 40 °C, respectively. The Mafai Jeen fruit candy sample stores in AL/Foil, 25 °C for 210 days fell slowly during storage, at day zero, sample was rated at 6.47 (like slightly to like moderately) on the 9-point hedonic scale and the rate was 6.02 (like slightly) at 210 days storage time.

Increasing the storage time and temperature resulted in decreasing acceptance of color, taste, texture, and overall acceptance. Mafai Jeen fruit candy were rated more than 6 (like slightly) for AL/Foil pouches 25 °C still acceptance after they had been stored at 210 days, but the OPP pouch at 40 °C became unacceptable for the texture and overall acceptance attributes score lower than 5 (neither like nor dislike) after 150 days storage. AL/Foil pouch delayed the drop in sensory quality, and extended shelf life.

## CONCLUSION

The volatile components of fruits, seeds, and leaves from Mafai Jeen obtained through headspace sampler, were analyzed by GC-MS. The sesquiterpene fraction (27.7%) was most common in the leaf. The monoterpene fraction (76 – 98%) was dominant in flesh, skin, and seed; with sabinene the main component in leaf (14.9%), flesh (50.6%), skin (69.1%), and seed (83.6%). Other major components in the leaf were  $\beta$ -bisabolene (9.9%),  $\beta$ -caryophyllene (7.7%), and  $\alpha$ -zingiberene (6.5%); in the flesh, 3-cyclohexen-1-ol (15%), cyclohexene (6.5%), 1,4-cyclohexadiene (6.2%), and 1-phellandrene (5%); in the skin,  $\alpha$ -phellandrene (10.6%),  $\alpha$ -pinene (9.4%), and isosativene (1.4%); and in the seed,  $\alpha$ -pinene (4.3%),  $\alpha$ -phellandrene (3.0%), and myrcene (2.9%). The volatile aroma compounds in Mafai Jeen fruit were also examined using three SPME fibers coated with polydimethylsiloxane (PDMS), polyacrylate (PA), and divinylbenzene/carboxen/polydimethylsiloxane (DVB/CAR/PDMS) equipped with GC-MS. Eighty-eight compounds were detected in the Mafai Jeen aroma. The main compounds were sabinene,  $\alpha$ -farnesene, and isosativene.

The study effect of drying methods on the Mafai Jeen qualities revealed the following conclusions. The drying time to reach 14% (wb) moisture content was 17, 32, 42, and 50 h by hot air drying at 60 °C, sun drying, hot air drying at 45 °C, and vacuum drying at 45 °C, respectively. The total changes in product color,  $\Delta E$ , were observed to be 21.49, 13.72, 12.75, and 6.61 by hot air drying at 60 °C, hot air drying at 45 °C, sun drying, and vacuum drying at 45 °C, respectively. Analysis by GC-MS of the volatile oils obtained from fresh fruit and dried fruits, it can report that the Mafai Jeen fruit consist a mixture of monoterpene hydrocarbons, sesquiterpene hydrocarbons, alcohols, aldehydes, ketones, carboxylic acids, and terpene oxides. No ester was detected in the examined fruit samples. All of Mafai Jeen oils were nearly similar in their main compositions. They consist mainly of monoterpene hydrocarbon (sabinene,  $\alpha$ -pinene,  $\alpha$ -phellandrene, and myrcene).

Time-intensity (TI) is a descriptive sensory technique in which the intensity of one or more sensory characteristics is rated in real time. In this study, the intensity of astringent taste was experimented in Mafai Jeen fruits using TI method. Twelve samples of dried Mafai Jeen, varying in the rate of sucrose from 0, 10, 20 to 30 g/100g of fruits and varying in the rate of ascorbic acid from 0, 1 to 2 g/100g of fruits were prepared. Solution of tannic acid 1 g/l both in water 7 and 25 °C tasted same astringent. The interaction between astringency and sweetness was investigated. Maximum intensity, time to maximum and total duration for astringency decreased significantly with increasing sucrose concentration. Raising ascorbic acid increased astringent intensity and duration significantly.

Results obtained from development Mafai Jeen fruit candy product through focus group discussion, study on sugar concentration in the recipe, study on thickening agent for Mafai Jeen fruit candy, descriptive sensory analysis of Mafai Jeen fruit candy, and consumer affective test. A focus group discussion among of 3 groups indicated that healthy natural Mafai Jeen candy product was required. The product should contain natural color or no artificial flavors, the least sucrose content and moderately sour taste. 35% of sucrose and 5% of glucose syrup added in Mafai Jeen fruit candy was the most accepted score of preference test. The 1<sup>st</sup> rank of preference of 3 thickening agents added in Mafai Jeen fruit candy were 2% of maltodextrin, 1.5% of pectin, and 1% of CMC.

Determination of the product sensory characteristics presented in each of the three Mafai Jeen fruit candy increased an understanding of the product quality. Descriptive sensory evaluations of the three Mafai Jeen fruit candy revealed that they were different among one another, based on descriptive sensory attributes. A lexicon developed to describe the Mafai Jeen fruit candy product included appearance note: glossy; aroma notes: pickled lemon, dried preserved mandarin peel, pungent, and caramel; taste notes: sweet, sour, bitter, and astringent; flavor notes: pickled lemon, and dried preserved mandarin peel; texture notes: hardness, cohesiveness, crumble, sandy, chewiness, and roughness; and residual note: bitter, astringent, and toothpack.

Consumer test was done with 135 consumers using a 9-point hedonic scale. Different thickening agents added to the Mafai Jeen fruit candy caused a significant difference in the consumer responses toward evaluated sensory attributes. 1.5% pectin and 1.0% CMC added in Mafai Jeen fruit candy were well accepted which overall liking scores 6.3 and 5.9 (like slightly), and 2.0% maltodextrin was least accepted which score 4.60 (Neither like nor dislike). Consumer purchase decision of Mafai Jeen fruit candy was positively influenced after the consumers known that promote health benefits. Consumers would be more willing to purchase Mafai Jeen fruit candy when they known the benefits of the product that for health promoting.

Processing steps to produce Mafai Jeen candy involved blending Mafai Jeen for 6 min, heating 58.5% of Mafai Jeen puree over gas stove at 95 °C for 20 min, 35% (w/w) of sucrose were added and continue heating for 20 min, added 5% of glucose syrup and 1.5% of pectin, continue heating until the total soluble solid reached 75 °Bx.

The effects of storage time and temperature resulted in decreasing sensory acceptance of color, taste, texture, and overall acceptance, Mafai Jeen fruit candy were rated more than 6 (like slightly) for AL/Foil pouches 25 °C still acceptance after they had been stored at 210 days, but the OPP pouch at 40 °C became unacceptable for the texture and overall acceptance attributes score lower than 5 (neither like nor dislike) after 150 days storage. AL/Foil pouch delayed the drop in sensory quality, and extended the shelf life.

## **RECOMMENDATION FOR FUTURE WORK**

The future study of aroma compounds in Mafai Jeen should be identified by varieties and by areas to provide more information on aroma compounds in Mafai Jeen fruit. The trend towards natural aroma compounds is creating opportunities for the development of new essential oils. Essential oils that are sources of natural aroma chemicals will be of particular interest to the flavor and fragrance industry. Mafai Jeen oil is a potential source of natural terpene and can be produced economically in North of Thailand. The oil has potential applications in flavors and fragrance compounds.

More research needs to be done before launching the product to the market. Some modification may be needed; this includes the addition of alternative thickening agent, such as carrageenan, gelatin, arabic gum or mixed together. In addition, the shape and size may be reformed for a new targeted to children. Nevertheless, new consumer sensory studies together with marketing research should be done to warrant the success of the new products.

This study represents the first step for the development of a process to insert or position the new Mafai Jeen candy in the market.

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