# The Physical and Sensory Characteristics of Ice Cream Enriched Corn Oil Using Different Stabilizers

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# The Physical and Sensory Characteristics of Ice Cream Enriched Corn Oil Using Different Stabilizers

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***Abstract:***
*The purpose of this researched was to determine the physical and sensory characteristics of ice cream enriched with corn oil with the addition of different stabilizers on physical and sensory characteristics such as overrun value, melting time, total solids and organoleptic tests such as of sandness texture, color, creamy taste, and overall preference. This study used 3 treatments and 7 replications with the difference in stabilizers that is without hydrocolloid, arabic gum 0,5%, and gelatin 0,5%. The raw materials used are skim milk, corn oil, whipped cream, sugar, arabic gum, gelatin, and water. The result shows that the addition of stabilizers to ice cream enriched with corn oil has a significant effect on all parameters such as overrun value, melting time, total solids, sandness texture, color, creamy taste, and overall preference. The best treatment was T2 addition of 0,5% gelatin that results in melting time 22,51 minutes, total solids 48,04% and the highest organoleptic score.*

***Keywords:*** *Ice cream, stabilizers, corn oil, Arabic gum, gelatin*

## 1. Introduction

Ice cream is a type of semi-solid food that is usually used as a snack (dessert) made from cow's milk with the main ingredients of fat, sugar, emulsifiers, non-fat solid ingredients and also stabilizers. The composition of ice cream consists of 10% - 16% milk fat, 9% - 12% nonfat solids, 12% - 16% sugar, 0.2% - 0.5% stabilizer and emulsifier, and 55% - 64% water comes from the milk itself or other ingredients used. The quality of ice cream is influenced by the raw materials used, food additives, the manufacturing process and the storage process of the ice cream itself (Hartatie, 2011). The principle in making ice cream is to form an air cavity in the mixture of ice cream ingredients so that it will be obtained by the development of a volume that makes ice cream lighter, less dense, and has a soft texture. Ice cream has a foam structure which is a result of gas dispersed in a liquid and then frozen (Widayanti *et al.*, 2018). The process of making ice cream generally includes material preparation, mixing, pasteurization, homogenization, stirring or shaking, cooling and packaging.

Ice cream made from 100% cow's milk contains high saturated fatty acids so that it can cause several diseases if consumed in excess so it needs diversification by replacing full cream cow's milk with skim milk and adding corn oil as a source of vegetable fat. The saturated fatty acid content of about 13% and unsaturated fatty acid reached 86% consisting of oleic acid and linoleic acid (Takdir *et al.*, 2007). However, if ice cream contains vegetable fat, the tendency to melt is higher so that a stabilizer is needed to emulsify the dough. Types of stabilizers that are commonly used in the food industry are Arabic gelatin and gum. Gelatin is a protein derivative obtained from the partial hydrolysis of collagen from the skin, white connective tissue and cartilage. The chemical structure of gelatin is ($C_{102}H_{151}N_{31}$) in which there are amino acids such as 14% hydroxyproline, 16% proline, 26% glycine, and depend on the raw material used (Agustin, 2013). Gelatin can increase the viscosity of the dough because it absorbs water 5-10 times its weight, is soluble in hot water and when cooled can swell. Arabic gum is a type of hydrocolloid obtained from the sap of the Acacia Senegal tree which is composed of high amounts of polysaccharides and amino acids in low amounts. Arabic gum can function as a stabilizer because it can encourage the formation of fat emulsions and can prevent sugar crystallization. Arabic gum has good solubility, does not dissolve in alcohol, does not smell or tastes when consumed by humans, has a water content between 12% - 15%, and can produce good viscosity.

Based on this, it is necessary to add the right stabilizing agent to produce ice cream that has a high melting time, soft texture, and produces a product that consumers like. This study aims to determine the effect of adding different stabilizers to ice cream enriched with corn oil on overrun values, melting time, total solids, and organoleptic ice cream such as sandness texture, color, creamy taste, and overall preference.

## 2. Materials and Methods

The materials used are skim milk powder 'Indoprima', whipping cream 'Anchor', corn oil 'Tropicana Slim'. Gum Arabic powder, gelatin powder, sugar 'Gulaku' and water. The equipment used are ice cream maker (ICM), mixer, freezer, measuring instruments (scales and measuring cups), basin, spoon, plastic cup, pan, stove. The tools used for physical analysis consisted of oven, petri dish, thermometer, plastic cups, stopwatch, beaker glass, other materials are label paper and organoleptic test form.

The experimental design used in this research was mono factor Completely Randomized Design (CRD) with 3 treatments, namely the different types of stabilizers namely T0 (control) = without hydrocolloid, T1 = arabic gum 0,5%, and T3 = gelatin 0,5%. Each treatment is 7 times repetitions.

The process of making ice cream enriched corn oil refers to Zahro and Nisa (2015). Ingredients such as skim milk powder, whipping cream, corn oil, sugar, arabic gum, and gelatin are weighted according to the formula. Skim milk powder, corn oil, sugar, and water are stirred until homogeneous and pasteurized at 70°C for 5 minutes, then allowed to stand at 40°C. Whipped cream mixed with hand mixer for 10 minutes until fluffy and white. Arabic gum and gelatin were dissolved in water at 50°C. Ice cream mixture is added with a stabilizer according to the formula, T0 (without hydrocolloid), T1 (arabic gum 0,5%), T2 (gelatin 0,5%) then mixed using a hand mixer until homogeneous for 10 minutes. Ice cream dough enters the aging process (ripening in the refrigerator) at 0°C - 4°C for 2 – 3 hours to increase the viscosity. The ice cream dough is homogenized again with 2-speed mixer for 5 minutes to homogenize the size of the fat globule. The ice cream mixture put into the ice cream maker for ±30 minutes for foaming and uniform size of the crystals that are formed. Ice cream is packaged in a cup and close tightly then stored in froze at a temperature ± -18°C for 24 hours. The parameters tested were overrun value, melting time, total solids, organoleptic test (sandness texture, color, creamy taste) and overall preference.

## 3. Results and Discussion

### *3.1. Overrun Value*

The value of the test parameters overrun value can be seen in figure 1. Based on the results of statistical analysis showed that the addition of hydrocolloid on ice cream significant effect ($P < 0.05$) to the value of the overrun. The value of the overrun generated in each treatment is different, with the highest value is T0 (without hydrocolloid) and the lowest value is T2 (gelatin 0.5 percent).

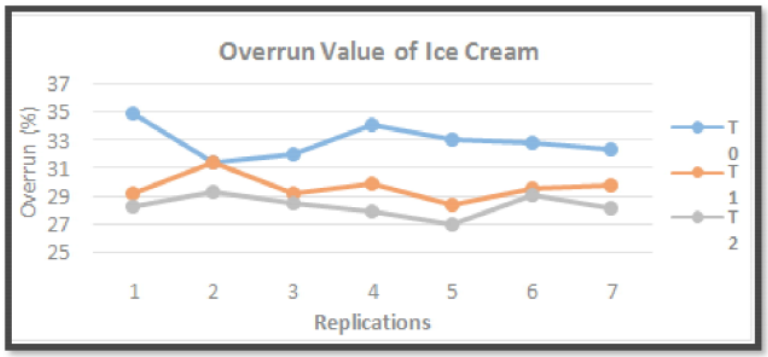


*Figure 1: Overrun Value of Ice Cream Enriched with Corn Oil Using Different Stabilizers*

Treatment T0 has the value of the overrun is high because of the absence of the hydrocolloid, which serves to bind the free water so that the water is not bound to reduce the surface tension and then the air will more easily penetrate the surface of the dough ice cream that can enhance the development of the dough. This is in accordance with the opinion of Zahro and Nisa (2015) which states that the lower the viscosity of ice cream mixture, the air is easy to redeemed surface and can develop the dough. The value of the overrun low on T2 (gelatin 0,5%) due to the high viscosity in the dough so the ability to inflate low. This is in accordance with the opinion of Mulyani *et al*. (2017) which states that the higher the viscosity, it can reduce the ability to inflate dough ice cream because the higher the concentration of gelling agent the more the cluster hydroxy that bind water so that the overrun decreased.

Overrun in ice cream indicates the level of air trapped in the ice cream mixture, the narrower the space between the particles causes less air to enter so that the value of overrun is low. The process of ICM is performed at a temperature of below 10℃ in the ice cream mixture so that the crystallization of fat can forming fat globular into three-dimensional structures that can trap air and water is large so that the volume of ice cream can inflate. The content of the hydroxyl group (-OH) on the hydrocolloid is hydrophilic, which can form hydrogen bonds with one or more molecules of water so that it can absorb water and hold it on the structure of the molecules and form a dough with a high viscosity. The content of the hydroxyl group (-OH) on the gelatin tends to be higher compared to gum Arabic because gelatin is composed of amino acids that are hydrophilic in high quantities while the gum Arabic is composed of polysaccharides and amino acids

low. This is in accordance with the opinion of Katili (2009) stated that gelatin is a derivative of collagen which contains amino acids high which contained hydroxyl groups that are hydrophilic and can form a gel.

In all treatments, ice cream enriched with corn oil with the addition of different hydrocolloids has an overrun value ranging from 28.23% - 32.99% so it can be said to be close to a good household-scale ice cream standard of 30% - 50%. This is in accordance with the opinion of SNI 01-3713-1995 which states that the standard overrun value of ice cream products on a household scale is 30% - 50%.

*3.2. Melting Time*

Melting time parameter test can be seen in Figure 2. Based on the results of the statistical analysis shows that the addition of hydrocolloids as stabilizers for corn oil ice cream has a significant effect ($p < 0.05$) on melting time. Melting time is the time needed for ice cream to melt completely at room temperature after passing through the freezing process.

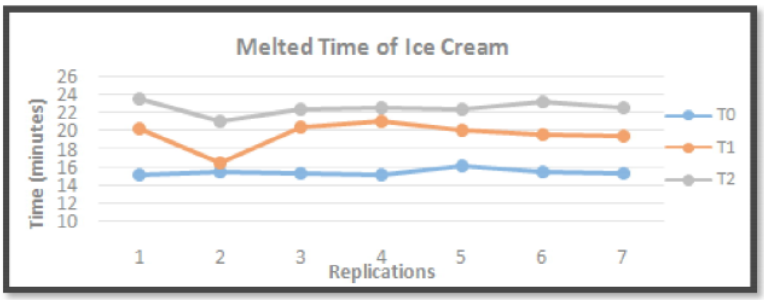


*Figure 2: Melting Time of Ice Cream Enriched with Corn Oil Using Different Stabilizers*

The melting time ice cream related to the value of the total solids and the value of the overrun. This can be seen in treatment T2 has a value of time of melting is high but the value of the overrun tends to below. The time of melting is the highest, namely at T2 (gelatin 0,5%) shows that melting takes a long time because the ice crystals a bit and the air cavity low. This is in accordance with the opinion of Aulia et al. (2019) which states that the decline in the capture of air can cause ice cream is difficult for melted or have the time of melting because crystals that are formed low. The lowest melting time at T0 (without hydrocolloid) due to the absence of a stabilizer has the ability of the connective power of water-free high to slow down the melting ice cream and to prevent the formation of ice crystals is high. This is in accordance with the opinion of Nugroho and Kusnadi (2015) which states that the stabilizer is a hydrophilic colloid that can reduce the concentration of free water by absorbing the water so that it will reduce ice crystallization and reduce ice crystals. The higher the ice crystal content in ice cream, the melting time of ice cream will be lower.

Melting time at T1 (arabic gum 0.5%) is good, because Arabic gum has good water solubility at cold temperatures so that it can maintain its water-binding function even in cold conditions such as freezing and aging. This is consistent with the opinion of Widiantoko and Yunianta (2014) which states that Arabic gum can maintain the binding of water well in cold temperatures because it has very good solubility. Melting time of ice cream enriched with corn oil using different stabilizers results in melting time ranging from 15.40 - 22.51 minutes. According to SNI no. 01-3713-1995 that a good range of melting ice cream is 15-25 minutes, in this study all treatments met a good melting range.

*3.3. Total Solids*

Test parameters total solids can be seen in figure 3. Based on the results of statistical analysis showed that the addition of hydrocolloid material as the stabilizer of ice cream of corn oil to give real effect ($p<0,05$) to the value of the total solids. Total solids are all the constituent components of the ice cream that are reduced by levels of water including solid material such as carbohydrates, protein, vitamins, and minerals (Ahmad *et al.*, 2012). The method put in the oven for approximately 5 hours will cause the free water contained in ice cream will evaporate so that only the remaining components of the solids.

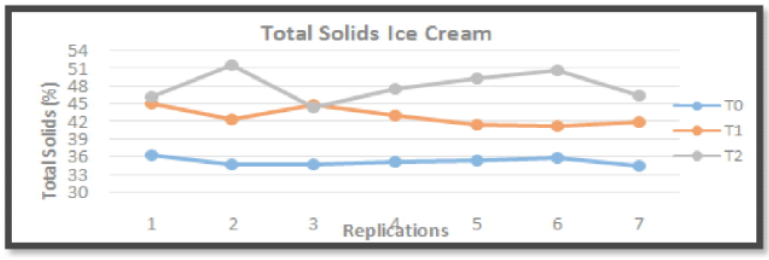


*Figure 3: Total Solids of Ice Cream Enriched with Corn Oil Using Different Stabilizers*

The value of the total solids of the highest is T2 (gelatin 0.5 percent) indicates that the gelatin can bind many particles is better than all the treatment. This is in accordance with the opinion of the Hidayah et al. (2017) which states that the use of gelatin in making ice cream will increase the viscosity followed by increasing the total solid because of the free water bound by the protein due to amino acid content is high. While the value of total solids low, namely T0 (without hydrocolloid). This is due to the absence of the addition of a hydrocolloid as the material of the stabilizer that can trap and bind free water and so increase the viscosity of the dough ice cream.

The value of the total solids of all treatments and replications ranged between 34,50 – 51,49 so that it meets the requirements of SNI quality requirements of ice cream that have total solids of at least 34%. The Total solids are high causing the water content to be less so the crystals of the ice cream are also low, the ice crystals in ice cream because it is more resistant to melting. While the Total solids that is too low can make the ice cream texture becomes rougher and its viscosity is low, however, if the total solids of the ice cream is too high then the texture becomes stickier and harder (Ismawati et al., 2016).

| Perlakuan | Skor | Criteria |
|---|---|---|
| T0 | 3,76 ± 1,05[a] | Rather sandiness |
| T1 | 4,00 ± 0,81[a] | Not sandiness |
| T2 | 4,56 ± 0,77[b] | Not sandiness at all |

*Table 1: Organoleptic Test Texture Sandness Ice Cream*
*Description: T0 = without hydrocolloid, T1 = arabic gum 0,5%, T2 = gelatin 0,5%*

*3.4. Organoleptic Ice Cream*

3.4.1. Texture Sandness

The results of the organoleptic texture sandness on ice cream can be seen in table 1. Based on these data it can be seen that the addition of hydrocolloid on ice cream enriched corn oil to give a significant difference ($P<0.05$) on the texture of sandness ice cream of corn oil. The average value of organoleptic attributes texture sandness range between 3,76 – 4,56.

Treatment on the T2 with the addition of 0.5% gelatin to produce a score of the highest because the gelatin has a gel with the style of a high affinity with water. This is in accordance with Hidayah et al. (2017) the opinion is expressed that the gelatin has a gel the force of Attraction (affinity) is high with water and contains amino acids hydrophilic to prevent the formation of ice crystals large. The addition of hydrocolloid material as a stabilizer on ice cream of corn oil can improve the texture because it can form a good emulsion and prevent the formation of ice crystals that are rough and large. Ice cream that is produced in treatment T0 produces the texture is a bit sandy shows the ice crystals tend to be large and not uniform due to the absence of the addition of stabilizer. Some of the factors that affect the softness of the ice cream is the size of the ice crystals, the value of the overrun, and the volume of the phase of ice. According to Ermawati *et al.* (2016) the texture of ice cream is associated with rough and smooth ice crystals are formed, the arrangement of the crystals, as well as the distribution of air cells in ice cream. So that the fine ice crystals will form the texture of ice cream that is smooth with solid particles that small.

| Perlakuan | Skor | Criteria |
|---|---|---|
| T0 | 3,24 ± 0,78[ab] | White yellowness |
| T1 | 3,00 ± 0,64[a] | White yellowness |
| T2 | 3,60 ± 0,76[b] | White |

*Table 2: Organoleptic Test Color Ice Cream*
*Description: T0 = without hydrocolloid, T1 = arabic gum 0,5%, T2 = gelatin 0,5%*

3.4.2. Color

The results of the organoleptic test of color on the ice cream can be seen in table 2. Based on these data it can be seen that the addition of hydrocolloid on ice cream enriched corn oil to give real effect ($P<0.05$) on the color of the ice cream. The average score color organoleptic test the ice cream of corn oil that is 3,00 – 3,60.

The resulting color on the ice cream of corn oil tends to be yellowish-white because of the carotenoid content in the skim milk. This is in accordance with the opinion of the Wijayanti and Ismawati (2016) which states that the white color in milk is a result of the spread of the granules of calcium caseinates, calcium phosphates, as well as material that gives a yellowish color, namely carotene and riboflavin. Treatment T1 has the most score low as 3.00 and the yellow color is more dominant than white due to the emulsion dough is less evenly distributed because of globule-globule fat of milk is not evenly distributed. Globule uneven will be fused into the globule bigger so more visible. This is in accordance with the opinion of the Hartatie (2011) who stated that the mixing process is not goodwill damage the membrane proteins that surround globule fat so globule fat can come closer together and converge the past will rise to the surface. Whereas in treatment T2 ice cream colored white uniform signifies that the emulsion and globule-globule small evenly distributed on all the dough so that the creamy taste due to the fat evenly. The material of the stabilizer to emulsify the dough as well as can help globula-globula fat are not mutually joined so that the ice cream that was created has a white color and attractive for the consumer.

3.4.3. Creamy Taste

The results of the organoleptic test of color on the ice cream can be seen in table 3. Based on these data it can be seen that the addition of hydrocolloid on ice cream enriched corn oil to give real effect (P<0.05) on the taste of creamy ice cream. The average score on the taste of the creamy ice cream that is 3,76 – 4,16.

Creamy taste high of 4,16 in treatment T2, namely with the addition of gelatin of 0.5%. Gelatin can increase the total solids and bind water taste-free ice cream is more stable and not bland. Also, solid materials such as protein and fat will be more dominant than water. Creamy taste on the treatment T1 is 4.00 and treatment at T0 (control) got the lowest score is 3,76 because of the absence of the addition of stabilizer which can serve as a stabilizer.

| Perlakuan | Skor | Criteria |
|---|---|---|
| T0 | 3,76 ± 0,92[a] | *Rather Creamy* |
| T1 | 4,00 ± 0,91[a] | Rather*Creamy* |
| T2 | 4,16 ± 0,85[a] | *Rather Creamy* |

*Table 3: Organoleptic Test of Creamy Test Ice Cream*
*Description: T0 = without hydrocolloid, T1 = arabic gum 0,5%, T2 = gelatin 0,5%*

Another factor that affects the taste of the creamy in ice cream is the protein content in milk and fat in the whipping cream because the fat serves to maintain the stability of the froth and makes the texture creamier. This is in accordance with the opinion of the Masykuri et al. (2012) who stated that the whipping cream is added on the ice cream causes the creamy taste and the milk taste is dominant. Also, the protein content in the skim milk can add a flavor of ice cream and increase the foaming because the protein may serve to stabilize the fat emulsion after homogenization, add flavor, and the texture of soft ice cream.

3.4.4. Overall Preferences

The results of the organoleptic test overall preferences in ice cream can be seen in table 4. Based on these data it can be seen that the addition of hydrocolloid on ice cream enriched corn oil to give real effect (P<0.05) on overall fondness on the ice cream.

| Perlakuan | Skor | Criteria |
|---|---|---|
| T0 | 4,08 ± 0,86[a] | like |
| T1 | 4,08 ± 0,81[a] | like |
| T2 | 4,68 ± 0,55[b] | So like |

*Table 4: Organoleptic Test of Overall Preferences Ice Cream*
*Description:*
*T0 = without hydrocolloid, T1 = arabic gum 0,5%, T2 = gelatin 0,5%*

Based on the data the overall favorite ice cream of corn oil look that the panelists liked all the treatment. T0 (without hydrocolloid), T1 (0.5% of gum Arabic), and T2 (0.5% of gelatin) because the scores on all of the above treatments to 4.00. Attributes overall preferences determined by texture sandness, color, and creamy flavor on corn oil. The highest score on the treatment T2 (gelatin 0,5%), namely of 4.68, which shows that panelists are very fond of ice cream with a texture not gritty, bright colors, and taste creamy. This is in accordance with the opinion of the Pangesti et al. (2019) that states that consumers like the ice cream have delicious flavors, attractive colors and smooth texture.

## 4. Conclusion

Based on the results of the research can be concluded that the addition of hydrocolloid on ice cream enriched corn oil can increase the time of melting, the total solids, as well as the texture of sandness, color, creamy taste, and overall preferences. Treatment ice cream of corn oil best namely T2 (gelatin of 0.5%) that produces time of melting is high, the total solids, and organoleptic rated by panelists.

## 5. References


i. Agustin, F. and W. D. R. Putri. 2014. Making jelly drink *Averrhoa blimbi* L. (Study of the proportions of the starfruit: water and the concentration of carrageenan). J. Pangan dan Agroindustri. 2 (3): 1 – 9.
ii. Aulia, S., H. Rizqiati, and Nurwantoro. 2019. The influence of the substitution of kefir on the physical properties, the yeast, and the hedonic ice cream. J. Teknologi Pangan. 3 (2): 192 – 198.
iii. Badan Standarisasi Nasional. 1995. Standar Nasional Indonesia. SNI 3713:1995. Terms of The Quality of The Ice Cream. Dewan Standarisasi Nasional, Jakarta.
iv. Ermawati, W. O., S. Wahyuni, and S. Rejeki. 2016. Study the utilization of leather waste plantain (*Musa paradisiaca var King*) in the manufacture of ice cream. J. Sains dan Teknologi Pangan. 1 (1): 67 – 72.
v. Hartatie, E. S. 2011. The study formulation (raw materials, stabilizers) and methods of making on the quality of ice cream. J. Gamma. 7 (1): 20 – 26.

vi. Hidayah, U. N., D. R. Affandi, and A. M. Sari. 2017. Study of microstructure, physical characteristics, and sensory of ice cream with the use of gelatin the bones catfish dumbo (*Clarias gariepinus sp.*) as the stabilizer. J. Teknologi Hasil Pertanian. 10 (2): 89 – 98.

vii. Ismawati, N., Nurwantoro, and Y. K. Pramono. 2016. The value of pH, total dissolved solids, and the nature of the sensory yogurt with the addition of beetroot extract (*Beta vulgaris L.*). J. Aplikasi Teknologi Pangan. 5 (3): 89 – 93.

viii. Katili, A. B. S. 2009. The structure and function of collagen protein. J. Pelangi Ilmu. 2 (5): 19 – 29.

ix. Masykuri, Y. B. Pramono, and D. Ardilia. 2012. Resistance melting, over-run, and the level of preference of vanilla ice cream that is made from the main ingredients a combination of milk cream and coconut milk. J. Aplikasi Teknologi Pangan. 1 (3): 78 – 82.

x. Mulyani, D. R., E. N. Dewi, and R. A. Kurniasih. 2017. The characteristics of the ice cream with the addition of alginate as a stabilizer. J. Pengolahan dan Bioteknologi Hasil Pertanian. 6 (3): 36 – 42.

xi. Nugroho, Y. A and J. Kusnadi. 2015. Application of mangosteen peel (*Garcinia mangostana* L.) as a source of antioxidants on the ice cream. J. Pangan dan Agroindustri. 4 (3): 1263-1271.

xii. Pangesti, W. D., V. P. Bintoro, and A. Hintono. 2019. The characteristics of the ice cream of purple sweet potato (*Ipomoea batatas* L.) with the addition of arrowroot starch (*Maranta arundinacea*) as a material stabilizer. J. Teknologi Pangan. 3 (2): 1 – 6.

xiii. Takdir, A. M., S. Henry, and M. J. Mejaya. 2007. The formation of varieties of hybrid corn. J. Agrotek. 3 (1): 74 – 95.

xiv. Widayanti, N., S. Maimurni, D. S. Milyadi, N. D. P. Ratnasari, S. Ayesha, and N. Syahria. 2018. Innovation utilization of the vegetables into smoothies and ice cream vegetable. J. Abadimas Adi Buana. 2 (1): 47 – 53.

xv. Widiantoko, R. K. and Yunianta. 2014. Manufacture of tempeh ice cream – ginger (Study of the proportions of ingredients and temperature on the physical properties, chemical and organoleptic). J. Pangan dan Agroindustri. 2 (1): 54 – 66.

xvi. Wijayanti, S. S. and R. Ismawati. 2016. The influence of the amount of skim milk and moringa leaves (*Moringa oleifera*) on the organoleptic properties and the speed of melted ice cream. J. Boga. 5 (3): 101 – 109.

xvii. Zahro, C. and F. C. Nisa. 2015. The influence of the addition of the juice of the grape (*Vitis vinifera* L.) and the stabilizer on the characteristics of the physical, chemical and organoleptic ice cream. J. Pangan dan Agroindustri. 3 (4): 1481 – 1491.

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