

DR. KURNIA HD.



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*"Improving the quality of life
through food and agricultural sciences"*

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HILL HOTEL AND CONVENTION, BUKITTINGGI-INDONESIA

Improving the quality of life through food and agricultural sciences

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Universiti Kebangsaan Malaysia.

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STUDY ON THE USE OF STABILIZER AND EMULSIFIER TO THE PHYSICAL AND CHEMICAL PROPERTIES OF ICE CREAM BASED ON AGRICULTURAL PRODUCTS

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ABSTRACT

Pumpkin (*Curcubita moschata*) and banana (*Musa sp*) is a cellulose source of agricultural product. Ice cream is kinds of semi-solid food are made by freezing. The softness of the texture is strongly influenced by the role of stabilizer (CMC) and emulsifiers (milk cream). Development of the ice cream industry requires raw materials based on cheap agriculture product; easily available, therefore necessary looked into raw material modification. Pumpkin and banana can be a CMC replacement option as stabilizer and soya bean milk is full cream substitute materials as emulsifiers. The purpose of this research is to determine the effect of raw material modification to the quality of ice cream produced in the views of the physical and chemical properties. This study uses completely randomized design of factorial based on factor perceived namely types of fruit difference (banana and pumpkin) and milk type difference (skimmed milk and soy milk) by four treatment combination and one control. The results of physical measurements show that the highest overrun was ice cream with banana-skimmed milk treatment, while the longest time for melting ice cream was pumpkin-soy milk. Results of the analysis on ice cream chemical composition show that the fat and protein level of ice cream sample is in the quality standard was prescribed

Key word: pumpkin, banana, ice cream

INTRODUCTION

Ice cream usually made for dessert. This dish is popular and favorite, especially among children. Ice cream is also good for children growth because it is made from milk which is rich of protein and energy [1] (Chan, 2008). According to Watt and Annabel 1963 in Wibowo [2], ice cream contains of 4.0% protein, 12.0% fat and 20.6% of carbohydrate. The high fat content of ice cream causes a lot of people are reluctant to consume ice cream, especially in the present, where many products developed low-fat food. Therefore, other materials needed with low-fat content as a mixture ingredient in the manufacture of ice cream.

Ice cream industry will continue to grow as we get ice cream consumers in Indonesia. According to Hidayat [3] in the last five years, the growth rate of ice-cream market in Indonesia at least 20% every year. According to Hadiwerdoyo [4]), ice cream consumption

in Sumatra 100% increased in the year of 2008. Therefore, it is natural if the ice cream business competition getting tighter because of the new business continues to appear. However, as in the food business in general, the ice cream business opportunity is providing a very promising because the ice cream is very popular in all levels of Indonesian society from children to adults. Moreover, ice cream business is easy, anyone can run and without the need for many employees [5] (Anon, 2003). In addition, the growth of the Indonesian state in the equator strongly supports the development of ice-cream business (Anon, 2009a). Therefore, the research conducted to determine the influence of raw material modification to the quality of ice cream

Ice cream has a lot of variations. Some variations of ice cream with a distinctive character and taste different from the others. At this time many ice cream manufacturers add other ingredients such as chocolate chips, fresh fruits, either mixed or just sprinkled on top. In addition to taste, these materials can also improve the performance of ice cream, thereby increasing consumer interest [1] (Chan, 2008). In general, each type of fruit with high solids content can be used in the composition of ice cream. In this study, ice cream was made using a banana (*Musa paradisiaca L*) and pumpkin (*Curcubita moschata*), because the fruit is widely available, have a favorite flavor and are inexpensive. These fruits serve as a substitute for fat solids in skim milk. In addition, these fruits can serve as stabilizers. According to Farid et al (2008), stabilizers are used in order to obtain the texture of ice cream that is to keep water content in ice cream not too cold and reduce the large amount of ice. Stabilizer which is often used in the manufacture of ice cream and frozen dessert is the CMC (Carboxymethyl Cellulose), gelatin, alginates, karagenan, guar gum and pectin. According to Glickman and Setianawati et al [8], the use of CMC as stabilizer in ice cream products will provide better stability when used in conjunction with one or more other stabilizer materials

Factors that influence the ice cream texture are the amount of homogenization, stabilization and overrun content. According to Saleh [9], rough texture of ice cream is the damage caused by the over-homogenization, stabilization and homogenization, and also

... by letting a long wait before it is inserted into the freezer. According to Saroso [10], the function of stabilizer is as body that forms the texture. Whereas the contents same as content of cream within ice cream which is between 8% to 16%. However, the price of cream milk on the market are relatively expensive, so the research examined the production of ice cream using stabilizer as a substitute for skim milk

Soy milk is a nutritious drink, mainly because of the protein content. But public attention is still lacking, although the price of soy milk is cheaper than milk products [11] (Anonymous, 2009^b). According to [12] (2007), soy milk has several advantages, namely: it does not contain lactose, the protein does not cause allergies, low in fat, cholesterol free, highly nutritious, relatively simple manufacturing technology, production costs are relatively inexpensive, and can be easily processed into ice cream, yogurt, mayonnaise, etc. Meanwhile, according to [13] Anonymous (2007), the composition of the soy milk is similar to cow milk. Quality of protein in soy milk is similar to cow milk protein quality. Soy milk is an attractive alternative for the people who can not stand to milk naturally.

This study aims to determine the effect the use of banana, banana and soy milk as a raw material of stabilizer to the physical quality (overrun and melting rate, the level of consumer preference and chemical composition (fat and protein content) of ice cream

METHODOLOGY

Instrument

The instrument used in this study are cutting knife, weighing, Ohaus analytical balances of 210 gram capacity, steamer, gas stoves, tools diminutive size (measuring cylinder), Kenwood ice cream maker of 1.5-liter capacity mixer (Philips), plastic containers, containers, ovens, pipettes drops, measuring glass, measuring flask, Soxhlet, filter paper, kjeldahl flask, 250 ml Erlenmeyer and 650 ml desiccators and equipment (refrigerator and freezer).

Material

Materials used in this study were banana, soybean, soy milk, skim milk powder, full cream milk powder, sugar, eggs, gelatin, water, aquadestillate, 10%, 5%, 50% NaOH, 0.1 N HCL, and diethyl ether.

Observation Parameters

Parameters were observed in this study consisted of physical quality of ice cream (overrun, melting rate), chemical properties of ice cream (fat and protein content) and Organoleptic properties (color, taste, mouthfeel and general appearance)

Design of Experiment

Study design used was Completely Randomize Design (CRD) factorial with two different factors. The first factor is the difference in the fruit as a filling material with two types of fruit. The second factor is the difference in milk as an ingredient emulsifiers with

two types of milk from which the four combinations of treatment and control (without the addition of pumpkin, banana and use skim milk

Research Stages:

Making of Ice cream

Ice cream making process based on Elisabeth et al. [14] (2007) research conduct. Pumpkin and bananas are washed, peeled and steamed, then ground using a blender or food processor separately. Egg yolk in shake until fluffy; add dry ingredients which have been dissolved in water. Followed by pasteurization at 80-85°C temperature for 25 seconds and cooled. The admixture was ready incorporated into ECM, (Ice Cream Maker), then stored in a refrigerator at 4°C temperature for 4 hours to the aging process. Homogenization was repeated for 15 minutes with the ECM and the mixture stored in the freezer until half frozen at a temperature -5°C until 8°C and agitation for 15 minutes. The admixture was ready packed in the container and save it back into the freezer at a temperature of -25°C to -30°C

Physical Quality Testing of Ice Cream

At this stage, the physical properties of the factors that affect the quality of ice cream were analyzed, that is overrun and melting rate. Developing of the ice cream volume was expressed as overrun and calculated based on the volume difference of product to the first admixture volume at the same mass, or based on mass differences of products to the first admixture mass at the same volume [2]. Initial admixture inserted into graduated cylinder at a certain volume and mass. Afterwards, ice cream inserted into a graduated cylinder at the same volume then measured the mass. The melting rate was expressed in minutes, as the resistance of ice cream against melting when served at the room temperature. Overrun percentage can be calculated by following formula.

$$\text{Overrun} = \frac{M_1 - M_2}{M_2} \times 100\%$$

where : M₁ = mass of initial admixture
M₂ = mass of ice cream

Chemical Quality Testing of Ice Cream

Chemical properties analysis was conducted on fat and protein content which affects the quality of ice cream

Fat Content Test (AOAC, 1995)

Water free sample extracted using ether solvent inside soxhlet extraction apparatus for 6 hours. Extraction result was left in the open air and then dried in an oven at a temperature of 100° C for 30 minutes and cooled inside desiccators until constant weight

$$\text{Fat content (\%)} = \frac{B_2}{B_1} \times 100\%$$

Note : B₁ = Weight of initial sample (gram)
B₂ = Weight of fat (gram)

Protein Level (Kjedahl Method/AOAC, 1995)

Samples that have been refined as much as 0.1 grams inserted into a 30 ml Kjedahl flask, added 2.5 ml of concentrated sulfuric acid, 1 gram of catalyst and boiling stones, respectively. Boiled for 1 to 1.5 hours until the liquid becomes clear. The flask cooled, transferred to the distillation equipment and add 15 ml of 50% NaOH solution, then rinsed with distilled water. Erlenmeyer containing 25 ml of 0.02 N hydrochloric acid placed under the condenser, previously added 2 to 3 drops of nitrogen indicator. End of condenser tube immersed within a chloride solution. Distilled was conducted until 25 ml of distillate within Erlenmeyer. Distillate titrated with 0.02 N NaOH until the green color changes to purple. Blank determination was done in the same way

$$\text{Crude Protein (\%)} = \frac{(Y-Z) \times 1.4 \times 5.25}{W} \times 100\%$$

Note: Y = ml NaOH titre for blank
 B = ml NaOH titre for sample
 N = normality of NaOH
 W = weight of sample (gram)

Data Analysis

Test results data of the physical properties analyzed using analysis of variant (ANOVAs). If there were significantly, the Tukey test performed as subsequent test using 95% of confidence interval ($\alpha = 0.05$) [15, 16,17] (Djarwanto, 2001; Yitnosumarto, 1993; Zar, 1984)

RESULT AND DISCUSSION

Physical properties of Ice Cream: The influences of Raw Materials against Ice Cream Overrun

Overrun is defined as the development of the ice cream volume toward the initial admixture due to air trapped in ice cream (Arbuckle, 1986 in Wibowo, 1992). The result data of overrun average value shown in Figure 1.

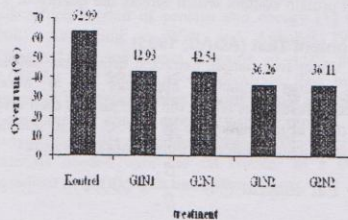


Figure 1. Effect of raw material on ice cream overrun

Figure 1 shows that the use of different types of fruit and milk as raw material of ice cream production may affect ice cream overrun value. The use of different types of fruit and milk as raw material may affect the overrun value lower. The overrun ice cream value from the highest to the lowest was the ice cream overrun of the control treatment, G₁N₁, G₂N₁, G₁N₂ and G₂N₂, respectively. The highest overrun value produced by the G₁N₁ treatment product for 42.93%, but when compared to controls (62.99%), the overrun is still under control, whereas the lowest overrun produced by the G₂N₂ treatment products in the amount of 36.11%. According to Padaga et al. (2005), ice cream with high-quality has overrun of 70-80%, whereas 25-30% for home industry. Based on this fact, the overrun in this study was still in the ice-cream quality standard. Overrun variation analysis shown in Table 3.

Table 3. Table of Anova

Source of Variance	Degree of freedom	Sum of square	Central square	F _{count}	F _{table}
Treatment	3	128,27	42,99	10,74	5
Error	8	0,30	0,04		
Total	11	128,57			

Analysis of variants (ANOVA) results showed that the use of combinations of fruits and type of milk give a significantly between treatments in the significance level of 5% toward the ice cream overrun produced, which F_{count} value greater than the value of F_{table} (F_{count} > F_{table}).

Results of further tests by the Tukey method showed that the ice cream overrun by using G₁N₁ treatment was not significantly to G₂N₁ treatment, but highly significant to treatment using G₁N₂ and G₂N₂. The discrepancies of the overrun values by using different types of milk presumably because skim milk has a deposition that will further increase the thickness of the ice cream admixture. This is also in accordance with Suprayitno et al. (2001) [12], that an increase in ICM (Ice Cream Mix) viscosity will increasingly restrict the mobility of water molecules because the space between particles in the ICM becomes increasingly narrow. Narrowness of the space between the particles causes the less of the air coming into the ICM during the agitation so overrun resulting was lower.

The influence of raw materials against Melting rate of Ice Cream

Good quality of ice cream characterized by be resistant to melting. Melting quality assessed by how in the mouth, i.e. whether the product can easily melt and give the impression of gliding easily in the mouth or stiff and difficult to melt. Melting power is identical with the time required to completely melting at room temperature. (Setianawati et al., 2002). The data averaging values calculated of melting rate can be seen in Figure 2

Protein Level (Kjedahl Method/AOAC, 1995)

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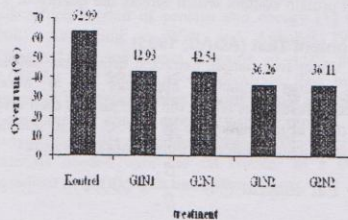


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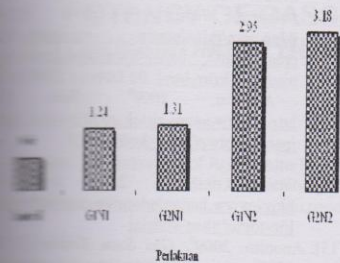


Figure 2. Material effect on the ice cream melting rate

Figure 2 shows that the use of different types of raw material as raw material affects the melting rate of ice cream. Melting time of ice cream will be longer by using different types of fruit and milk as raw material. Melting rate of ice cream, from the highest to the lowest, was the sample of ice cream with control treatment, G₁N₁, G₁N₂ and G₂N₂, respectively. The longest melting rate produced by the product with treatment G₂N₃, namely 0.66. The lowest melting rate produced by the product with G₂N₂ treatment, in the amount of 3.18. The overrun analysis results are shown in table 4.

Table 4. Anova Table

Source	Degree of Freedom	Number of Squares	Central Squares	F _{count}	F _{table} (5%)
Treatment	3	10,70	3,57	19,817	4,07
Error	12	1,44	0,18		
Total	15	12,14			

Analysis of variants (ANOVA) showed that the influence of fruits and milk type was significantly between treatments in the 5% level of confidence of the ice cream melting rate that is indicated when F_{count} value greater than the value of F_{table} (F_{count} > F_{table}). Tukey tests performed as a post-hoc test to see the significantly between treatments.

Post-hoc test results of Tukey method showed that the melting rate on G₂N₂ treatment was significantly to G₁N₂ samples, but significantly to G₁N₁ samples. Ice cream made of G₁N₁ was significantly to G₁N₂ samples. This shows that the influence of ice cream by using different fruits, but not the milk type, does not provide a significant to the melting rate of ice cream sample. The influence of ice cream with different kinds of raw material significantly to the melting rate of each ice cream. When compared to the melting rate of ice cream for 1.25 minutes, the rate of the ice cream in this study was not much different. However, the rate of melting ice cream is related to the ice cream texture. Ice cream with

rough texture would melt easily because of low of viscosity and melting resistance.

Chemical Properties of Ice Cream Influence of Raw Material against Ice Cream Fatty contents

Fat test conducted on the most preferred panelist sample which is ice cream made of skimmed milk and pumpkin. With the percentage of skim milk and pumpkin of 7.5%: 2.5% shows contained fat amounted to 9.966%. The results of this test were under the SII quality standard, where the allowed fat content at least 8%. Whereas Padaga and Beads [18] categorize the ice cream with fat content of 10-12% in the standard category. This decrease in fat levels presumably because the use of pumpkins in the ice cream. Pumpkin has a relatively low fat content in the amount of ± 0.30%

Influence of Raw material against protein contents of Ice Cream

Protein test conducted on the most preferred panelist sample which is ice cream made of skimmed milk and pumpkin. The test results on the protein content of ice cream by using skim milk and pumpkin (7.5%: 2.5%) showed levels of protein are contained by 4.3311 grams and according to the SII (Indonesian Industrial Standard) No. 1617 of 1985 in [18] there is no quality standard for protein content of ice cream. But according to Buckle et al. (1985), the average composition of ice cream for the protein content amounted to 4.6 grams. Meanwhile, when compared to fat content in the 4 grams of diamond ice cream, then the protein content of ice cream samples in this study was still higher. High content of fat in ice cream sample suspected because of pumpkin has a protein content of ± 1.10% whereas skim milk of ± 3.5%

CONCLUSIONS

Based on research observations, the influence of modifications to the quality of ice cream can be concluded as follows:

1. Ice cream which has the highest overrun was made from bananas-skim milk.
2. banana-skim milk ice cream was melts the fastest, whereas melting power of pumpkin-soy ice cream (G₂N₂) was the longest.
3. Chemical composition of ice cream shows that the levels of fat and protein content of ice cream samples still in the quality standard.

To do further research on consumer acceptance of ice cream, technique/method of making ice cream and shape of the final product consumer preferred.

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