Addition of Carboxymethyl Cellulose Concentration on Lemongrass Extract Ice Cream

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Abstract. The purpose of this study was to obtain the best concentration of carboxymethyl cellulose (CMC) on the physical quality and organoleptic properties of lemongrass extract ice cream. This study used a Completely Randomized Design (CRD) which consists of five treatments and three replications. The treatments performed were P1 (addition of 0.5 \% CMC), P2 (addition of 0.75\% CMC), P3 (addition of 1\% CMC), P4 (addition of 1.25\% CMC), and P5 (addition of 1.5\% CMC) on lemongrass ice cream formulation. Data were statistically analyzed using analysis of variance (ANOVA) and then continued with Duncan’s New Multiple Range Test (DNMRT) at 5\% level. The results of the research showed that the addition of CMC concentration significantly affected total solids, overrun, melting rate (minutes/10 g), viscosity, and mouthfeel sensory of the ice cream. The best treatment was P1 (addition of 0.5\% CMC) which had 33.46\% total solid, 38.51\% overrun, 16.56 minutes/10 g melting rate, and 22470.00 cP viscosity. Result of the descriptive test on the ice cream with the addition of 0.5\% CMC was soft and panelists like the ice cream for the mouthfeel parameter.

Keywords: Total Solids; CMC; Overrun; Melting Rate

1. Introduction

Ice cream is one of the most popular frozen dessert products made from mixing dairy product with other ingredients such as sweetener, flavor, stabilizer, etc. Ice cream is preferred because the taste of ice cream is delicious, sweet, and soft texture. Ice cream is also known as foods that contain high in nutrients. Currently, the innovation of ice cream continues to grow. Besides that, ice cream is known as a food that high in nutrients contains.

Currently, the innovation of ice cream continues to develop. One of the innovations that have been made in adding the material containing antioxidants to ice cream. Several studies have been carried out are the addition of apple extract [1], the addition of honey pineapple [2], and the addition of mangosteen peel [3]. [4] also have been added lemongrass extract to the manufacture of ice cream.

Lemongrass has a high content of antioxidants, namely phenolic and flavonoids. According to [5], lemongrass extract contains alkaloids, saponins, tannins, anthraquinones, steroids, phenolic acids, and flavone glycosides. [4] has added lemongrass extract to ice cream and result in the higher of lemongrass extract the more water is in the ice cream and result in rough ice cream. To improve the lemongrass extract ice cream, a stabilizer is needed to the manufacture lemongrass extract ice cream so that the total solid, overrun, melting rate, viscosity, and texture of ice cream can improve.

The stabilizer is a part of the hydrocolloid. According to [6], hydrocolloids can form colloids, can thicken, and form a gel. Several studies have shown that carboxymethyl cellulose (CMC) provides better ice cream characteristics for overrun value, melting rate, texture, and is acceptable to panelists.
[7] in the studies, the addition of CMC is the best treatment compared to gum arabic and carrageenan. The research of [8] also showed that the addition of CMC to edamame ice cream as a whole was the best treatment compared to carrageenan. The addition of CMC with different concentrations can have different effects on ice cream as in the research of [9] in making purple sweet potato ice cream where the CMC concentration of 0.5% was preferred by panelists. The research by [10] in making jackfruit seed extract ice cream, the addition of 1.25% CMC was the most preferred for softness. Based on these description, the addition of CMC concentration in making lemongrass ice cream is expected to improve the physical characteristics and sensory of the ice cream.

2. Materials and methods

2.1. Materials

The materials used in this study were lemongrass obtained from Pasar Panam, sugar, UHT full cream milk, whipped cream, cornstarch, and CMC. The tools used in this study were juicer, refrigerator and freezers, mixer, stove, pans, ice cream containers, stirrers and ice cream spoons. The tools used for analysis were analytical scales, oven, measuring cup, beaker glass, porcelain cup, measuring flask, stopwatch, viscometer tester, ice cream cup, and booth.

2.2. Making lemongrass extract

The lemongrass stalk is cleaned and cut into ± 6 cm lengths. Then, the lemongrass is weighed as much as 250 g and put in a juicer to separate the extract from the dregs.

2.3. Making lemongrass extract ice cream

The process of making ice cream includes: mixing ingredients, pasteurization, homogenization, aging, freezing, hardening, and storage. Mixing ingredients for ice cream is done gradually. The manufacturing process is: mix CMC into the dough of ice cream while. The dough of ice cream is homogenizing using a mixer for 15 minutes, then added lemongrass extract to the dough. Put into the freezer for 1 hour. The homogenization was repeated 3 times.

2.4. Research design

This study used a completely randomized design (CRD) with 5 treatments and 3 replications, namely: P1 (addition of 0.5% CMC), P2 (addition of 0.75% CMC), P3 (addition of 1% CMC), P4 (addition of 1.25% CMC), P5 (addition of 1.5% CMC).

2.5. Analysis

2.5.1. Physical analysis

The physical analysis includes total solids, overrun, melting rate, and viscosity. Total solids were analyze based on [11] method. Overrun was analyze based on [12] method. The melting rate was analyze based on [13]. Viscosity was analyze based on [14].

2.5.2. Sensory analysis

The sensory analysis includes the descriptive and hedonic test of mouthfeel were analyze based on [15]. A descriptive test was carried out on 30 panelists and a hedonic test on 80 panelists. The descriptive range from not very soft up to very soft. The hedonic range from not very like up to very like. The samples are placed in ice cream cups with a random number code. Panelists are asked to provide an assessment of each sample on the questionnaire form presented.

2.6. Data analysis

The data obtained from the research results were analyzed using Anova (Analysis of Variance) to determine whether or not there were any differences in the results of the test. The data analysis results were continued with Duncan’s Multiple Range Test (DMRT) at a 5% level. The data analyzed using the IBM SPSS Statistics 26 for Windows application.
3. Results and discussion

3.1. Physical characteristics

Physical analysis of lemongrass extract ice cream product was carried out with 4 tests, namely total solid, overrun, melting rate, and viscosity. Physical characteristics of lemongrass extract ice cream are indicated in Table 1. As a foreseeable, the addition of CMC concentration affected the total solid, overrun, melting rate, and viscosity of lemongrass extract ice cream.

Table 1. The physical characteristic of lemongrass extract ice cream.

|     | Total solids (%) | Overrun (%) | Melting time (minutes) | Viscosity (cP) |
|-----|----------------|-------------|------------------------|---------------|
| P1  | 33.46 ± 1.27\textsuperscript{a} | 38.51 ± 0.55\textsuperscript{d} | 16.56 ± 0.45\textsuperscript{a} | 22470.00 ± 1007.93\textsuperscript{a} |
| P2  | 35.08 ± 1.34\textsuperscript{ab} | 34.07 ± 0.73\textsuperscript{c} | 17.403 ± 0.58\textsuperscript{a} | 26809.33 ± 1436.48\textsuperscript{b} |
| P3  | 35.40 ± 0.89\textsuperscript{abc} | 31.07 ± 0.80\textsuperscript{b} | 18.55 ± 0.49\textsuperscript{b} | 28880.67 ± 1372.04\textsuperscript{bc} |
| P4  | 38.11 ± 2.47\textsuperscript{bc} | 28.98 ± 0.45\textsuperscript{a} | 18.96 ± 0.40\textsuperscript{b} | 31723.33 ± 1603.33\textsuperscript{c} |
| P5  | 38.35 ± 1.67\textsuperscript{c} | 25.18 ± 1.05\textsuperscript{a} | 20.75 ± 0.67\textsuperscript{c} | 35335.67 ± 2451.17\textsuperscript{d} |

Values in the same column followed by different letter are significantly different (P<0.05)

3.1.1. Total solid

The addition of CMC concentration significantly (P < 0.05) affected the total solid of lemongrass extract ice cream (Table 1). Statistic analysis on Table 1. Shows that the total solid of lemongrass extract ice cream in treatment P5 is highest (38.35%) and the lowest the treatment of total solid of ice cream in treatment P1 is 33.46%. The highest total solid of lemongrass extract ice cream in treatment P5 caused in these treatments the highest addition of CMC. Carboxymethyl cellulose is a cellulose derivative included in carbohydrates. Carbohydrates included in total solid, so that with the increase of CMC also increase total solid of lemongrass extract ice cream. The result of this study is in accordance with [16] that the addition of CMC concentration increases total solid of black mulberry sorbet.

The total solids of lemongrass extract ice cream in this study were higher than the total solids of [9] with ranges from 32.164 to 37.674%. The increase of the total solid in this study caused on lemongrass extract ice cream uses cornstarch that can increase the total solids of lemongrass extract ice cream. According to the ice cream quality standards (SNI 01-3713-1995), the total solid is at least 34%, while the total solid in this study ranges from 33.46 to 38.35%, which means that the ice cream in this study has in line with the quality standards of ice cream.

3.1.2. Overrun

Statistic analysis shows that the overrun value of lemongrass extract ice cream significantly (P < 0.05) is influenced by the addition of CMC concentration (Table 1). The addition of CMC concentration will reduce the overrun of ice cream. The addition of 0.5% CMC (P1) significantly resulted in the highest overrun for lemongrass extract ice cream, which was 38.51% followed by treatment P2, P3, P4, and the lowest in treatment P5, which was 25.18%.

Decreasing the overrun of lemongrass extract ice cream along with the addition of CMC concentration. The decrease of the overrun value caused the increase in total solid which causes the ice cream to thicken. As a result, the space between the particles is getting narrower, thus inhibiting the development of the ice cream dough and reducing the overrun value. This is supported by the opinion of [17] which states that the increase of stabilizer concentration affected the binding of free air so that the ice cream dough is thicker and decreases the overrun value. The result of this study is following [18] that the overrun value of black mulberry sorbet decreased along with the addition of CMC concentration.

3.1.3. Melting rate

The melting rate is the amount of time it takes for ice cream to melt perfectly. The adding of CMC concentration significantly (P < 0.05) affected the melting rate of lemongrass extract ice cream. Table
1 showed that the melting rate of lemongrass extract ice cream on treatment P5 had the longest melting rate (20.75 minutes), while the lowest of ice cream in treatment P1 is 16.56 minutes.

With the increase of CMC concentration in lemongrass extract ice cream, the melting rate of ice cream is longer. The melting rate of ice cream correlates with the overrun and total solids. This study shows that the higher of the overrun value of lemongrass extract ice cream, the melting rate is decreased. The increase in total solids of the ice cream, the melting rate is increased. The increase of total solid causes the viscosity to increase and the space between the particular becomes narrow, so that trapped free air is less. Decreasing the amount of free air trapped will produce ice cream that melts slowly. This is supported by the opinion of [7] which states, the increased amount of stabilizer in the manufacture of ice cream will affect the binding of free air so that the ice cream dough is thicker and decrease the overrun value.

3.1.4. Viscosity
The addition of CMC concentration significantly affected the viscosity of lemongrass extract ice cream. (Table 1). From these result, it can be seen that the viscosity of lemongrass ice cream increase with increasing concentration of CMC. P5 (addition of 1.5% CMC) has the highest viscosity value, which is 35335.67 cP and P1 (addition of 0.5% CMC) with the lowest viscosity value of 22470.00 cP. The addition of large amounts of CMC will increase total solids which will result in reduced overrun values. This is because higher CMC can blind large amounts of free water so that the structure of gel becomes stronger and increase the viscosity of the ice cream. This is supported by the opinion of [19] which states, the increase of CMC concentration adding to the ice cream increasing the viscosity.

3.2. Sensory characteristic
Statistic analysis shows that the sensory test of lemongrass extract ice cream significantly (P<0.05) is influenced by the addition of CMC concentration. The average sensory test of the descriptive and hedonic test of mouthfeel lemongrass extract ice cream can be seen in Figure 1.

Figure 1. Sensory analysis of lemongrass extract ice cream mouthfeel

The descriptive test showed that the score for the mouthfeel of lemongrass extract ice cream ranges from 3.63 to 4.50 (soft to very soft). Figure 1 showed that the score of the mouthfeel parameter of lemongrass extract ice cream on treatment P5 (addition of 1.5% CMC) is the highest (4.5), it means very soft. Treatment P1 has the lowest of mouthfeel score which is 3.63 (soft). The mouthfeel of lemongrass extract ice cream is strongly influenced by CMC as a hydrocolloid that able to bind the amount of water and forming a gel that can improve the texture of ice cream. Carboxymethyl cellulose is a hydrocolloid binding the free water during the agitation process so that the ice crystals can be avoided so that the texture of lemongrass extract ice cream was softer. [20] states that the use of CMC in ice cream has a role to improve the texture and decrease the ice crystals.

Based on the result of the sensory hedonic of mouthfeel, it is seen that P1 (4.47) and P2 (3.30) have a higher preference level. From Figure 1, it can be seen that lemongrass extract ice cream with the addition of high concentrations of CMC has a lower preference level. It means the softest of ice cream...
mouthfeel preference of panelists is decreased. The decrease level of preference of ice cream can be caused by total solids and viscosity of ice cream with affect the level of preference of panelists. This can be due caused the total solids and viscosity are too high, resulting in an ice cream that is getting denser and harder, it can be gummy and hard to melt in the mouth.

4. Conclusion
Based on this research that has been done, it can be concluded that the addition of carboxymethyl cellulose concentration in the manufacture of lemongrass extract ice cream significantly affected total solids, overrun, melting rate, viscosity, and sensory of mouthfeel. the addition of CMC concentration increased total solid, melting rate, viscosity, preference of mouthfeel, and decreased overrun. The best treatment was lemongrass extract ice cream with P1 treatment with the addition of 0.5% CMC which had 33.46% total solids, 38.51% overrun, 16.56 minutes of melting rate, and 22470.00 cP viscosity. the descriptive test on the ice cream with P1 treatment was soft and panelists liked the ice cream for the mouthfeel parameter.

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