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Effect of Kappa-Carrageenan Concentration on Physical Properties of Carrot Pineapple Velva

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Abstract Velva is a frozen food product similar to ice cream, but velva has lower fat content. Velva contains high crude fiber and vitamin contents that come from fruits and vegetables. Pineapples and carrots were chosen as the main ingredients to produce velva. Yellow color from pineapple was found to be less attractive, so that the addition of orange color from carrots 77 make it more attractive. A stabilizer is needed to produce velva with appropriate characteristics such as smooth texture and hard-melted. The stabilizers used in this study was kappa-carrageenan. The research aimed to examine the effect of the various kappa-carrageenan concentration on the physicochemical properties (first drip, flow rate, color, and pH) of the carrot-pineapple velva. Based on the results of the study, it was found that by using kappa-carrageenan with a concentration of 0.25%, 0.50%, 0.75% and 1% (w/w) produced the first drip at 132.67 - 420.83 seconds with flow rate 1.41-0.55 cm/seconds, color with parameters lightness 47.45-47.50, redness +9.97 - +10.52, yellowness +17.50 - +18.33, chroma 20.79-21.57, and °hue 58.39 – 60.73, and pH 4.53-4.59. An increase in the concentration of kappa-carrageenan produces a thicker velva, so it is necessary to examine its organoleptic properties further.

Keywords: Velva, Pineapples, Carrot, Kappa-Carrageenan

1. Introduction

Velva is a frozen food product similar to ice cream, but velva has lower fat content. Velva contains high crude fiber and vitamin contents that come from fruits and vegetables. Pineapples and carrots were chosen as the main ingredients to produce velva. Yellow color from pineapple was found to be less attractive, so that the addition of orange color from carrots was proven to make it more attractive. A stabilizer is needed to produce velva with appropriate characteristics such as smooth texture and hard-melted. The stabilizers used in this study was kappa-carrageenan.

The addition of kappa-carrageenan affects viscosity and uniformity of velva, by making it more stable, can bind and control moisture during the freezing process [1]. Kappa-carrageenan also do not affect the product's taste, are effective at low pH, and can be well dispersed [2].

The research aimed to examine the effect of kappa-carrageenan concentration on the physicochemical properties (flow rate, first drip, color, and pH) of the carrot-pineapple velva produced. The concentration variations used were 0%, 0.25%, 0.50%, 0.75%, 1% (w/w).

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2. Methods

The experiment were conducted on September – November 2020 in Food Processing Technology Laboratory, Widya Mandala Surabaya Catholic University.

2.1 Raw Material

The ingredients used in the study were honey pineapple, carrots, kappa carrageenan, sugar, and mineral water.

2.2 The Research Design

A randomized block design (RBD) was used as the research design and four-factor levels, with six replications. The parameters tested were first drip, melting power, flow rate, pH, and color. The data obtained were tested by ANOVA (Analysis of Variance) with $\alpha = 5\%$. The ANOVA results showed a significant effect between each treatment and continued with Duncan's Multiple Range Test (DMRT) with $\alpha = 5\%$ to determine which treatments were significantly different.

2.3 The Research Design

Table 1. Product Formulation

Material (g)	Treatment			
	C1	C2	C3	C4
Pineapple Juice	80	80	80	80
Carrot Juice	80	80	80	80
Water	40	40	40	40
Sugar	40	40	40	40
Kappa-Carrageenan	0,5	1.0	1.5	2.0

2.4 First Drip Analysis [3]

The first drip is the time at which the sample begins to melt. The first drop test is carried out by recording the time of the first drop of the sample melt. A good sample is expected not to melt easily at room temperature.

2.5 Flow Rate Analysis [4]

The flow rate value was obtained from a distance traveled by the Velva dough to flow on a sloping glass plate per second with a sample weight of 15 grams and a glass plate tilt degree of 11.54°

2.6 Color Analysis with Color Grab Application

Color testing was done using a color reader. The carrot-pineapple velva was placed in a plastic cup. The sample was placed on a black mat with the lid open, and color measurements were taken under a lamp. In this test, values were obtained in the form of L (lightness), a* (redness), b*(yellowness), C (chroma), H (degree of hue).

2.7 pH Analysis

pH testing is done using a portable pH meter.

3. Results and Discussion

3.1 First Drip

The first drip is the time of the first drip in melting ice cream (frozen dessert). The constituent composition influences the first drip, the amount of air introduced, the nature of the ice crystals [5]. Based on the study results, the value of the first drip of carrot-pineapple velva produced was 132.67-420.83 seconds. Based on the results of the ANOVA test ($\alpha=5\%$), it can be shown that there was a significant difference in the concentration of kappa-carrageenan used against the first drip of carrot-pineapple velva. Furthermore, the DMRT ($\alpha=5\%$) test showed that there was a significant difference between treatments.

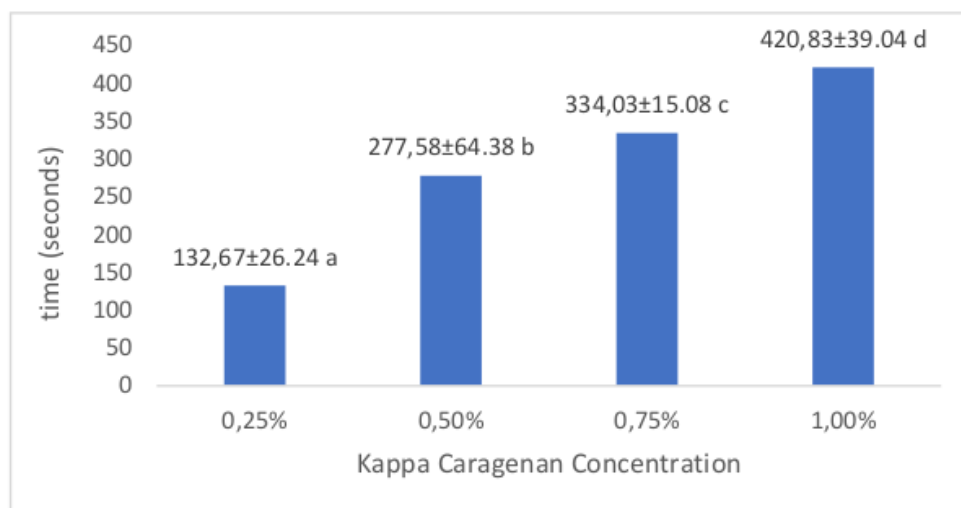


Fig.1 First Drip Analysis

The average of the first drips on the carrot-pineapple velva showed a significant increase. At 0.25% kappa-carrageenan concentration, the lowest value of the first drip was 132.67 seconds. The low first drip time indicates that the velva was easier to melt at room temperature. While the concentration of kappa-carrageenan 1% has the highest value of the first drip of 420.83 seconds. This results indicates the higher concentration of stabilizer used, the longer the time for the first drip on the velva. The first drip is affected by the size of the ice crystals formed during freezing associated with the recrystallization of ice. Kappa carrageenan works as a stabilizer that can control water by binding water during freezing. The increase in the first drip is caused by a decrease in the free water content bound by the stabilizer, which causes the size of the ice crystals formed during storage to be smaller so that it takes a longer time to melt [6].

3.2 Flow Rate Analysis

The flow rate is the distance traveled by a fluid divided by its time to travel the distance in cm/second [7]. Factors that can affect the flow rate are the viscosity of the solution, the degree of slope of the glass plate, the frictional force between the glass plate and the solution. The flow rate test was carried out using an inclined glass plate with a slope of 11.50°. Flow power has an inverse relationship with viscosity—the greater the flow rate, the lower the viscosity of the material. Based on the study results, the flow rate of carrot-pineapple velva was range from 1.41 to 0.55 (cm/second). Based on the results of the ANOVA test ($\alpha=5\%$), it can be shown that there is a significant difference in the

concentration of carrageenan to the flow rate in the carrot pineapple veins. Furthermore, the results of the DMRT ($\alpha=5\%$) test showed a significant difference between treatments.

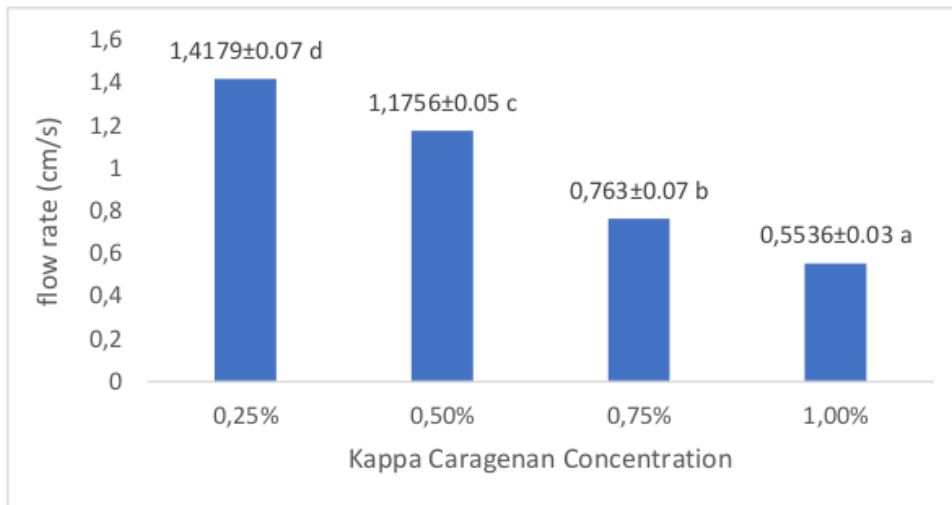


Fig. 2 Flow Rate Analysis

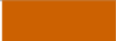



The average flow rate on the carrot pineapple valve showed that at a concentration of 0.25% kappa-carrageenan, the highest flow rate value was 1.4179 cm/second. While at a concentration of 1% kappa-carrageenan, the lowest flow rate was 0.5536 cm/second. The higher the concentration of kappa-carrageenan used, the lower the flow rate (slower). This results were caused by the characteristic of carrageenan which can form a gel and increase the thickness of liquid. The thickening of the valve makes the valve take longer to flow across the glass surface of the inclined plate. The viscosity of the carrageenan solution is mainly due to the characteristic of carrageenan as a polyelectrolyte. The repulsion between the negative charges along the polymer chain, namely the sulfate groups, causes the molecular chain to stiffen. Due to its hydrophilic nature, the polymer is surrounded by water molecules that are mobilized, causing the carrageenan solution to be more viscous [8]. Hydrocolloids can bind water and increase viscosity so that they can affect the quality of flowability [9]. Our results was also in line with the research conducted by Basito et al. [10] with the use of CMC and carrageenan stabilizer that increased the viscosity of the super red dragon fruit velva.

The best Velva qualities is its smooth texture and hard-melting character, so a stabilizer added to its manufacture. Increasing the concentration of kappa-carrageenan in the manufacture of carrot pineapple Velva has resulted in a product with a smooth texture and good durability in the melting process (the first drip is longer while the flow rate is slower). The results of this study can continue to obtain the best concentration to produce products that have organoleptic properties that are acceptable for consumers.

3.3 Color Analysis

Color is used as an indicator to determine the quality of a product. The data from the ANOVA test ($\alpha=5\%$) showed that there was no significant difference between carrageenan concentration and carrot-pineapple velva color. Pineapples and carrots were chosen as the main ingredients to produce velva. Yellow color from pineapple was found to be less attractive, so that the addition of orange color from carrots was proven to make it more attractive.

Table 2. Color Analysis with Color Grab Application

Kappa Caragenan Concentration	Lightness	Redness (a*)	Yellowness (b*)	Chroma	°Hue	Color
0.25 %	47.49±0.4	10.49±0.9	17.87±0.45	20.79±0.61	60.73±1.74	
0.50 %	47.5±1.24	10.51±0.59	18.33±0.23	21.2±0.2	60.65±1.03	
0.75 %	47.48±0.5	9.97±0.95	17.5±1.76	21.38±4.23	58.39±3.65	
1.00 %	47.45±1.06	10.52±0.69	18.23±1.26	21.57±0.91	60.08±3.21	

3.3.1 Lightness

The lightness value indicates the brightness level of carrot-pineapple velva. The value of the lightness range of the carrot pineapple velva was 47.45-47.50. Kappa-Carrageenan can bind water which causes the water content in the veins to decrease. With the decrease in the water content, the matrix molecules that make up the valve will be more tightly packed [11].

3.3.2 Redness (a*)

The value of redness (a*) indicates the intensity or presence of red color in the product. The redness of carrot-pineapple velva was 9.97-10.52. Redness in Velva products **4**mes from the raw material used, mainly carrots. Carrots have carotenoid pigments, which are a group of pigments that give orange, red and yellow colors [12]

3.3.3 Yellowness (b*)

Yellowness value (b*) indicates the intensity or presence of yellow color in the product. The yellowness of carrot-pineapple velva was 17.50-18.33. The yellow color in Velva products comes from the raw material used, mainly pineapple. Pineapple has carotenoid and xanthophyll pigments [13]. Carotenoid and xanthophyll pigments are orange-yellow pigments [12].

3.3.4 Chroma

The chroma value shows the intensity or color saturation of the product [7]. The greater the chroma value, the brighter the product will be, while the lower the chroma value, the color will fade. The chroma of carrot-pineapple velva was ranged from 20.79 to 21.57. The large concentration of carrageenan used causes a lot of kappa-carrageenan to immobilize the water so that the color of the veins becomes pale [14].

3.3.5 °Hue

The value of °hue indicates the dominant wavelength that determines the color of a material [15]. The °hue of carrot-pineapple velva was ranged from 58.39 to 60.73. If it is included in the color indication based on the °hue value, the carrot pineapple Velva product is included in the orange color category. The orange color was caused by the carrots and pineapple. Each of these ingredients has carotenoid and xanthophyll pigments that can produce orange color.

3.4 pH Analysis

In Velva products, pH affects the ability of hydrocolloids to work, because each hydrocolloid has a certain **3** pH condition to work optimally. Based on the data from the ANOVA test ($\alpha=5\%$) it showed that there was no significant difference between kappa-

carrageenan concentration and the pH of the carrot-pineapple velva. These results indicate that there is no increase in pH as the concentration of kappa-carrageenan increases. This is because the hydrocolloid used has one of the properties that did not affect the pH of the product. The optimal ability of kappa-carrageenan as a stabilizer is at pH lower than 4.3. Kappa-carrageenan solution might lose its gelling and stabilizing properties at pH below 4.3. The cause is the occurrence of an autohydrolysis process that forms 3,6-Anhydro-D-galactose bonds [16]. The results of the pH of the velva in the test obtained pH in acidic conditions caused by the velva-forming material in the form of pineapple which has a pH of about 4-5 [17].

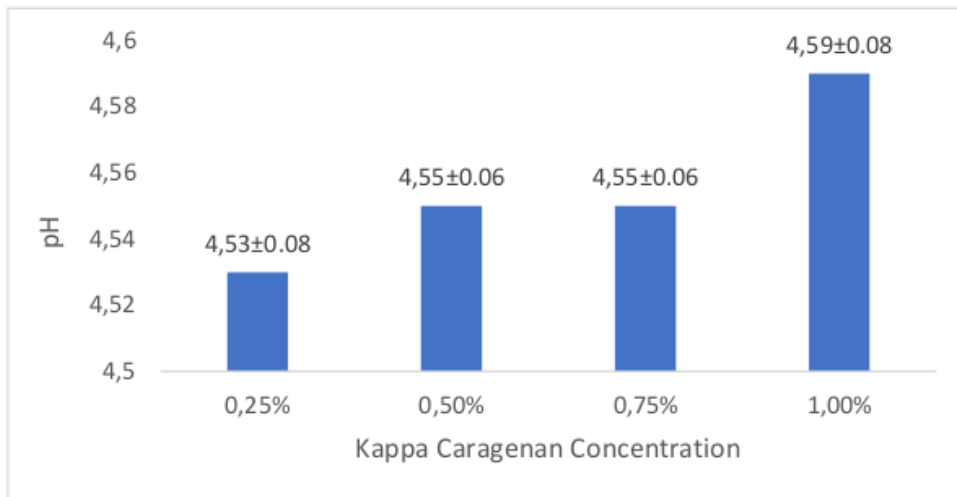


Fig. 3 pH Analysis

4. Conclusion

The difference in concentration of kappa-carrageenan has a significant effect on the physicochemical properties, including the first drip and flow rate. However, it did not have a substantial impact on color and pH. The increase in the concentration of kappa-carrageenan caused an increase in the first drip with a value range of 132.67-420.83 seconds but decreases the flow rate with a value range of 1.41-0.55 (cm/second). The color of the carrot-pineapple velva includes lightness (L) of 47.45-47.50. Redness (*a) is 9.97-10.52. Yellowness (*b) is 17.50-18.3. Chroma (*c) is 20.79-21.57, and hue is 58.39-60.73. The pH produced by carrot-pineapple velva ranged from 4.53-4.59.

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