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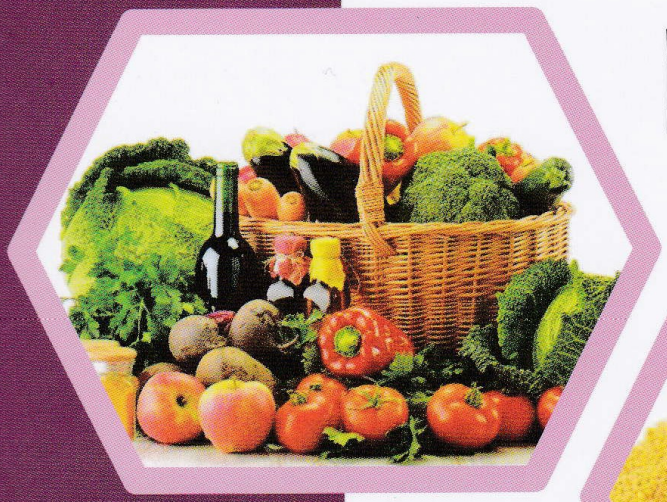

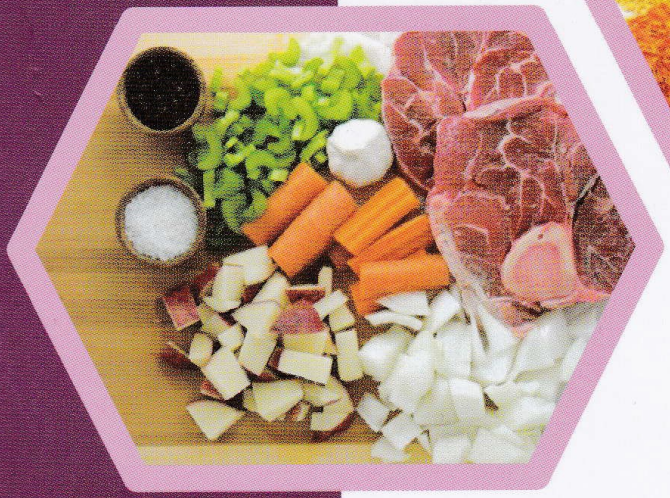

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THE CHARACTERISTIC OF MANGOSTEEN PEEL SOFT CANDIES WITH DIFFERENT GELATIN CONCENTRATIONS

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ABSTRACT

Mangosteen peel (*Garcinia mangostana* L.) contains xanthone as antioxidant, antiinflamation, and antihistamine which bring loads of benefit for human body. Mangosteen peel soft candy is an innovation of food product. This research aimed to know the characteristic of mangosteen peel soft candy with different gelatin concentrations. In this research, the experimental design was completely randomized design with treatments of gelatin concentration of 6%,7%, 8%, 9%, and 10%. Each treatment was repeated 3 times so that there were 15 units of experiment. The parameters of this study were elasticity, water content, ash content, reducing sugar content, saccharose content, xanthone content, and sensory properties. Sensory properties included color, taste, flavor, and elasticity. Data was analyzed by ANOVA at 1% level and significantly different test followed by Duncan's new multiple range test at 1% level. The result showed that gelatin had effect on elasticity, water content, ash content, and color but did not affect the reducing sugar content, saccharose content, and taste. Gelatin 8% had the best physical, chemical, and sensory properties. At this concentration, soft candy had elasticity 471.314 g/mm^2, water content 19.758%, ash content 0.207%, reducing sugar content 4.776%, saccharose content 55.119%, xanthone concentration 20.05 mg/100 g, and a chewy texture that panelists preferred.

Keywords: *Gelatin, mangosteen peel, soft candy, xanthone*

INTRODUCTION

Mangosteen (*Garcinia mangostana* L.) peel isone of an agricultural wastethat still has low economic value. The average percentage share of the mangosteen fruit that can be consumed is approximately 27-32%and the

68% residues arecome from seeds and skin of the mangosteen (Iswari, 2005). The use of mangosteen peelin Indonesia is still low. Currently, it can be consumed as juice, syrup, and capsules.

Mangosteen peel contains high antioxidant. The antioxidant content is greater than orange and the flesh itself. One of the antioxidants contained in the skin of the mangosteen fruit is xanthone. Extract of mangosteen peelroles as anantiproliferation which can inhibitcancer cell growth. Xanthone also roles as anti inflammatory, antihistamines, antibacterial, and antifungal. Because of that benefits, the research of mangosteen peel as food products needs to be developed. The one way to enhance the utility value mangosteenpeel is to use it as a raw material in the manufacture of soft candy.

Soft candy is a semi-moisture food which is made from fruit extract and gelation agent. It is a clear and transparent candy with a particular texture and elasticity (Harijono et al, 2001).Soft candies with various flavors of fruit are favored by children and adults because of their sweet taste and chewy texture. Soft candies mostly sold in the market use synthetic fruit flavor as it is cheaper and more practical, but there is no functional benefit derived from that candy. To add the functional benefit, mangosteen peel can be used as the main raw material of soft candy.

In the manufacture of soft candy, hydrocolloid is used as emulsifiers, stabilizers, thickeners, and gelling agents. Gelatin is one of hydrocolloidwhich has a distinctive texture that is plastic rubbery and chewy, while other hydrocolloid such as carrageenan produces a harder gel texture and agar produces easily broken gel texture. Gelatin is different from other hydrocolloids, as most hydrocolloids such as carageenan and pectin made from polysacharide. Gelatin is a protein which is easily digestible and contain essential amino acids e.g glycine, proline, hydroxyproline, glutamic acid, and alanine (Grobben et al., 2004). Gelatin has a high nutritional value because of its protein content (especially essential amino acids) and has a low fat content.

There are two types of gelatin; gelatin A and gelatin B. The gelatin A is processed by soaking the raw material with acid solution, while the gelatin B is processed by soaking the raw material with alkaline solution (Bosch and Gielens, 2003; Junianto, et al, 2006).

The concentration of gelatin can affect the physical, chemical, and organoleptic contents of food products. This research aimed to know the characteristic of mangosteen peel soft candy with different gelatin concentrations.

MATERIALS AND METHODS

The ingredients of softcandy were mangosteen peel, gelatin, sucrose, HFS, water, citric acid, and flavor. The reagents were amilum 1%, pòttasium iodide (KI) 20%, sodium thiosulfate ($Na_2S_2O_3$) 0.1N, $(NH_4)HPO_4$ 10%, HCl 30%, H_2SO_4 6 N, NaOH 45%, phenolptalein, lead acetate, Na_2CO_3, sodium phosphate 8%, chloroform ($CHCl_3$).

The equipments were knife, cutting board, blender, wathmann filter papers, measuring cylinders, thermometer, weight scale, stove, pans, strirring bars, timer, candy molds, wrapping plastic,pippettes, erlenmeyers,volumetric flasks, burettes, statives, hotplate, and dishes. The instruments were desicator, oven, furnace, and texture analyzer (TA-XT plus with TA-5 probe) .

The method was a one factor completely randomized design (CRD) with five level and three replications. The study treatment used different gelatin concentrationswhich were 6%, 7%, 8%, 9%, and 10% (Schrieber R and Gareis H, 2007). The data was presented as the mean values. This research was conducted in November 2015 until February 2016 in Food Technology Laboratory of the Sahid University Jakarta and Bogor Agricultural University.

The mangosteen peel soft candy made by mixing sucrose and high fructose syirup for 10 minutes at the temperature of 80°C untilcompletely dissolved. The gelatin was addedin to the mixture which had previously been diluted with warm water (70°C). The gelatin on each treatment based on the percentage concentration of the total ingredients (90 g). A mixture of mangosteen peel extract was added citric acid then stirred until completelydissolved, the heating was continued in the temperature of 90°C until the sugar content measured on the refractometerwas ± 68%. The mixture was added flavor. Then the mixture was poured into a mold. After that,the candy was cooled at room temperature for 1 hour (cooling step I). Then refrigerate (cooling step II) at a temperature of 0° C for 24 hours

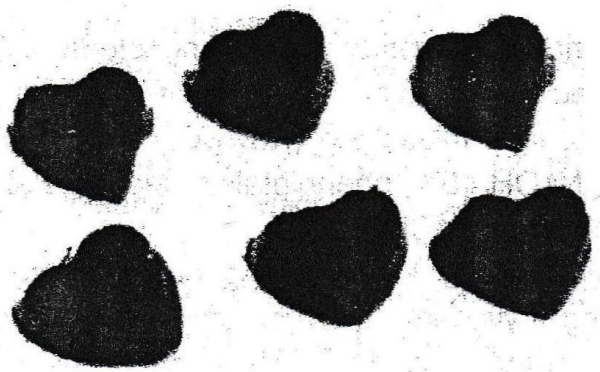

Figure 1. Mangosteen Peel Soft Candies with 8 % Gelatin

The mangosteen peel soft candy that has been cooled removed from the mold was coated by cassava flour and sugar in the ratio of 1:1 and then inserted into the packaging (Haryati, 1999 dan Iskandi, 2011) [Picture 1].The formulation of mangosteen peel soft candy can be seen in Table 1.

Table 1. Mangosteen Peel Soft Candy Formulations

Materials	g*	%	g*	%	g*	%	g*	%	g*	%	g*	%
HFS	40	44.44	40.00	44.44	40.00	44.44	40.00	44.44	40.00	44.44	40.00	44.44
Sucrose	15	16.67	15.00	16.67	15.00	16.67	15.00	16.67	15.00	16.67	15.00	16.67
Mangosteen peel extract	21.45	23.83	21.45	23.83	21.45	23.83	21.45	23.83	21.45	23.83	21.45	23.83
Citric acid	0.3	0.33	0.30	0.33	0.30	0.33	0.30	0.33	0.30	0.33	0.30	0.33
Flavor	0.25	0.28	0.25	0.28	0.25	0.28	0.25	0.28	0.25	0.28	0.25	0.28
Water	13	14.44	13.00	14.44	13.00	14.44	13.00	14.44	13.00	14.44	13.00	14.44
Gelatin**	5.4	6.00	6.3	7.00	7.2	8.00	8.1	9.00	9	10.00	9.9	11.00

*wet basis
**The gelatin on each treatment based on the percentage concentration of the total ingredients (90 g)

The parameter which was observed were the physical, chemical, and sensory properties. The physical property was elasticity; chemical

properties were water content, ash content,levels of reducing sugars and sucrose; and sensory properties were color, aroma, flavor, and texture. This research also measured the xanthone concentration of the best characteristic mangosteen peel soft candy.

RESULTS AND DISCUSSION

Elasticity

The physical properties measured in this research was elasticity. The elasticityof the mangosteen peel softcandiesranged from 370.213 to 500.770 g/mm^2. The elasticities weresignificantly different at α=0.01 for each treatment (Table 2).

Table 2 Physical and Chemical Properties of Mangosteen Peel Soft Candies with Different Gelatin Concentrations

Parameter	6%	7%	8%	9%	10%	Sig	r^2
Elasticity (g/mm^2)	370.213±0.006^e	460.970 ±0.005^d	471.314±0.006^c	476.210 ±0.000^b	500.770± 0.005^a	0.000*	0.871
Water Content (%)	19.028±0.0061^e	19.454± 0.0059^d	19.758±0.0055^c	19.961± 0.0055^b	20.021±0.0045^a	0.000*	0.926
Ash Content (%)	0.111±0.002^e	0.132±0.003^d	0.207±0.006^c	0.272±0.004^b	0.307±0.006^a	0.000*	0.974
Reducing Sugar (%)	4.779±0.009	4.779±0.010	4.776±0.004	4.775±0.004	4.777±0.003	0.171	0.500
Saccharose (%)	55.114±0.012	55.115± 0.014	55.119±0.002	55.118± 0.003	55.115±0.003	0.942	0.133

*Significantly different (α=0.01)

The increasing concentration of gelatin increased the mangosteen peel soft candy elasticity. This was estimated byits function as a gelling agent. Gelation occured due to the formation of three-dimensional mesh or network by primer molecules spanning the entire volume of the gel formed by the concurrent amount of water on it. The occurrence of crosslinking the polymers consisting of a molecular chain length in sufficient quantities will be formed of the three-dimensional continuous so that the solvent molecules will be trapped in between, occurs immobilization solvent molecules and form a rigid and tough structure that hold to force and certain pressure. If the gelatin concentration is too low, the texture of the candy that formed is soft, nevertheless the concentration is too high,the gelatin texture will be like chewing gum (Rahmi, 2012).

Chemical Properties

Water Content

The water content of mangosteen peel softcandiesranged from 19.028 to 20.021%. They were significantly different at α=0.01 for each treatment (Table 2).The water contents of 6%, 7%, 8%, and 9% gelatin were fit to the SNI requirement of soft candy's water content (max 20,0%).

The increasing concentration of gelatin increased the water content of the candy. This result accorded to the Rahmi et al (2012) that showed the increasing of gelatin concentration increased the water content of jelly candies. Gelatin is a gelation agent that would bind the water. Gel formation is a phenomenon or crosslinking polymer chains to form a continuous three-dimensional mesh, then nets can capture or immobilize the inside water that form a strong and rigid structure. The addition of gelatin concentration would bind more water to gel formation (Nelwan, 2014).

Ash Content

The ash content of mangosteen peel soft candies ranged from 0.111 to 0.307%. They were significantly differentat α=0.01 for each treatment (Table 2). The ash content of all treatments were fit to the SNI requirement of soft candy's ash content (max 3,0%).The increasing concentration of gelatin increased the ash content of the candy. This was presumably that gelatin donate the largest mineral to the candy. Gelatin contains minerals 2-4% (Nelwan, 2014).

Reducing Sugar

The reducing sugar of mangosteen peel soft candy levels ranged from 4.775 to 4.779% (Table 2). There was no significant difference between the levels of mangosteenpeel soft candy reducing sugars made with different concentrations of gelatin.The reducing sugar of all treatments were fit to the SNI number 3547-2-2008 requirement of soft candy's reducing sugar (max 25%).

Saccharose

The mean of saccharose levels ranged from 55.114 to 55.119% (Table 2). There was no significant difference between the levels of mangosteen peel soft candy sachacrose made with different concentrations of gelatin.The saccharoseof all treatments were fit to the SNI requirement of soft candy's saccharose (min 27%).

Sensory Properties

The sensory properties determine level of consumer acceptance to a product in the market.Sensory quality of mangosteen peel soft candy was measured through hedonic quality test and hedonic test. The tests were followed by 20 semi-trained panelists.

Hedonic Quality Scores

There were four parameters that were measured in hedonic quality test. They were color, taste, flavor, and texture. The mean values of hedonic quality mangosteen peel soft candy can be seen in Table 3.

Table 3 Hedonic Quality Scores of Mangosteen Peel Soft Candies with Different Gelatin Concentrations

Parameter	6%	7%	8%	9%	10%	Sig
Color	4.24±0.02 a	4.00±0.00 b	3.64±0.06 c	3.49±0.05 c	1.66±0.12 d	0.000 *
Taste	4.05±0.00	4.05±0.05	4.07±0.03	4.05±0.15	4.03±0.06	0.989
Flavor	4.25±0.05	4.25±0.05	4.27±0.03	4.27±0.08	4.22±0.08	0.833
Texture	1.75±0.15 d	3.25±0.46 c	4.08±0.06 b	4.13±0.08 b	4.92±0.03 a	0.000 *

Color: 1= Brown; 2=Brownish; 3= Brownish red; 4= Red; 5= Magenta red
Taste: 1=Very not sweet-sour; 2= Not sweet-sour; 3= Slightly sweet-sour; 4= Sweet-sour; 5= Very sweet-sour
Flavor: 1= Very typical flavor; 2= Not typical flavor; 3= Slightly typical flavor; 4= Typical flavor; 5= Very typical flavor
Texture: 1= Very not chewy; 2= Not chewy; 3= Slightly chewy; 4=Chewy; 5= Very chewy
*Significantly different (α=0.01)

Color

The hedonic quality scores of mangosteen peel soft candy color with gelatin concentration of 6%, 7% and 10% significantly different at α 0.01 in each treatment, while at the concentration of 8% and 9% were not significantly different. The color of 6% gelatin was 4.25 (magenta-red). The color of 7% gelatin was 4.00 (red). The colors on the hedonic quality gelatin of 8% and 9% were not significantly different respectively at 3.65 and 3.45 (brownish red). The poorest color was on 10% gelatin i.e 1.70 (brown). The increasing concentration of gelatin made the mangosteen peel soft candy become more brownish. This is presumably because the brownish-yellow gelatin so that the gelatin used increasingly causing the red color browner

jelly beans (Rahmi, 2012). Another research results the increasing the concentration of green tea then there is an increase the color of hard candy is yellow to rather greenish yellow (Pujilestari, 2017).

Taste

The hedonic qualityscores ofmangosteen peelsoft candy taste ranged from 4.03 to 4.07 with a description of the sweet-sour taste. The lowest value was at a 10% gelatin and the highest wasat 8% gelatin. There was no significant difference between the taste of the candies were made with different gelatin concentrations.

Flavor

The hedonic qualityscores ofmangosteen peelsoft candy flavor ranged from 4.22 to 4.27 with a strong aroma descriptions (typical flavor). The lowest value was at a 10% gelatin and the highest wasat 8% and 9%.There was no significant difference between the flavor of the mangosteen peel soft candies were made with different gelatin concentrations.

Texture

The hedonic qualityscores ofmangosteen peelsoft candy texture for gelatin concentration of 6%, 7% and 10% significantly different at α=0.01. There was no significantly different of candies's texture with8% and 9% gelatin. The lowest scorewas at 6% gelatin, i.e 1.75 (very chewy). And the highest was at 10%, i.e gelatin (very chewy-chewy). The score of the hedonic quality textures with gelatin 7%, ie 3.25 (a bit chewy). While the score of the hedonic quality gelatin texture with 8% and 9% gelatin were not significantly different respectively at 4.08 and 4.13 (chewy).

The increasing concentration of gelatin affected on the increasing scores of mangosteen peel soft candies's texture. These results were consistent with the results of viscosity tested by Texture AnalyzerTMS.Pro. that showed the higher the level elasticity as the higher gelatin concentration. We also correlated the candy's elasticity with the hedonic quality score of texture. There was a strong correlation between elasticity with the hedonic quality score of texture (0,97) [Table 4].

Table 4 Correlation of Mangosteen Soft Candies Elasticity with the Hedonic Quality Score of Texture

Gelatin Concentration	Elasticity (g/mm^2)	Hedonic Quality Score of Texture
6%	370.213	1.75
7%	460.97	3.25
8%	471.314	4.08
9%	476.21	4.13
10%	500.77	4.92
r^2		0.971077545

Gelatin roles as gelling agent. Gelation occurs because of the three-dimensional mesh or network formation by primer molecules spanning to the entire volume of the gel formed by the concurrent amount of water on it. The formation of polymers crosslinking consisted of a length chain molecular in sufficient quantities willform the three-dimensional continuous so that the solvent molecules will be trapped in between, occurs immobilization solvent molecules and form a rigid and tough structure for resilient force and certain pressure. If the gelatin concentration is too low, the texture of the candy is too soft, andif the concentration is too high,the texture will be like chewing gum (Rahmi, 2012).

Hedonic Scores

A hedonic test is one of anacceptance test. In this test panelists asked to reveal personal feedback about likes and dislikes about the product. The levelof likes and dislikes called hedonic scale e.g like very much, like, slightly like, dislike, and dislike very much. Hedonic scale can be stretched or narrowed according to the desired scale. In this analysis,the hedonic scale was transformed into a numerical scale with ascending numbers according to the level of preference. The meanvalue of the hedonic the mangosteenpeel soft candy can be seen in Table 5.

Table 5 Hedonic Scores of Mangosteen Peel Soft Candy with Different Gelatin Concentrations

Parameter	6%	7%	8%	9%	10%	Sig
Color	4.57±0.08^{a}	4.12±0.06^{b}	3.98±0.06^{bc}	3.83±0.06^{c}	2.80±0.05^{d}	0.000*
Taste	4.18±0.03	4.20±0.13	4.22±0.10	4.20±0.13	4.13±0.13	0.905
Flavor	3.57±0.15	3.63±0.13	3.65±0.10	3.57±0.16	3.30±0.23	0.125
Texture	1.78±0.06^{d}	3.13±0.12^{b}	4.73±0.06^{a}	4.53±0.06^{a}	2.18±0.18^{c}	0.000*

Color: 1= Dislike very much; 2=Dislike; 3= Like slightly; 4= Like; 5= Like very much
Taste: 1= Dislike very much; 2=Dislike; 3= Like slightly; 4= Like; 5= Like very much
Flavor: 1= Dislike very much; 2=Dislike; 3= Like slightly; 4= Like; 5= Like very much
Texture: 1= Dislike very much; 2=Dislike; 3=Like slightly; 4= Like; 5= Like very much
*Significantly different (α=0.01)

Color

The hedonic scores of candies color ranged from from2.80 to 4.57 (dislike, like slightly, and like). The 6% gelatin had the highest score and the 10% gelatin had the lowest score. The hedonic scoresofcandies colorwith6% and 10% gelatin was significantly different, while hedonic color with 7% gelatin was not significantly different from the 8% gelatin. The hedonic color of 8% gelatinwas not significantly different from the 9% gelatin.

Taste

The hedonic scoresofcandiestasteranged from 4.13 to 4.22 (like) with a description of the sweet-sour taste. The highersscorewas at 8% gelatin and thelowest was at10% gelatin. There was no significant differenceofmangosteen peel soft candies taste with different gelatin concentrations.

Flavor

The hedonic scoresofcandies flavor ranged from from 3.30 to 3.65 (like slightly). The highestscore was at 8% gelatin and thelowest was at10%. There was no significant differenceof mangosteen peel soft candies flavor with different gelatin concentrations.

Texture

The hedonic scoresofcandiestextureranged from from1.78 to 4.73 (dislike very much, dislike, like slightly, like). There was significant difference

of the mangosteen peel soft candiestexture with 6%, 7%, and 10% gelatin (dislike very much, like slightly, and dislike) while there was no significant difference of mangosteen peel soft candies texture with 8% and 9% gelatin. The highest texture score was the candies with 8% gelatin (like).

Xanthone Concentration

The xanthone concentration was only analyzed to the selected mangosteen peel soft candy. The selected candy was 8% gelatin of candy which had the highest score of hedonic scores (taste, flavor, and texture).The elasticity was 471.314 g/mm², the water content was 19.758%, the ash content was 0.207%, the reducing sugar content was 4.776%, and the saccharose content was 55.119%. The sensory characteristics based on the test results of the organoleptic quality of the choices mangosteen peel soft candy was brownish red color, sweet-sourtaste, strong aroma (typical flavor), and chewy texture.

In this research, we analyzed the xanthone content of mangosteen peel, mangosteen peel extract, and mangosteen peel soft candy. The xanthone content of mangosteen peel was107.76 mg per 100 g; the mangosteen peel extract was 99.25 mg per 100 g; and the mangosteen peel soft candy was 20.05/100 mg (Picture 2).

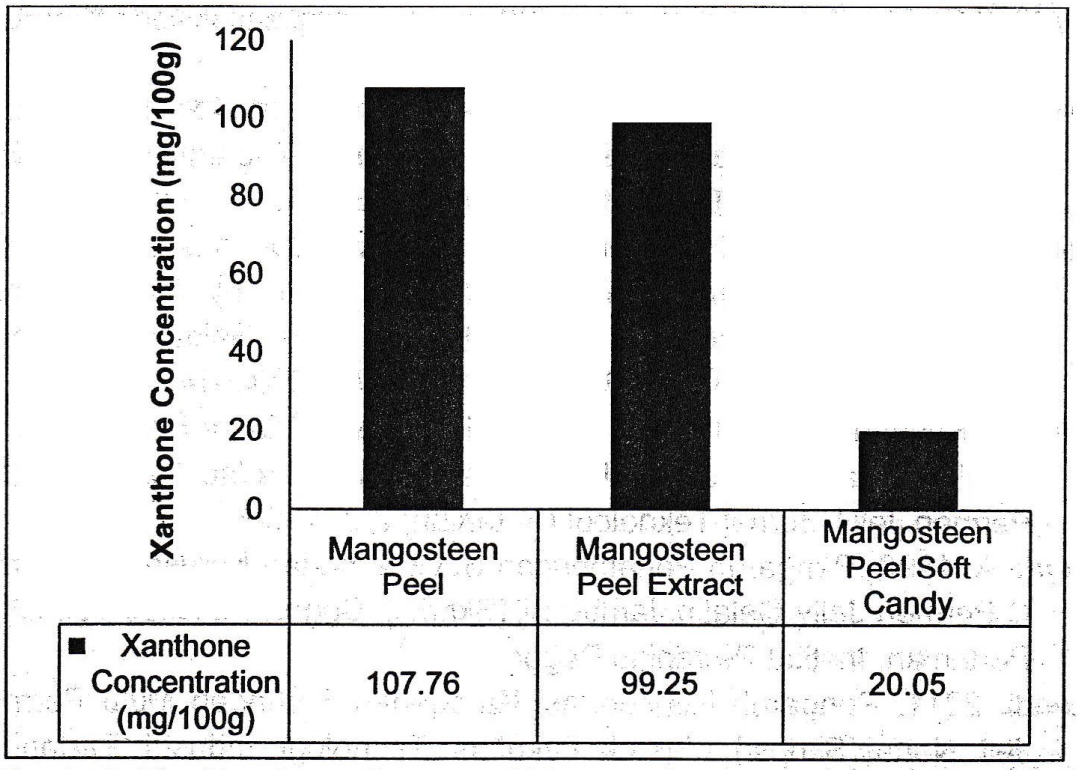

Figure 2. The Xanthone Content of Mangosteen Peel, Mangosteen Peel Extract, and Mangosteen Peel Soft Candy with 8% Gelatin.

This result was higher than Pidianti (2012) which had 70.40-94.54 mg/100g. The mangosteen peel soft candy had the lowest xanthone content. The decreasing level of xanthonewas caused bythe process of blanching/heating, according to the research Arry, et al (2011), xanthone activity/content may decrease due to the heating process.

CONCLUSION

There are differences in the physical property (elasticity), chemical properties (water and ash content), and sensory properties: hedonic quality test (color and texture) and hedonic test (color and texture). The selected formulation was set by the highest texture score of hedonic with a concentration of gelatin 8% that have characteristics: elasticity 471.314 g/mm^2, water content 19.758%, ash content 0.207%, reducing sugar content 4.776%, sacharose content 55.119%. The hedonic quality of mangosteen peel soft candy with 8% gelatin had brownish red color, sweet-sour taste, strong aroma (typical flavor), and chewy texture. The xanthone concentration was 20.05 mg/100 g sample.

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