

The Effect of Toting up Carrageenan to Some Quality Components of Ice Cream

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Abstract: This study aims to determine the effect of toting up carrageenan to the quality component of ice cream. Randomized Completely Block Design (RCBD) was used in this experiment, namely the addition of carrageenan (0.1%, 0.3%, 0.5% and 0.7%). Parameters to be observed were chemical properties (fat content and reducing sugar levels, and physical properties including organoleptic tests (taste, texture and aroma). Data Analysis were tested by ANOVA and continued using the orthogonal polynomial method for chemical parameters while the physical parameters used the Least Significant Difference (LSD). The results indicate that the toting up of carrageenan has a significant effect on fat content but does not have a significant effect on reducing sugar levels in ice cream. However, in the organoleptic test, the taste, texture and aroma hedonic gave a significantly different effect, but for the organoleptic test of taste and texture, the scoring also gave significantly different effects but did not significantly affect the organoleptic aroma test. The toting up of 0.5% carrageenan used in making ice cream is the best treatment, both in terms of taste, texture and aroma preferred by the panelists.

Keywords: Carrageenan, Quality, Yellow Pumpkin, Yellow Sweet Potatoes, Ice cream

I. INTRODUCTION

Yellow Pumpkin and Sweet potatoes that are quite popular in Indonesia that have nutritional content such as carbohydrates, protein, vitamins A, B1 and C so that it can be a potential source of nutrient. The high production of pumpkin and sweet potatoes in Indonesia is not balanced with the utilization. As a food ingredient, yellow pumpkin and sweet potatoes are usually only processed as compote, or boiled, in addition to making traditional cakes, both has nutritional potential and bioactive components such as carotenoid in the form of beta-carotene, and has not been optimally utilized. One of the reasons is the limited public knowledge of the benefits of these food commodities. In fact, yellow pumpkin and sweet potatoes can also be processed into nutritional enhancing snacks for the family. One of the efforts to develop -based food products is the manufacture of ice cream [14]. Ice cream is a frozen food product made through a combination of freezing and agitation processes consisting of milk, sugar, whipped cream, egg yolk and salt. In making ice cream, a stabilizer is needed that can bind water. The results of the study using purple sweet potato in making ice cream and as a stabilizer using agar obtained purple sweet potato can bind water to ice cream products so that it can maintain the

level of melting and water-binding capacity of ice cream products [6].

The stabilizer serves as an emulsion, which is to form a micro-sized membrane to bind fat, water and air molecules. This way the water won't crystallize and the fat won't harden. The stabilizer also thickens the dough, so that the membranes can be stable. Other common stabilizers used in the manufacture of ice cream are CMC (carboxymethyl cellulose), gelatin, Na-alginate, carrageenan, gum arabic and pectin. Various types of stabilizers are thought to have different effects on the quality of ice cream [13].

The stabilizer that will be used in this research is carrageenan. Carrageenan is a compound that belongs to the galactose polysaccharide group extracted from seaweed. Carrageenan is able to prevent the emergence of large ice crystals and the taste (flavor) can be felt clearly and melts in the mouth well, but when the carrageenan concentration is increased again to 0.70%, it turns out that the liking level decreases. Therefore, the optimal or appropriate carrageenan concentration is in the range 0.10% - 0.50% [16]. The results of the research by Masykuri et al. [7] using carrageenan in chocolate ice cream showed that giving 0.5% carrageenan was able to improve the physical texture of the ice cream and the level of preference for the panelists. Based on the results of this study, a research has been carried out on "The Effect of Addition of Carrageenan to Some Quality components of Ice Cream. This research aims to determine the effect of the addition of carrageenan on several chemical properties (reducing sugar and fat content) and organoleptics (taste, aroma and texture) of ice cream.

II. MATERIALS AND METHODS

The yellow squash of pumpkin and sweet potatoes are cleaned from the skin using a knife and then washed using running water until the sap and dirt attached to the pulp is completely clean, and then steamed for 15 minutes. After steaming, then mashed using a blender for 3 minutes until it becomes a paste then finally weighed in the amount of 3000 g, the amount of carrageenan (0%, 0.1%, 0.3%, 0.5% and 0.7%) used in making ice cream., Mixing carrageenan into the mixture, sugar (75 g), carrageenan solution and salt (7 g) are cooked with 100 ml water until boiling (for 5 minute). Then cooled, mix ingredients such as sugar solution, skim milk (30 g) and full cream milk (30 g) for 25 seconds at a temperature of 80°C. After it is cooled, the pasteurized ingredients are then

mixed with other ingredients such as coconut milk (100 ml) and egg yolk (5 g). then homogenized using a mixer for 15 minutes, the ice cream dough that has been put into a container then stored in the freezer for 4 hours at a temperature of -5°C. After the ice cream is processed, then the ice cream is mashed again until it melts using a mixer for 5 minutes. Then the smooth ice cream is place into the container again and the mashed ice cream is put into the container and stored for 12 hours at a temperature of -20°C. The parameters observed in this study were chemical fat, protein, reducing

sugar content [11] and organoleptic parameters taste, texture and aroma [9]. The experimental design used in this study was a RCBD with a single factor, namely the concentration of carrageenan (0%, 0.1% , 0.3%, 0.5% and 0.7%), and triplicate. The observed data were analyzed for diversity (analysis of variance) at the 5% significance level using Co-Stat software. then it is further tested with the Orthogonal Polynomial method for chemical tests and using the Least Significant Difference Test (LSD) for organoleptic parameters at the same level [5].

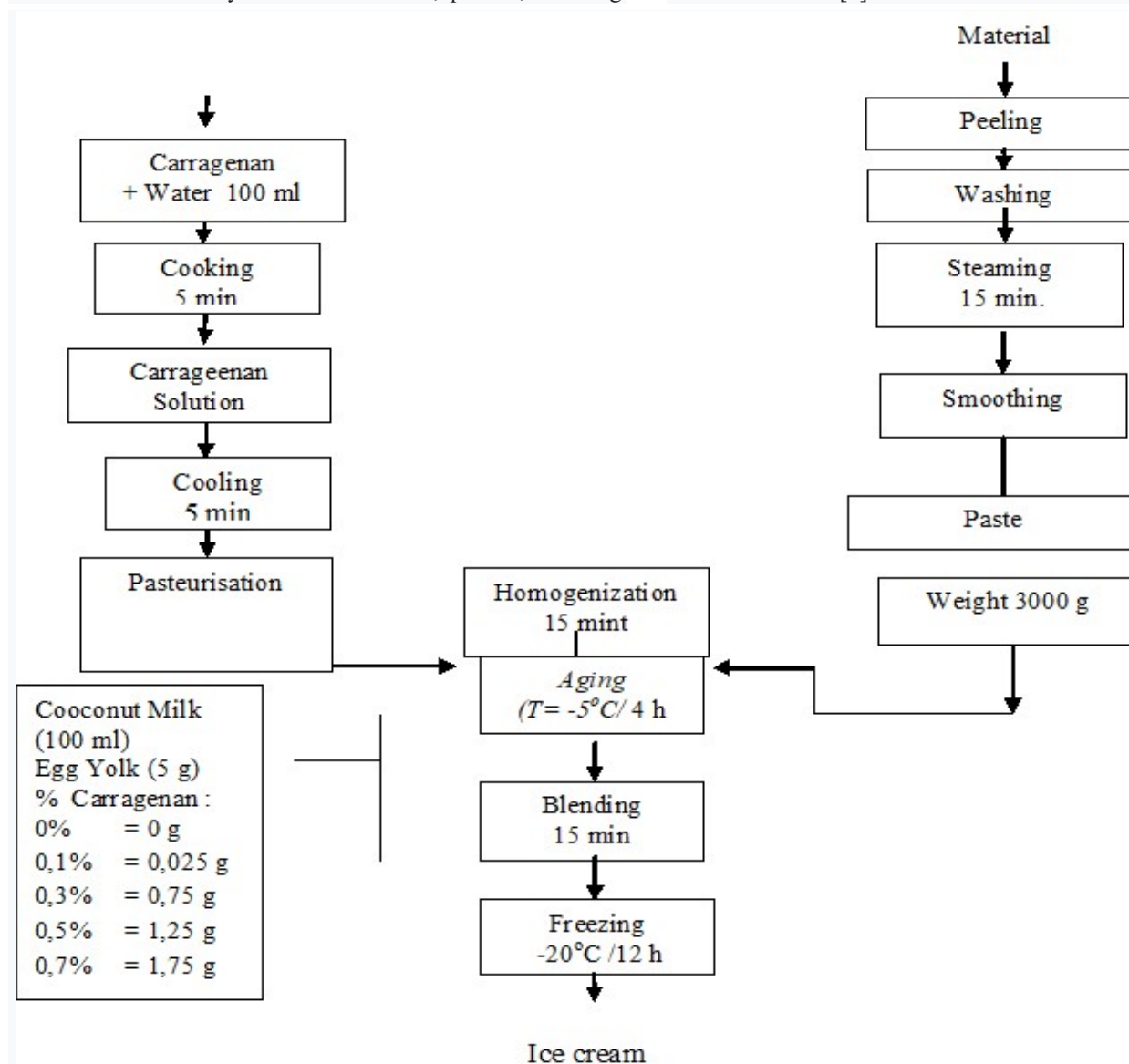


Fig 1. Flowchart of Making of Ice Cream

III. RESULTS AND DISCUSSION

1. Fat Content

Based on the data from the observation and analysis of variability, the addition of carrageenan has a significant effect

on the fat content of ice cream. Therefore, further tests were carried out with Orthogonal Polynomials to determine the tendency of the fat content in each treatment (Fig. 2.).

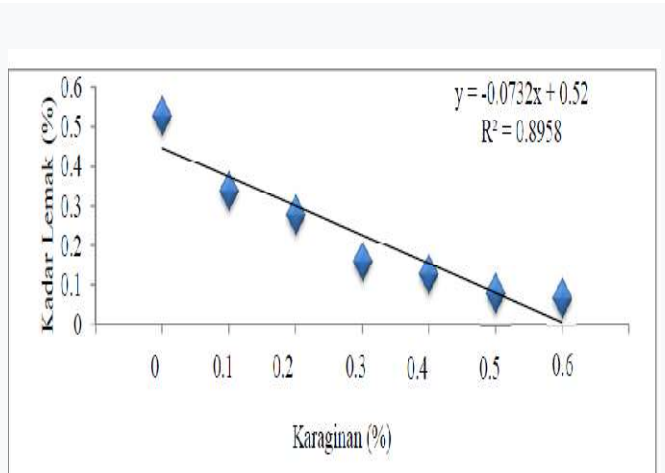
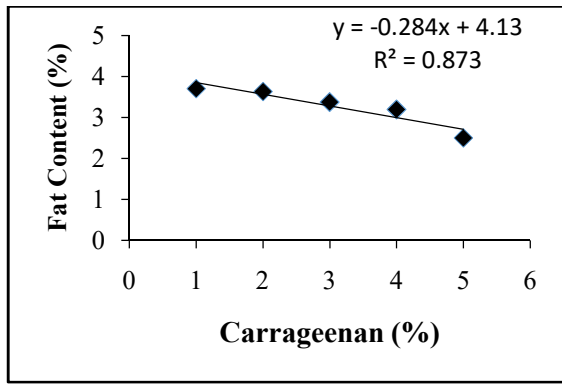


Figure 2. Effect of Carrageenan Addition on Fat Content of Pumpkin Ice Cream (above) and Sweet Potatoes Ice Cream.(below)

Based on the results of the study, the more additions of carrageenan the low fat content of ice cream. This probably occurs because carrageenan is hydrophilic, so that the addition of carrageenan will cause the hydrophilic group to absorb water and be able to increase the emulsion by increasing the viscosity of the water phase and increasing viscosity. This is supported by the opinion of Fardiaz [4], that carrageenan is able to increase the viscosity of the water phase so that it can prevent or reduce the tendency of fat globules to move and join with other globules. The fat content of pumpkin ice cream with treatment 0%, 0.1, 0.3, 0.5 and 0.7% in this study is not in accordance with SNI for ice cream 01-3713-1995 [11], that the fat content in ice cream is minimum 5.0% and the results of the research on the fat content of pumpkin ice cream of 3.70%, it can be said that the fat content in pumpkin ice cream is still very low, so it does not meet the SNI for the fat content of ice cream. Based on the Orthogonal Polynomial test, it is known that the most appropriate line is on the linear line with a coefficient of $y = -0.284x + 4.13$ with $R^2 = 0.873$. The value $-0.283x$ determines the direction of linear regression, because the value is negative, it shows a negative relationship, meaning that more carrageenan is added, it will decrease the fat content of pumpkin ice cream by 0.28%. The value 4.13 means a constant value, so that at the value $(x) = 0$, the fat content is 4.13%. The coefficient of determination is 0.873. By rooting the value 0.873 obtained 0.934. The rooting result

(0.934) is the coefficient of correlation, meaning that the close correlation between fat and treatment (independent variable) is 0.934. The meaning of the correlation value can be seen in the appendix. The value of 0.934 is in the very strong category. Then the determinant coefficient of 0.934 means that 93.4% change in fat content is influenced by the treatment (the addition of the amount of carrageenan concentration) and the remaining 6.6% (100% -93.4%) is another factor outside the variable.

The addition of carrageenan in the manufacture of yellow sweet potato ice cream gives a significant effect on fat content of yellow sweet potato ice cream. So that further tests were carried out using Orthogonal Polynomials to determine trend of fat content in each treatment. If seen from the chemical composition of carrageenan which is 0.13% and levels yellow sweet potato ice cream fat with the addition of 0.1% carrageenan treatment up to 0.7% in this study is not in accordance with SNI for ice cream 01-3713-1995 which requires the fat content that ice cream must have at least 5.0%. The ice cream produced in this study is included in the low type of ice cream fat which can help consumers who are running a diet program. Based on the Orthogonal Polynomial test it is known that the line is the most right is on a linear line with a coefficient of $y = -0.073x + 0.52$ with $R^2 = 0.895.49$. The value of $-0.073x$ determines the direction of the linear regression, because the value is negative, then shows a negative relationship, meaning that more carrageenan is added it will cause a decrease in fat levels of yellow sweet potato ice cream by 0.07%. Value 0.52 means a constant value, so that at value $(x) = 0$, then fat content of 0.52%. The coefficient of determination shows the amount of 0.895. By rooting the value of 0.895, the result is 0.946. Root results (0.946) is the coefficient of correlation, meaning the closeness of the correlation between fat and treatment (independent variable) of 0.946. The meaning of the correlation value can be seen in the attachment. The value of 0.946 is in the very strong category. Then The coefficient of determination is 0.946 which means that 94.6% of the change in fat content influenced by treatment (increasing the number of carrageenan concentration) and the rest 5.4% (100% - 94.6%) is another factor outside the independent variable.

2. Reducing Sugar

It can be seen that the use of carrageenan here does not have a significant effect even though there is a tendency to increase in reducing sugar levels with more carrageenan concentrations added. The lowest reduction sugar analysis results were obtained in the treatment without the addition of 0% carrageenan, amounting to 2.35%, while the highest reducing sugar was obtained in the addition of carrageenan with a concentration of 0.7% of 3.23% (Fig. 3).

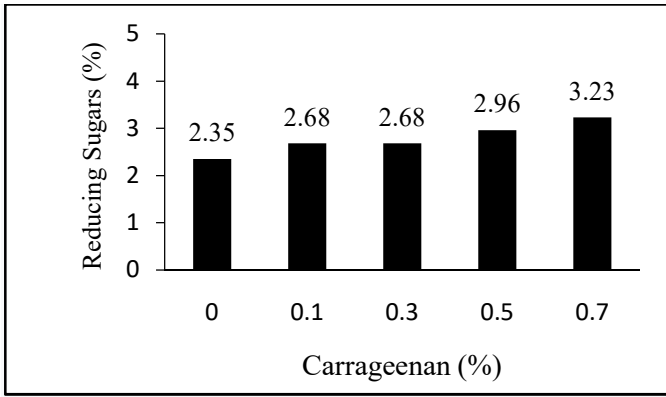


Figure 3. The Effect of Carrageenan Addition on Reducing Sugar in Pumpkin Ice Cream

The greater the concentration of the addition of carrageenan in making ice cream, it will increase the reducing sugar content. The results of the analysis of variance showed that the carrageenan concentration treatment had no significant effect on the reducing sugar of pumpkin ice cream. The reduction sugar in pumpkin ice cream with the addition of carrageenan concentrations of 0.1% to 0.7% is increasing because carrageenan is more easily broken down to simpler molecules so that the component of simple sugar (reducing sugar) more available. According to Winarno [17], sucrose which is dissolved in water and heated will decompose into glucose and fructose which is called invert sugar. This is reinforced by the opinion of Desrosier [3], that sucrose is non-reducing because it does not have a hydroxyl group which is reactive, but during heating and in the presence of acid, sucrose can be hydrolyzed to invert sugar, namely fructose and glucose. According to SNI No. 01-3713-1995, that the sugar content in ice cream is a minimum of 8.0% and the results of the research on the sugar content of pumpkin ice cream are 3.23%, the sugar content in pumpkin ice cream is still very low, so it does not meet the SNI requirement.

3. Protein Content

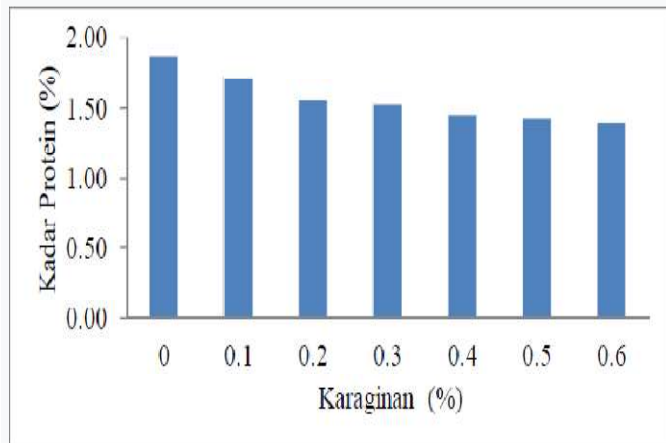


Figure 4. Effect of Carrageenan Addition on Protein Content of Sweet Potato Ice Cream

The addition of carrageenan lowering protein content of yellow sweet potato ice cream, this is probably due to carrageenan is a polysaccharide. This result is supported by the opinion of Abubakar [1] that carrageenan can bind to proteins to become proteocarragenates, so that increase the surface area that can absorb or bind water. In this study, protein content of yellow sweet potato ice cream was not in accordance with SNI for ice cream 01-3713-1995

4. Organoleptic Taste

Based on Table 1 it can be seen that the addition of carrageenan has a significantly different effect on the level of preference for ice cream both hedonic and scoring. Whereas with the addition of carrageenan, the panelists response to the organoleptic taste hedonic has started to like the taste of ice cream from the criteria of somewhat like to like. In the treatment without the addition of carrageenan, the response of the panelists to the taste value of ice cream showed the criteria were rather like, because in the 0% carrageenan treatment there were still ice crystals in the ice cream dough so that the panelists did not like the taste of ice cream, whereas with the addition of carrageenan, namely 0.1%, 0.3%, 0.5% and 0.7% of panelists' responses to the value of pumpkin ice cream have shown like criteria, because with the addition of carrageenan the texture of the ice cream has begun to form so that the panelists' assessment has started to like the taste of pumpkin ice cream. yellow. This is because the higher the carrageenan concentration added will increase the sugar content in ice cream. The highest level of preference for adding carrageenan in making ice cream is the addition of carrageenan at 0.5% of 4.33 with the criteria of liking for the hedonic organoleptic test and for scoring that the highest level of preference for panelists is obtained in the addition of 0.7% carrageenan at 4.13 with sweet criteria. While the lowest results were obtained in the addition of 0% carrageenan at 3.47 hedonic testing and for testing by scoring the lowest results can be seen in the addition of k1 of 3.40 with the criteria a bit sweet. According to Winarno [16], the addition of 0.5% carrageenan in ice cream making is the optimal and maximum concentration, so that the higher the addition of carrageenan will affect the taste and texture of the ice cream. Carrageenan is able to prevent the emergence of large ice crystals and the taste (flavor) can be felt clearly and melts in the mouth well, but when the carrageenan concentration is increased again to 0.70%, it turns out that the liking level decreases. Panelists' love for the texture of ice cream will affect the taste of the resulting ice cream. If the texture of the ice cream is getting soft it will affect the taste of the ice cream. Apart from that it was also influenced with the addition of increasing carrageenan concentration. This matter supported by the opinion of Sinurat [10] that carrageenan functions as a thickener, gelling and stabilizer. So that the taste produced from sweet potato ice cream This yellow is the sweet potato taste

This is because the higher the carrageenan concentration added will have a significant effect on the change in the

texture of pumpkin ice cream. According to research by Masykuri et al [7], the addition of 0.5% carrageenan in the manufacture of chocolate ice cream can have an effect on the physical texture of the ice cream. This is because carrageenan is a stabilizer that can bind free water to food so that it can reduce the formation of small crystals in the ice cream dough. The highest level of preference for panelists to the texture of pumpkin ice cream was obtained at the addition of carrageenan 0.5% of 4.00 with the criteria of liking for the hedonic organoleptic test and for scoring that the highest level of preference for the panelists was also obtained in the same treatment, namely the addition of 0.5% carrageenan of 4.00 soft criteria. While the lowest result was obtained at the addition of 0% carrageenan at 3.20 with the criteria rather like for hedonic testing and for testing by scoring the lowest result on without the addition of 0% carrageenan at 2.87 with rough criteria. This is because there is no addition of carrageenan, so the texture of the resulting ice cream feels rougher when compared to the addition of carrageenan, but overall the panelists like the texture. The use of carrageenan should not exceed the maximum capacity limit, because it will decrease the quality of a product, for example in ice cream making products, if the addition of carrageenan exceeds the usage limit, the resulting product will have a rough and hard texture. This is in accordance with the opinion of Widjanarko [15], which states that the amount of carrageenan added in food / beverage products must be in a small amount, because it will produce a rough texture. The addition of 0.15% - 0.2% carrageenan in dairy products prevents the separation of whey or milk liquid. The carrageenan concentration has a significantly different effect on texture of yellow sweet potato ice cream by hedonic test (Table 1) It is known that addition treatment carrageenan has a significant effect on the texture of sweet potato ice cream yellow sweet. The panelist's preference level scale for the yellow sweet potato ice cream color ranged from 3.33 to 3.87, i.e. like. Panelist response to texture in the addition of 0%, 0.5% and 0.6% carrageenan is not significantly different but in the treatment of 0.5% carrageenan is the highest score. This is probably due to the difference of carrageenan concentration used. This is in accordance with the Winarno [16] that carrageenan is very good at binding water so that the product does not dries quickly in air with low humidity, besides its excellent texture smooth can also be maintained.

Aroma

It can be seen that the addition of carrageenan has a significantly different effect on the level of preference. The aroma of ice cream is hedonic and does not have a significant effect on the organoleptic scoring of aroma

Table 1: Average of Organoleptic properties Scoring of Yellow Pumpkin Ice Cream and Sweet Potatoes Ice Cream.

Carrageenan	Taste		Texture		Aroma	
	Ypumpkin	Sweet	Ypumpkin	Sweet	Ypumpkin	Sweet
0%	3.47 b	3.61 b	3.20 b	3.33 b	3.60 b	3.73 c

0.1%	4.00 a	3.71 ab	3.47 b	3.57 b	3.87 ab	3.19 d
0.3%	3.87 ab	3.14 ab	3.33 b	3.47 b	3.47 b	3.47 c
0.5%	4.33 a	3.90 a	4.00 a	3.87 a	4.13 a	4.08a
0.7%	3.87 ab	3.87 a	3.60 ab	3.63 ab	3.80 ab	3.67 b

Whereas with the addition of carrageenan, the panelists' response to organoleptic aroma hedonic has begun to like the aroma of ice cream with like criteria. Whereas the panelist response to the organoleptic test of ice cream aroma by scoring without the addition of 0% carrageenan is 3.60, the addition of 0.1% carrageenan is 3.87, the addition of 0.3% carrageenan is 3.47, the addition of carrageenan is 0.5% by 4.13 and the addition of carrageenan is 0.7% is 3.80 that carrageenan did not significantly influence the organoleptic aroma test by scoring. According to Winarno,[16] the addition of carrageenan in the manufacture of ice cream has properties as a stabilizer, so that the higher the addition of carrageenan will affect the taste and texture of the ice cream. The highest level of preference for the panelists for the aroma of pumpkin ice cream was obtained in the addition of 0.5% carrageenan at 4.13 with the criteria of liking for the hedonic test and for the scoring test that the highest level of preference for panelists was also obtained in the addition of 0.5% carrageenan and 0.7% carrageenan, respectively. 3.80 with the criteria of a pumpkin flavor. While the lowest result was obtained in the addition of carrageenan at 0.3% of 3.47 with the criteria rather like it for the hedonic organoleptic test and the lowest result scoring can be seen in the addition of carrageenan at 3.13 with the criteria a little pumpkin flavor.

The carrageenan concentration has a significantly different effect on yellow sweet potato ice cream aroma by hedonic test (Table 1) and The addition of carrageenan has a significantly different effect on aroma yellow sweet potato ice cream. The panelist's preference level of the sweet potato ice cream color yellow ranges from 3.19 to 4.13 i.e. dislike to like. Panelist response to aroma in the addition of 0%, 0.5% and 0.7% carrageenan is not significantly different but in the treatment of 0.5% carrageenan is the highest score. The expected yellow sweet potato ice cream aroma is light yellow. The degree of brightness or color change is affected by addition of carrageenan. If more and more carrageenan is used it will affect the color of yellow sweet potato ice cream. This is supported by Winarno [16] argued that carrageenan is a complex mixture of some polysaccharides when in contact with heat will produce a different aroma.

Overrun

Overrun shows how much air is trapped inside ice cream mixture due to the agitation process (stirring). Overrun affects texture and density that greatly determine the quality of the ice cream. More and more the air cavities will cause the ice cream to quickly shrink and melt at this temperature room. Quality ice cream has an overrun of 70% to 80% while for

home industry 35% to 50% [8]. In Table 2. The test results of yellow sweet potato ice cream overrun with the addition of carrageenan in the range 0% to 0.7% resulted in an overrun value in accordance with the standards for the home industry which ranges from 40% to 50%. This is because yellow sweet potato ice cream is made up of solids instead of the surrounding fat 40% so as to produce a good overrun according to the ice cream quality standard Household scale.

Melting time

The melting rate is the time it takes for the ice cream to melt perfect. Good quality ice cream is resistant to ice cream melting. Ice cream that is coarse in texture and low in total solids will have low resistance to melting, so it will melt easily [2]. Ice cream is expected not to melt quickly at room temperature, however quickly melts at body temperature. So, ice cream with low melting resistance is more expected. In this study, the melting time of sweet potato ice cream yellow ranges from 30 to 85 minutes. This is likely because the addition of carrageenan used increases and the total solid contained in yellow sweet potato. And supported by the opinion of Winarno [16] that carrageenan in ice cream making with an increasing percentage increase the melt time (long melt time) of ice cream

Table 2: The Effect of Carrageenan Addition on Over run and Melting time of Sweet Potatoes Ice Cream

Carrageenan	Over run (%)	Melting time (min.)
0%	40.03a	30a
0.1%	44.17b	59b
0.3%	46.17c	72c
0.5%	48.28d	79d
0.7%	50.90e	82e

IV. CONCLUSION

The addition of carrageenan in ice cream has a significant effect on fat content but does not have a significant effect on reducing sugar. The addition of carrageenan by 0.5% to the organoleptic taste, texture and aroma is the highest score and is highly favored by panelists. The higher the carrageenan addition, preference panelist for the aroma, taste and texture of ice cream decreased. Carrageenan is a stabilizer and

thickener so as to avoid the formation of small crystals in the ice cream dough.

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