__Original Research Article__

Comparative Study of Emulsifier in Mellorine

ABSTRACT

Aims: Mellorine is a type of frozen dessert such as ice cream in which part or all of the milk fat is replaced with vegetable fat with low-fat content. The purpose of this study was to determine the effect of adding alginate, agar, guar gum, carrageenan, gelatin and casein as an emulsifier to mellorine

Study design: This research was prepared using a completely randomized design method with several factors, namely the addition of alginate, agar, guar gum, carrageenan, gelatin, and casein

Place and Duration of Study: The present study was conducted in Department of Aquatic Product Processing and Storage, Pangkep State Polytechnic of Agriculture. The duration of research is 6 month i.e from April, 2022 – September, 2022

Methodology: 400 mL low-fat milk, 200 mL of mango fruit juice, 100 g of sugar, and 300 mL of water The pieces of fruit were crushed using a blender with the addition of a bit of water (fruit:water = 2:1). While waiting for fruit blending, emulsifier with each treatment were heated with 50 mL of water until boiling. Then the water (according to a predetermined ratio) is heated, and the sugar is mixed together until dissolved. After that, the liquid milk and emulsifier ingredients are mixed with 15% fruit while stirring slowly for 10 minutes. The combined material is then cooled at 4°C for 24 h. After that, the ingredients that have been put together and cooled (fruit, liquid milk, stabilizer, and sugar) are stirred and homogenized with a mixer for 15 minutes. Mellorine that has been standardized, then packed in a cup. Then the mellorine was frozen in the freezer at -20°C for ± 24 h. The parameters tested were organoleptic, viscosity, overrun, melting time, fluid stability

Results: Alginate emulsifier produces the best mellorine with an organoleptic assessment having a color (5.4), taste (7), odor (6.33), texture (6.33). Physical test resulted with Viscosity (271 cP), Emulsion stability (100%), Melting time (15 minutes) and Over Run value (21.9%).

Conclusion: The use of different types of emulsifiers in the production of mellorine affects the organoleptic value, over run, emulsion stability, viscosity and melting time

Keywords: Agar, Alginate, Carrageenan, Casein, Guar Gum, Mellorine

1. INTRODUCTION

Ice cream is a dairy product made through a process of freezing and agitation with the principle of forming air cavities in the mixing of ice cream ingredients [1]. Ice cream is one type of frozen food made by freezing a mixture of dairy products, sugar, stabilizers, emulsifiers, and other ingredients that have been pasteurized and homogenized to obtain consistent results. Ice cream is a semi-solid food made by freezing ice cream flour, and sugar with or without other food ingredients, and permitted food ingredients. Ice cream is usually composed of several main ingredients, including fat, nonfat milk solids, stabilizers, and emulsifiers. One of the ice cream products is mellorine or imitation ice cream. Mellorine is a type of frozen dessert such as ice cream in which part or all of the milk fat is replaced with vegetable fat with low-fat content [2]

Making ice cream includes material preparation, mixing (stirring), pasteurization, homogenization, cooling, and packaging. Shaking or stirring is the key to making ice cream because, during the freezing process, the dough must be shaked. This mixing process has two purposes namely, the first to reduce the size of the ice crystals formed and the second purpose of this process to allow air to mix into the ice cream mixture. The air bubbles are incorporated into the ice mixture to produce foam. Stirring during cooling will damage the protein membranes surrounding the fat globules, and if this protein membrane is damaged, the fat globules can approach each other, and then the cream will rise to the surface. The way to prevent the cream from rising to the surface is to add an emulsifier [1].

Emulsifiers are molecules that absorb on the surface of newly formed droplets during homogenization and form a protective membrane that keeps droplets from aggregating [3]. Emulsions are a two-phase system in the form of a mixture of two liquids. Which is insoluble, whereas an emulsifier is a substance that results in an emulsion of two liquids that do not naturally unite. The function of the emulsifier is to improve the whipping quality of the dough, produce a soft texture and give strength to the product when it is transferred to the freezer. An emulsifier serves to reduce the surface tension between the water phase and the fat phase in ice cream. Several types of emulsifiers are surfactant compounds that can reduce surface tension on materials that have two steps that cannot be combined. The use of different combinations of emulsifiers in ice cream will produce other characteristics of ice cream [4].

Mellorine is food produced by freezing when stirred, the result of mixing ingredients with pasteurization, which is made from safe and suitable ingredients, including but not necessarily milk solids without fat and vegetable or animal fats or both or only a tiny amount of milk fat [5]. Mellorine products are less favored by consumers because they have a less soft texture, unlike ice cream in general. The challenge in producing low-fat ice cream is related to the absence or disruption of fat globule tissue. The combination of using the suitable emulsifier will produce mellorine products with good quality in terms of physical and organoleptic. Based on this background, it is necessary to conduct a study on the effect of emulsifiers on the organoleptic and physical properties of mellorine.

2. MATERIAL AND METHODS

2.1 MATERIAL

The ingredients used in the process of mellorine are low-fat milk, mango fruit juice, sugar, water, alginate, agar, guar gum, carrageenan, gelatin and casein. Equipment used in this reasearch include a knives, cutting boards, measuring cups, jars, pans, digital scales, blenders, mixers, refrigerators, freezer, centrifuge, aluminium foil, Brookfield viscometer, beaker, thermometer and ovens.

2.2 METHOD

The ingredients used in the process of mellorine are 400 mL of low-fat milk, 200 mL of mango fruit juice, 100 g of sugar, and 300 mL of water. The emulsifier used is alginate, agar, guar gum, carrageenan, gelatin and casein with a concentration of 1% of the weight of the dough, which is mellorine. Process of mellorine, the first step is to prepare all the ingredients that will use. Beginning with the selected ripe fruit is still fresh, not damaged or deformed, and not rotten. The chosen fruit is washed with clean running water and then drained. Fruit that has been washed, split, and cut into medium size. The pieces of fruit were crushed using a blender with the addition of a bit of water (fruit: water = 2:1). While waiting for fruit blending, the emulsifier with each treatment was heated with 50 mL of water until boiling. Then the water (according to a predetermined ratio) is heated, and the sugar is mixed together until dissolved. After that, the liquid milk and emulsifier ingredients are mixed with 15% fruit while stirring slowly for 10 minutes. The combined material is then cooled at 4 °C for 24 h. After that, ingredients that have been put together and cooled (fruit, liquid milk, stabilizer, and sugar) are stirred and homogenized with a mixer for 15 minutes. Mellorine has been standardized and then packed in a cup. Then the mellorine was frozen in the freezer at -20 °C for ± 24 h.

2.3 TEST OF QUALITY MELLORINE

2.3.1 Sensory Test

Sensory tests were performed to assess specific organoleptic properties. Sensory testing was carried out by 15 semi-trained panelists. The scale used is a numerical scale with nine scales. The data obtained were then processed using the Statistical Package for Social Science (SPSS) version 16 (IBM SPSS) [4].

2.3.2 Viscosity

Viscosity was measured using a Brookfield Viscometer. 100 mL sample was placed into a 100 mL beaker. By using adjust the spindle and speed until the reading of the viscosity value is read. Measurements were carried out until the needle reading was in a stable position. The rotor rotates, and the needle will move until the sample viscosity is obtained. The task of the viscosity value is done after the hand is stable. The scale that is read shows the viscosity of the sample being examined in units of cP (centiPoise) [6].

2.3.3 Overrun Measurement

The expansion of the volume of mellorine is expressed as an overrun value. It is calculated based on the difference in the volume of mellorine with the volume of the dough at the same mass or the difference in the mass of mellorine and the mass of the dough at the same volume [7].

2.3.4 Melting time measurement

Melting time was measured on mellorine that had been frozen for 24 h. Melting time was calculated as follows: A total of 5 g of mellorine was placed in a sieve and collected by glass, then allowed to dissolve completely, then the melting time was recorded. Observations were made at the same temperature and humidity [8].

2.3.5 Emulsion stability

The sample was weighed as much as 5 g and put in an oven at 45 °C for 15 minutes and then place again in a cooler at a temperature below 0 °C for 3 h. This process is repeated three times. Observations were made on the possibility of emulsion separation. If separation occurs, the emulsion is said to be unstable, and the level of stability is calculated based on the percentage of the separated phase to the overall emulsion [9]

3. RESULTS AND DISCUSSION

3.1 Organoleptic Test

Color is one of the factors that affect consumer acceptance. The results of sensory (organoleptic) testing of mellorine color parameters showed values between 5.40 to 5.93. The lowest average value was owned by mellorine with the addition of an alginate emulsifier. In contrast the highest average weight was owned by mellorine with the addition of a casein emulsifier with a value of 5.93 (fig. 1). The results of the Kruskall Wallis test on color parameters showed that the difference in emulsifier in mellorine had no significant effect on the color of the resulting mellorine. Odor determines the delicacy of the food. Odor has more to do with the nose senses [10].

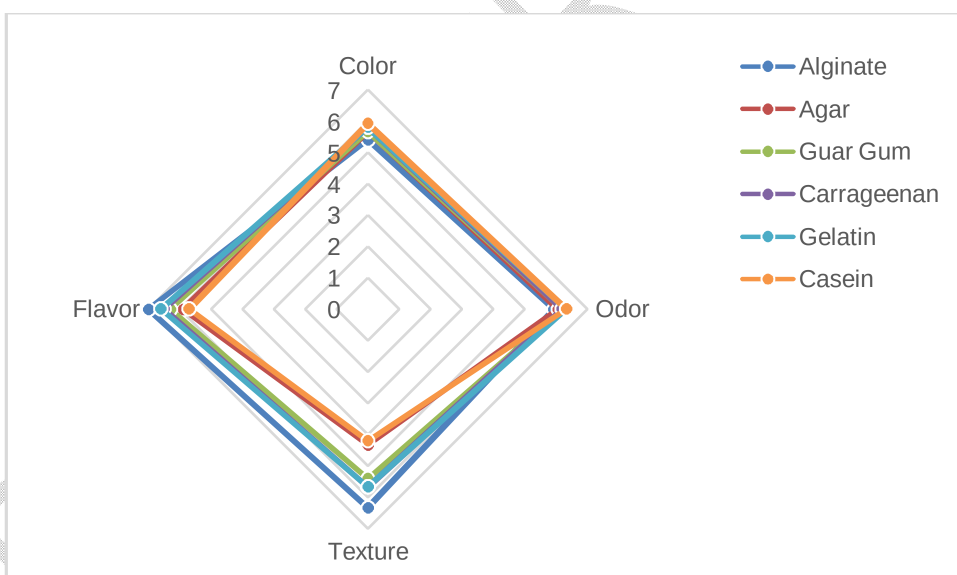

Figure 1. Organoleptic of Mellorine

The results of organoleptic tests on the mellorine Odor parameters showed values ranging from 5.93 to 6.33 (Fig. 1). The highest value was found in the addition of gelatin emulsifier, while the lowest value was found in ice cream with the addition of agar. Kruskal Wallis analysis conducted on Odor parameters showed that the difference in the addition of emulsifier and stirring speed had no significant effect on the Odor of ice cream. According to [11] smell is one of the parameters that affect the perception of the delicious taste of food.

The desired texture of mellorine is soft, creamy, and uniform. Organoleptic testing of the texture of mellorine showed the average ranged from 4.20 to 6.33 (Fig. 1). The highest average value was found in mellorine with the addition of alginate with a value of 6.33. The results of Kruskall Wallis analysis of the texture parameters of mellorine showed that the difference in the addition of an emulsifier had a significant effect on the texture of mellorine. The excellent texture of mellorine is smooth and soft (smooth), not hard and looks shiny, while the bad is the taste of lumps of fat (greasy), feels like flour (grainy), feels flaky [19].

The results of organoleptic tests on mellorine flavor parameters showed values ranging from 5.7 to 7.0 (Fig. 1). The highest organoleptic values for mellorine flavor in the treatment of adding alginate emulsifier were 7.0. Factors that influence panelists' acceptance of taste include chemical compounds, temperature, concentration, and interactions with other flavor components [12]. Products that have a bad taste will not be accepted by consumers even though the color, Odor, and texture are good. Therefore, the taste is one of the critical factors in consumer decisions to accept or reject a product.

3.2 Viscosity

Viscosity is the flow of molecules in a solution system. Colloidal suspension in the solution can be increased by thickening the liquid so that the absorption and development of colloids occurs. The principle of viscosity measurement is to measure the frictional resistance of a fluid between two adjacent molecular layers. The high viscosity of a material is due to the significant internal friction so that the liquid flows. The results of the viscosity test can be seen in Table 1.

Table 1.Viscosity value of mellorine

Ingredients	Speed (rpm)	Viscosity (cP)
Casein	10	72,4
Carrageenan	10	55,5
Agar	10	336,4
Gelatin	10	1417,6
Alginate	10	271
Guar gum	10	33160

Suitable viscosity value of ice cream ranges from 50 to 300 cP. The best viscosity value was found in the treatment with the addition of an emulsifier with Alginate, and the lowest viscosity value was in the treatment with the addition of Guar gum. According to [13] in the manufacture of ice cream, the composition of the dough will significantly determine the quality of the ice cream. Several factors that affect the rate are raw materials, manufacturing processes, freezing, and packing operations. The thickness of the ice cream dough will affect the level of smoothness of the texture and the resistance of the ice cream before it melts. [15] the factors that affect viscosity are temperature, solution concentration, solution molecular weight, pressure, and materials used. Viscosity can decrease because it is influenced by the ingredients mixed in dough, the more liquid is added it can reduce the more viscosity. Conversely, the more solids are added, the viscosity will increase.

3.3 Melting Time

Melting power is the time it takes for ice cream to melt entirely at room temperature. Melting power measurements were carried out at room temperature (±25 °C). According to [15] that the higher the fat content in ice cream, the longer the melting time, but too much fat can make the ice cream hard. This melting speed is one of the parameters to determine the quality of ice cream. According to [16], high-quality ice cream is ice cream that is resistant to melting. Mellorine's best melting time value is to use Alginate. The results of the melting power data in this practicum can be seen in Figure 2.

Good melting time of ice cream is 15-20 minutes at 20 °C. Ice cream whose melting speed is too low can cause the texture of the ice cream to become stiff and have to wait a while to be consumed. The melting rate of ice cream is closely related to the texture of the ice cream. Coarse-textured ice cream has low viscosity and melting resistance, so it melts quickly, so the higher the emulsifier or stabilizer added, the thicker the resulting dough [17]

Melting process in ice cream is where water diffuses out into the serum by gravity, passing through the components that make up the ice cream. The melting speed of ice cream is influenced by several factors such as the amount of air entering, the presence of ice crystals, and the formation of tissue by fat globules during freezing [4] Resulting value for viscosity will be related to the overrun value, followed by the overrun value, which will affect the melting speed of ice cream. The high overrun value causes the time required for melting at room temperature to be faster and the influence of the ice cream-making process can form large air cavities in the ice cream dough and make the ice cream melting time [14].

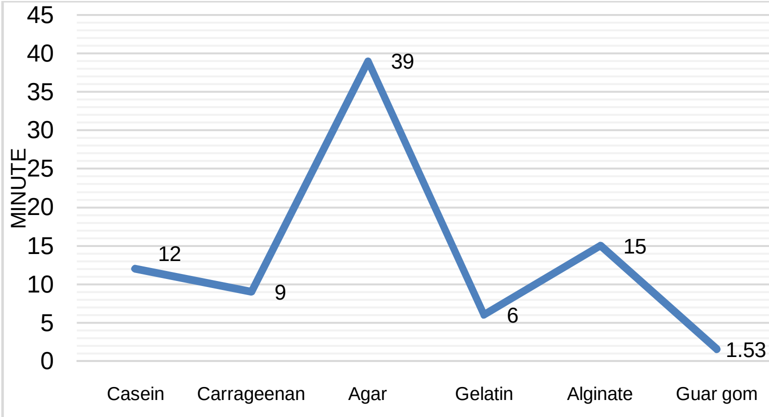

Figure 2. Melting Time of Mellorine

Characteristics of the melting speed of ice cream are not only influenced by stabilizers and emulsifiers but also by the balance of the ice cream constituents and the process of making and storing ice cream. The slow melting speed can be due to the lack of heat propagation in the ice cream due to the large volume of air in the ice cream. Melting speed measurement is also determined by room humidity, temperature difference, wind speed, and direction, which will choose the results of the melting rate of ice cream [18]. High total solids cause the water content in the dough to be less so that there are fewer ice crystals. Total solids in ice cream have a vital role in shaping the texture of ice cream and slowing down the melting of ice cream. The melting time of ice cream is related to the body and texture as well as the intensity of sweetness [14]

The addition of cream in the manufacture of ice cream can increase the fat content of the product and affect the length of the melting speed. Fat affects the rate at which ice cream melts. The higher the amount of fat aggregate, the higher the resistance to melting ice cream. The melting speed of ice cream is also influenced by the amount of air trapped in the ice cream mixture, the ice crystals formed, and the fat content in it. The fat content in ice cream affects the melting time of ice cream because the fat crystals in ice cream have a high melting point, which is -7.9 to 9.6 °C depending on the fatty acids and the position of the fatty acids that make up the triglycerides. The melting time of ice cream will be faster on ice cream with low-fat content.

3.4 Overrun

Size of the air trapped in the ice cream is called overrun. The overrun value of the importance of ice cream is calculated based on the importance of the product with the initial dough volume at the same weight or based on the difference in product weight with the initial dough weight at the same volume. Overrun will affect the texture and density, which will determine the quality of ice cream [19]. Overrun in ice cream can reduce the formation of large ice crystals. Overrun reflects the foaming ability and foam stability associated with a decrease in surface tension in a system consisting of air and water caused by absorption by protein molecules [17]. The overrun value of mellorine with different types of emulsifiers and stirring speed can be seen in Figure 3.

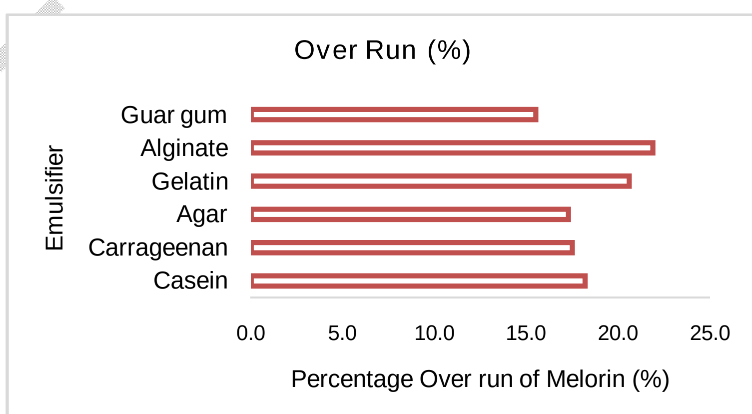

Figure 3. Over Run value of mellorine.

Based on the data in Figure 3, it is found that the highest overrun percentage value is in mellorine with an alginate emulsifier with value 21,9%, while the lowest average overrun value is in mellorine with a guar gum emulsifier with value overrun 15,5%. According to [18], a good overrun value for the home industry scale ranges from 35%-50%, then added to [17], quality ice cream has an overrun ranging from 70-80 %. Overrun will affect the texture and density, which will determine the quality of ice cream. Good stability during the cycle from freeze to thaw will be able to maintain the ice cream overrun. Ice cream that has a low overrun value will form like lumps of hard mass. A low overrun value (<30%) will make the ice cream hard, while a high overrun value (>140%) will make the ice cream too soft.

Overrun occurs through the trapping of air in short chains of protein, fat, and lactose. Overrun is a critical parameter in making ice cream, because it can determine the price level. If the overrun of ice cream produced is high, the profits obtained will also be high. The addition of the volume of ice cream that occurs before the freezing process, where the air trapped in the ice cream will result in an increase in the importance of ice cream. The more stabilizers used, the more the overrun will decrease [20]

Thick dough of mellorine will cause low overrun because the dough has difficulty expanding, and the air is difficult to penetrate the surface of the dough. Overrun is also strongly influenced by the protein present in ice cream. The lower the protein content, the more complex the ice cream dough to expand so that the ice cream overrun is softer. The protein element in the manufacture of ice cream serves to stabilize the fat emulsion after the homogenization process, helps foaming, increases and stabilizes the water holding capacity, which affects the thickness of the soft ice cream texture and can also increase the overrun value of ice cream [21]

Process of mixing dough using a low temperature causes the dough to freeze so that the trapped air cannot be released. The level of overrun can be influenced by the processing process, the composition of the ice cream, such as the emulsifier used, the fat content, and the total dry matter [18]

3.5 Emulsion Stability

Emulsion stability relates to its resistance to the separation of its constituent components, including protein, fat, sugar, and water, as a continuous phase. Stable emulsions occur when the separation process is slow. Unstable emulsions cause proteins to clump and settle, resulting in the separation of protein from fat. The measurement of emulsion stability in ice cream that was given the addition of different emulsifiers showed an average value of 100%. The emulsifier used in the ice cream dough will bind more ice particles and be assisted by a perfect homogenization process, causing the dough to become thicker and have high stability.

Table 2. Value of emulsion stability in mellorine.

Sampel	**Initial Weight (gr)**	**Final Weight (gr)**	**Persentation Emulsion Stability**
Casein	32	29	91%
Carragenan	26	24	92%
Guar gum	32	30	94%
Alginate	33	33	100%
Gelatin	28	27	96%
Agar	28	25	89%

The stability of the emulsion is influenced by the type and amount of stabilizer, the size and uniformity of fat globules, and the thickness of the dough [22]. The smaller and more uniform the fat globules, the higher the emulsion stability. Therefore, the combination of the addition of alginate as a stabilizer and a perfect homogenization process will cause the dough to become thick and have a small size of fat globules so that the resulting emulsion stability is high. Emulsifiers is intended to bind water so that it binds to fat to form ice cream that has good swelling power. One of the functions of the stabilizer is that it can create a micro-sized membrane to bind fat and water and can stabilize the air molecules in the dough so that there is less free frozen water and the fat will not harden due to the stabilizer [2]

4. CONCLUSION

The use of different types of emulsifiers in the production of mellorine affects the organoleptic value, over run, emulsion stability, viscosity and melting time. Alginate emulsifier produces the best mellorine with an organoleptic assessment having a color (5.4), taste (7), odor (6.33), texture (6.33). Physical test resulted with Viscosity (271 cP), Emulsion stability (100%), Melting time (15 minutes) and Over Run value (21.9%).

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