Diversification of Dairy-Based Food Processed Animal Product by Ice Cream Machine (ICM) at Vocational High School of Muhammadiyah Piyungan

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Abstract. The rotary ice cream machine's experiment technology improves students' diverse food processing skills at the Department of Culinary, Vocational High School in Piyungan, Bantul. An ice cream machine (ICM) has been granted to facilitate the processing of livestock milk food products. This research provides skill training to students about making good-quality ice cream from goat milk. The ice cream machine is set at 80 rpm to turn for 20 minutes, then put 3 Kg ice block and 100 gr salt mixed into the coolant rim. Thus, the final ice cream product has a food quality standard by melting and texture tests. For the results test, the melting point of plain ice cream plain tasted has a melting time longer than chocolate tasted.

1 Introduction

Milk is the best source of nutrition, such as protein and calcium, and even has a highly beneficial drink for the health of the human body. Furthermore, milk-rich components for human physiological function include carbohydrates, fats, proteins, minerals, and vitamins [1]. In Indonesia, milk become one of the animal protein contributors. Besides having high nutritional content, it has a delicious taste. Goat's milk has some advantages than cow's milk especially the small size of fat globule [2] so it had higher digestibility. Thus, 20% of the fatty acids of goat milk fall into the short chain fatty acid [3], it recommend for malabsorbtion syndrome [4]. Therefore, the demand for milk and dairy products such as whipped cream [5], yogurt [6], and ice cream continues to increase rapidly [7]. Ice cream is very popular with people of all ages [8], usually served as dessert. The feeling of happiness generated when eating ice cream is called fun food and gives the impression of luxury taste, making it a favorite food [7].

The main composition of ice cream was milk, some whipped cream, and sugar with the mixing method used ice cream machine maker [9]. Ice cream machines give some advantages such as quality, will ultimately the standard, hygiene, and avoid food poisoning. Furthermore,

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previous research reports in Khartoum State, Sudan, that ice cream does not have significant differences in sensory (color) characteristics between the machines and the factory [10]. The other research shows that there is no significant effect (NS) $P>0.05$ on the chemical composition of ice cream, especially protein content between machines (2.49% and factory (2.69%), which means there is no nutritional damage during processing. Moreover, the advantages of making ice cream using a machine include the dose product used to become, the final texture softer, and crystalline. However, during the freezing process, whipping cream and ice destabilized the fat emulsion in the mix [11].

The consumer's favorite characteristic of ice cream is its softer texture and lower melting properties [12]. Melting point, also determined by room humidity, temperature difference, and wind direction, will determine the yield of melting rate [13]. Different authors stated that the melting rate influenced by the structural content from dispersed phase ice cream includes ice, air, and fat [14]. The demand for a softer texture and melting rate properties is struggling to gain market. The critical point of making ice cream is when mixing and processing (homogenizing) all ingredients that will affect the texture and final taste of ice cream. This study aimed to determine ice cream was made from dairy goat which is processed by rotary ice cream machine of sensory texture analysis and melting rate.

2 Material and Method

Students at the department of culinary in Bantul Region, Yogyakarta (SMK Muhammadiyah Piyungan) have carried out practical learning to make ice cream process from animal products (goat's milk). This implementation material used goat's milk, whipping cream, sugar, an emulsifier, a stabilizer, and an ice cream machine. Fig. 1 shows the method of implementing these research activities, including making ice cream. Two kinds of ice creams that are plain and chocolate flavors are made. In addition, the melting point of ice cream has been tested at the Laboratory of Milk and Egg Technology in the Department of Livestock Product Technology Universitas Gadjah Mada, Yogyakarta, Indonesia.

Table 1. Nutritional value ice cream between plain and chocolate flavors Composition and Health Effects [12]

Product	Weight (g)	Fat (g)	Protein (g)	Carbohydrate (g)	Total Solid (g)	Calories (cal)
Plain ice cream	100	12	4.1	20.7	36.7	196.7
Chocolate ice cream	100	13.1	3.6	25.8	42.1	221

2.1 Ice cream preparation with modification

Pasteurized processing was all the ingredients prepared were fresh giats milk, skim milk, whipping cream, stabilizer, and emulsifier put to the pan until a reached temperature of 60°C. After that, we added some emulsifiers and then pasteurized again to 80°C temperature for 30 min. After the pasteurized processing, aging processing in the refrigerator at a temperature of 4°C for 12 hours, then mixing the ICM used ice cream machine for 20 minutes (give chocolate flavor). Then put the ice cream to the freezer were stored overnight, then the ice cream ready for analysis [13].

2.2 Ice Cream Machine (ICM)

Principal of the vocational high school, Muhammadiyah Piyungan, has approved rotary ICM. The feature of rotary ice cream machine was donated maximum can hold 10 liters of ice cream dough and is driven by a 250-watt electric motor so that ice cream production takes a

short time. The machine divides into two parts center tube and a coolant rim. First, the mixture of ice cream is put into a center tube, and then a tiny ice block is put into a coolant rim of 3 Kg. The center tube is rotated at 80 rpm for 20 minutes to make 5 liters of ice cream (50% from maximum capacity).
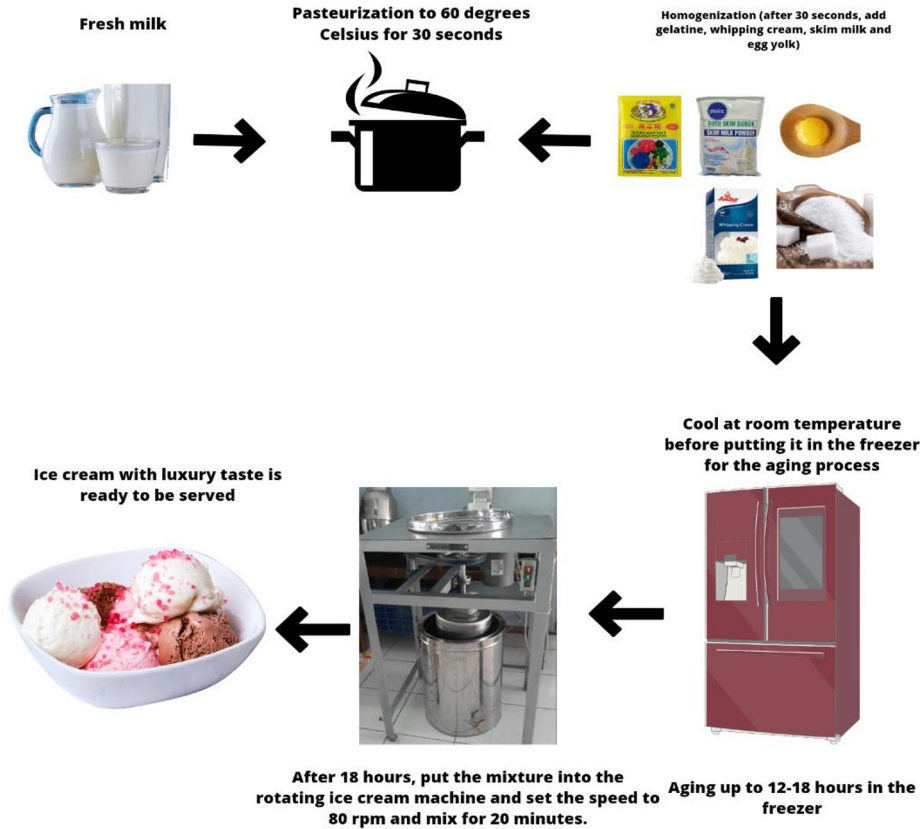

Fig. 1. The scheme of ice cream process with rotary ICM

2.3 Melting rate ice cream analysis

The fifth-gram sample of ice cream has been placed in the cup of ice cream, then put in the freezer till it is a product frozen. Then, it was taken out from the freezer machine and left at room temperature. The melting rate is the time for ice cream melts completely.

2.4 Sensory texture analysis

Sensory analysis used 25 student panelists, they were observed ice cream sensory of texture and give the score for texture.

3 Result and discussion

The first, making ice cream was homogenizing all ingredients, such as milk, sugar, and stabilizer, until homogeneous, which is then a pasteurizing process of all ICM to kill pathogenic bacteria [15]. Fig 2a. shows ice cream preparation using mix all ingredient such as goat milk, yolk, gelatin, whipping cream, and skim milk and then homogenization of all of the ingredients. Fig. 2b. shows ice and salt put into coolant rim in the rotary ice cream machine. Fig 2c. shows the students are being package ice cream into cup after rotating process in the rotary ICM.
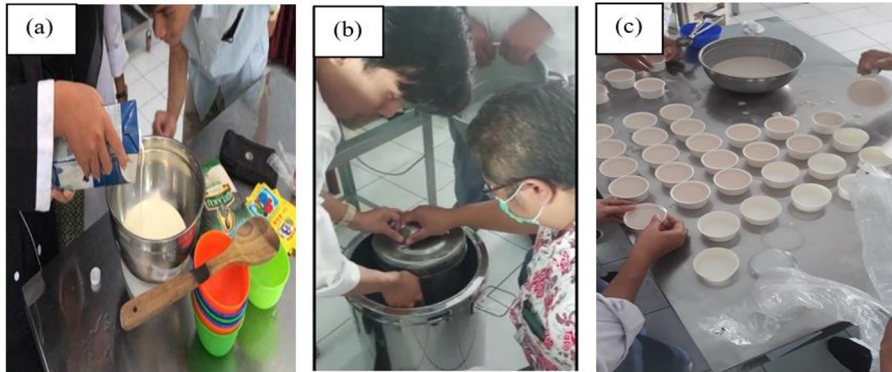

Fig. 2. ice cream mix preparation with ice cream machine.

Tools in food processing will provide advantages, including facilitating processing, increasing the quantity and quality of processed products, and increasing the product's hygiene. There is a critical point during ice cream processing especially homogenizing all the ingredients after aging. The texture could be better, and the final taste from ingredients not mixed properly is unattractive to consumers. Besides that, ice cream in small volumes will be very tiring if using human power, so small businesses and factories need ice cream machines.

Rotary ICM constantly rotates at 80 rpm for 20 minutes optimum to produce five liters of smooth ice cream. The rotation process be held at the 4 degrees temperature to avoid crystallization. The structure of ice cream and frozen desserts develops progressively as the mix goes through the processing stages [16]. Even. Milk protein concentrate formulations have higher viscosity and are narrower with ice-melting curves and more excellent shape retention [17]. The other studies report that ice recrystallization determines texture and structure stability post-freezing operation. Moreover, it impacts ice crystal growth during aging and storage processing [18].

Table 2. Melting rate different ice cream flavour

Treatment	Melting rate time (min)
Plain ice cream	51.9 ± 2.46^{x}
Chocolate ice cream	31.9 ± 3.98^{y}

Note: $^{x, y}$ different superscript in the same column indicate significant ($P<0.05$)

Melting rates have been analyzed between plain ice cream and chocolate ice cream. The data is shown in Table 2. The plain ice cream melting time rate is higher (51.9 min) than chocolate ice cream (31.9 min). Previous research stated that reducing the fat concentration of ice would make the ice cream harder and melt more rapidly, moving icy and crumbly. Chocolate ice cream has the highest fat content (13.1 %) than plain ice cream (12 %). Ice

cream was a complex food system. There were main structural components (air bubbles, ice crystals, and emulsified fat globules) [11]. This research added cocoa powder flavor to the ice cream mix, thus giving slight destabilization of the fat globule surface.

Previous research [16] stated that fat destabilization affects the melting rate of ice cream. The destabilization takes the form of clumps of fat globules that support the air and chains of fat globules. It indicated that adding chocolate flavor (powder) causes the fat globule content decreases and impacts the ice cream product to melt quickly. The melting ice cream contained smaller fat globules while the foam contained maximum fat of big globules. The homogenization processing (adding cocoa powder), the foam structure was unstabilized because the free fat wasn't enough to form a continuous network [5]. Fig 3 and 4. show the ten different samples of two flavors on the melting rate analysis process, there is some crystalline on each sample.
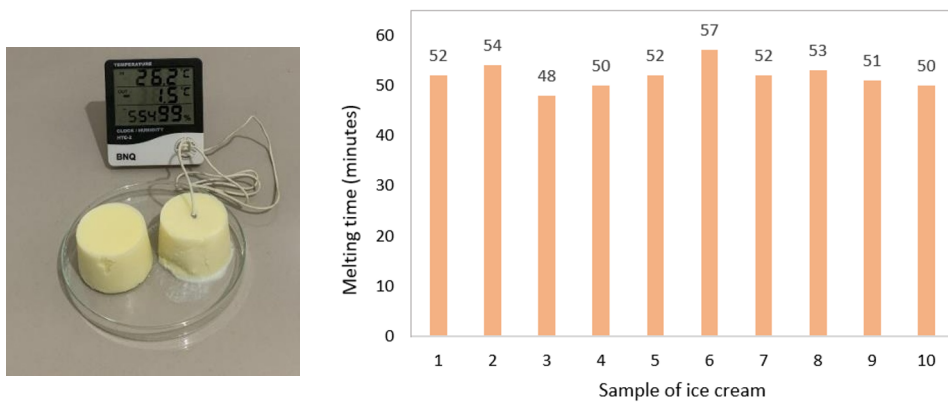

Fig 3. Melting rate processing of plain ice cream
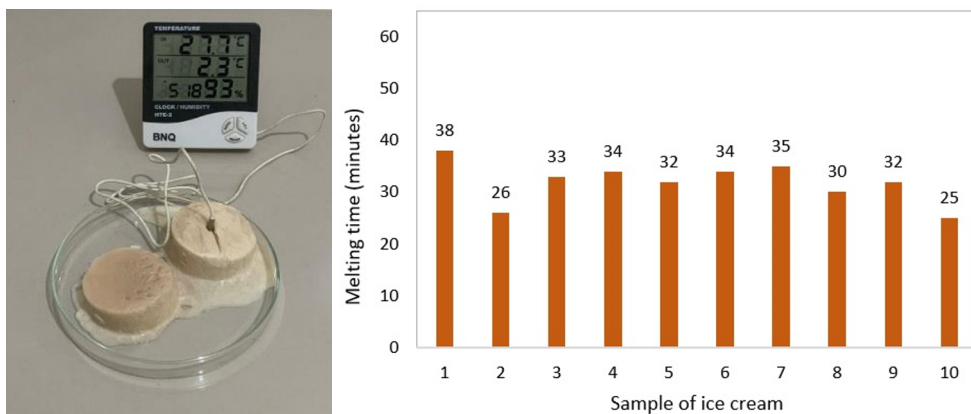

Fig 4. Melting rate processing of chocolate ice cream

The other author reported that ice cream properties with different stabilizers and emulsifiers did not affect the melting rate. However, it stated that the composition and fat globule size influenced the significant difference in the melting rate of ice cream samples [17]. Furthermore, the final product affected the mixing process, and the ice cream processing was frozen foam that was air dispersed in an aqueous. Muse and Hartel [16] stated that

melting down ice cream affected many factors, including the amount of air incorporated, so if we use human power, there will be instability in apprehending the air.

Ice cream texture is one of the senses evaluated for the product's hardness and softness. Previous research stated there is some factor that is influenced by texture, it was fat content. Fat content is essential for conferring creamy and smooth texture [19]. Fat in ice cream affects textural attributes such as ice crystallization, smoothness, and hardness [20]. The chocolate ice cream of this research looks snowy and sandy than plain ice cream (Fig 4). It indicated that powdered chocolate for flavouring decreased the stability of fat. The most likely texture for ice cream was smooth, less hard, and lighter than the terrible ice cream, which looks grainy. There is some flak, snowy and sandy. Factors affecting it are composition, processing method, lactose percentage, and fat globules [21].

4 Conclusions

The produces five liters of ice cream using of automatic rotary ice cream machine (ICM) was highly recommended for small and large scales industries. It needs 80 rpm to turn, times 20 minutes, and the coolant rim uses a 3 Kg ice block and 100 gr salt to produce 5 liters of ice cream. The melt point test has resulted in an Ice cream with a plain taste melting longer than a chocolate taste. Panelis liked most plain ice cream because it was smoother than chocolate ice cream, not snowy and sandy. In addition, the student of department culinary can learn ice cream processing used ice cream machine and entrepreneurship.

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