Indonesian Journal of Halal Research 2(1): 1-7, February 2020
E-ISSN: 2657-0165
P-ISSN: 2656-3754

Characteristics of Spanish Mackerel (*Scomberomorus commerson*) Bone Gelatin for Ice Cream Stabilizer

Souvia Rahimah*[1,2], Anisa Fadhila[1], Elazmanawati Lembong[1,2], Nandi Sukri[1], Tri Cahyanto[3]

[1]Department of Food Industrial Technology, Faculty of Agroindustrial Technology
Universitas Padjadjaran, Bandung, West Java, 45363, Indonesia
[2]Padjadjaran Halal Center, Faculty of Agroindustrial Technology, Universitas Padjadjaran, Bandung
West Java, 45363, Indonesia
[3]Department of Biology, Faculty of Science and Technology, UIN Sunan Gunung Djati Bandung
West Java, 40614, Indonesia
*e-mail: *[1]souvia@unpad.ac.id , [1]anisa.fadhila2@gmail.com , [1,2]elazmanawati.lembong@unpad.ac.id , [4]nandi@unpad.ac.id, [3]tri_cahyanto@uinsgd.ac.id*

*Correspondent Author
DOI: 10.5575/ijhar.v2i1.7820

ABSTRACT

Ice cream is a milk-processed-based product that provides enough nutrients. The ice cream making process requires a stabilizer. The stabilizer used in this study was gelatin. This research used mackerel fish bones as the basic material for the gelatin, where the protein content is high enough to be made as gelatin. The purpose of this research was to determine the right amount of mackerel to make ice cream with good characteristics. The descriptive experimental method with an advanced regression analysis method was used to analyze the results of ice cream physical characteristics, while randomized block design (RBD) and descriptive method were used on the organoleptic results of the ice cream. The experiment consisted of four repetition sessions with different gelatin concentrations of 0%, 0.1%, 0.3%, and 0.5%, each treatment was repeated three times. The results showed additions of gelatin concentration on ice cream making had a very strong relationship with the characteristics of the ice cream namely overrun value, melting power, and viscosity with a correlation coefficient of 0.94, 0.911, and 0.995 respectively. While in terms of organoleptic, the higher the concentration gelatin, the softness of ice cream is higher, therefore more panelists preferred it.
Keywords: *Fish Bone, Ice Cream, Spanish Mackerel, Stabilizer*

1. Introduction

Ice cream is the milk-based processed product that provides a high nutritional intake. The premium cream contains 15% sucrose, 0.3% stabilizer and emulsifier, 12% fat, 11% nonfat milk solids, and 38.3% total solids (Mc Sweeney & Fox, 2009). According to BSN (1995), a good quality ice cream has a normal appearance, smell and taste, minimum fat of 5%, minimum protein of 2.7%, minimum sugar (sucrose) of 8%, minimum total solids of 34%, and melting quality approximately 15-25 minutes.

Ice cream is an emulsion food system. Therefor ice cream need a stabilizer. The use of stabilizers in ice cream is to prevent the formation of large ice crystals, to maintain emulsion stability, to improve texture to become softer and smoother, as well as slowing the melting process (Sursrini, 2003). The stabilizers commonly used in ice cream making are Na-alginate, carrageenan, arabic gum, pectin, CMC (*Carboxymethill Cullulose*) and gelatin with concentrations of 0.1% - 0.5% (Padaga & Sawitri, 2006).

The gelatin in the food industry used as an emulsifier, adhesive, thickener, gel maker, foam maker, elasticity regulator, stabilizer, and has a high digestibility (Yenti et al., 2016; Kumala, 2017). Gelatin as a stabilizer is able to produce a better quality of ice cream compared to other stabilizers (Hartatie, 2011). The main source of gelatin are bones and skin of mammals such as cow bones, cow skin and pigskin (Harianto, 2008). Gelatin can also be obtained from other animals including fish.

Fish was chosen as an alternative source of raw material for making gelatin based on high fisheries production in Indonesia. Fish gelatin is also an alternative to avoid non-halal gelatin. Fish bone contains high protein that can be used as a raw material in producing gelatin.

Therefore, the study of used the basic ingredients of mackerel fish bones in the making of gelatin, which then gelatin produced will be added in the manufacture of ice cream. The purpose of this study was to determine the proper concentration of mackerel bone gelatin in making ice cream in order to produce ice cream with good characteristics.

2. Materials and Methods

2.1. Research Method

The Randomized Group Design (RBD) method was used in this research. Data were analyzed using analysis of variance (ANOVA) followed by Duncan's multiple range test. The ranking test method was used. The experiment consisted of 4 treatments with the addition of mackerel fish gelatin in the concentrations of 0%, 0.1%, 0.3% and 0.5% and used 15 panelists as replications.

2.2. Fishbone Gelatin Extraction

Fishbone was boiled using sufficient distilled water at 80°C for 30 minutes. The fish bones were separated from the remaining meat. The hydrolysis process was carried out by immersing the fish bones in HCl 2% for 24 hours. After soaking for 24 hours, the fish bones were washed 3 times in distilled water. Furthermore, the extraction process of clean fish bones heated in distilled water with the ratio of 3:1 at 80°C for 5 hours. Extract were filtrated using a filter cloth to separate the residue and the filtrate. The filtrate was dried using vacuum oven at 50°C for 24 hours. The dry filtrate was ground to produce gelatin flour.

2.3. The Ice Cream Making

Five hundred grams of fresh cow's milk was pasteurized at 90°C for 25 seconds. Then 40 grams of sugar and 20 grams of whipping cream were mixed. Mackerel fish gelatin with the concentration of 0%; 0.1%; 0.3%; 0.5% % was added along with 50 grams of skim milk. The mixture was mixed using a mixer at a temperature of 70°C for 5 minutes. The aging process was carried out to the homogenized mixture at a temperature of 4°C for 24 hours. The whipping process was carried out with the addition of 2 grams of vanilla flavoring for 15 minutes. Furthermore, the stirring process was done using an ice cream maker for 30 minutes. The ice cream was frozen immediately at a temperature of -20°C for 24 hours.

2.4. Analysis Methods

The Expansion of Dough Volume (Overrun) (Goff & Hartel, 2013)

Overrun was calculated based on the difference in weight of the ice cream and the weight of the dough in the same volume (100 mL). Overrun calculation using the following formula:

$$Overrun = \frac{weight\ of\ the\ dough - weight\ of\ the\ ice\ cream}{weight\ of\ the\ ice\ cream} x\ 100\%$$

Melting Velocity (AOAC, 2000)

Measurements were carried out by taking 2 grams of ice cream that has been frozen at temperature of -20°C for 24 hours and placed on a plate. The ice cream was allowed to melt completely at room temperature. Melting time was measured using a stopwatch. The ice cream was considered completely melted when ice cream can flow like liquid. The melting unit is minutes/2g

Viscosity (Manual Laboratory Brookfield Viscometer, 2006)

The viscosity of aging ice cream dough is measured at 60°C using a digital viscometer. Measurements were carried out using the L2 spindle at 50 rpm.

Organoleptic Assessment Test (Setyaningsih et al., 2010)

The organoleptic test was carried out by two methods, the preference test and the ranking test using 15 semi-trained panelists. Organoleptic tests performed included color, flavor, softness, and aftertaste. The preference organoleptic test was performed to determine the level of preference or panelist acceptance of the ice cream samples given, numerical scale given 1=equally preferred, 2=equally to moderately preferred, 3=moderately preferred, 4=moderately to strongly preferred, 5=strongly preferred. While the ranking test was carried out to determine the order of the sample according to differences in the level of sensory quality. The smaller value/rank, the better the quality of ice cream.

3. Results and Discussion

3.1. Overrun

Based on the regression analysis, the regression equation y = 21.166 – 4.499x is obtained with a value of R^2 = 0.885 and r = 0.94 (Figure 1). It shows that the overrun value is influenced by the concentration of mackerel fish bones gelatin by 88.5% with a very strong relationship (r = 0.94). The negative slope value indicates that each addition of mackerel fish gelatin by 0.1% results in a decrease in overrun of 4.49%. The higher the concentration of mackerel fish bone gelatin resulted in the thicker dough causing lower overrun values.

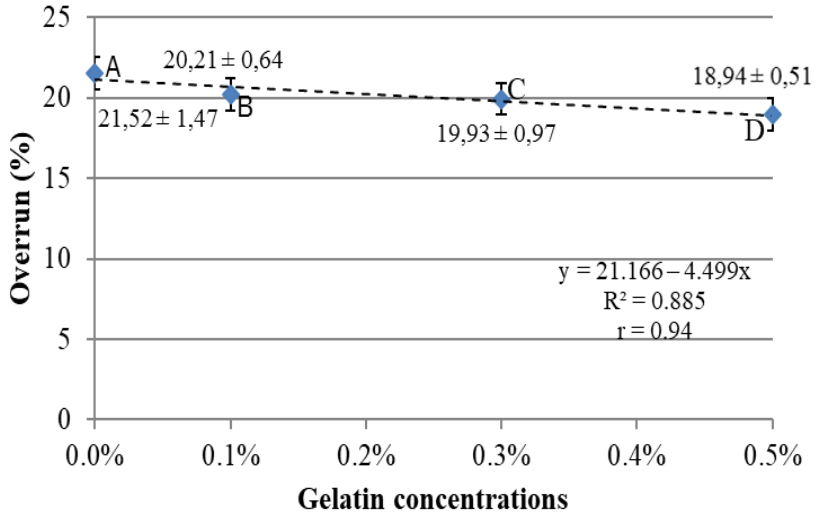

Figure 1. Relationship Curve between Concentration of Mackerel Fish Gelatin vs The Ice Cream Overrun

Overrun values are influenced by gelatin. Gelatin is able to increase the thickness of the dough by forming a gel matrix and holding the dispersed liquid phase, the thick dough causes air to not easily enter so the dough will be difficult to expand (Muse et al., 2004). In addition, according to Lampert (1970), low overrun values can be due to the slow process of stirring while making ice cream. The ice cream maker used in this study has a capacity of 30 revolutions per minute (rpm). To produce good ice cream, it is better to use mixer with a capacity of 200 rpm. Some other factors that can affect the overrun value are homogenization in the manufacturing process, fat content in ice cream and the amount of stabilizer (Harper & Hall, 1976).

3.2. The Melting Velocity

Based on the regression analysis, the regression equation of y = 16.045 + 8.321x was obtained with a value of R^2 = 0.83 and r = 0.911 (Figure 2). It shows that the value of melting velocity is influenced by the concentration of gelatin of mackerel fish bones by 83% with a very strong relationship (r = 0.911). A positive slope value means that each addition of mackerel fish gelatin by 0.1% results in an increase in the melting power of 8.32%. The higher gelatin concentration of mackerel fish bones resulted in the higher ability of the dough to bind water causing the dough thicker and the melting time of ice cream will be higher thus the melting time will be longer (Arbuckle, 1986).

The melting velocity has a close relationship with the value of overrun. The high overrun value resulted in the shorter melting time, on the contrary, the low overrun the longer the melting time (Susilorini, 2006). The gelatin in ice cream affects the melting power, where the ability of gelatin in binding water causes water molecules trapped in the gel structure formed by the presence of gelatin (Zahro, 2015). Even though gelatin has the ability to bind water, but not all water can be absorbed, water that is not absorbed by gelatin causes the formation of ice crystals (Zahro, 2015).

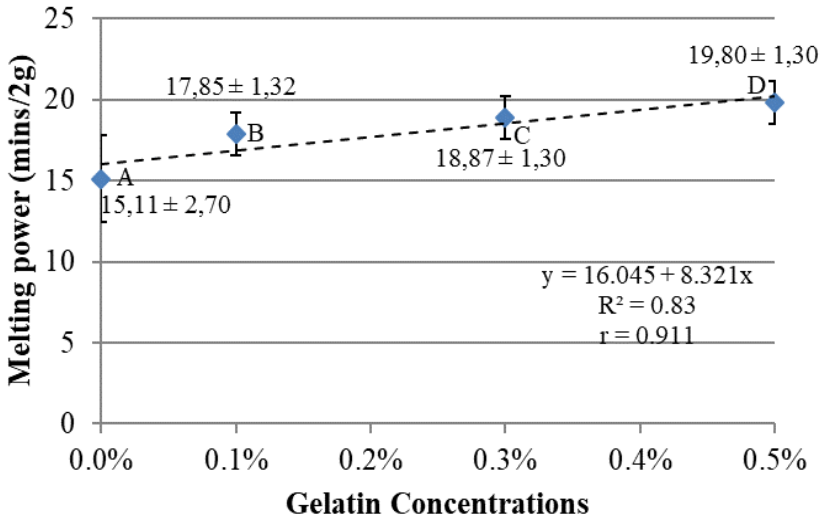

Figure 2. Relationship Curve Between Concentration of Mackerel Fish Gelatin and Ice Cream Melting Velocity

3.3. Viscosity

Based on the regression analysis, the regression equation y = 22.112 + 15.423x was obtained with the value of R^2 = 0.991 and r = 0.995 (Figure 3). The equation indicated that the viscosity value is influenced by the concentration of mackerel fish bones gelatin by 99.1% with a very strong relationship (r = 0.995). A positive slope value means that each addition of mackerel fish gelatin by 0.1% results in an increase in viscosity of 15.42%. The higher the mackerel fish bones gelatin concentration, the thicker the dough causing the value of viscosity higher.

A high viscosity value causes a low overrun value, and a soft texture due to the shrinking of ice crystals which inhibit the melting power of ice cream at room temperature (Susilorini, 2006). Mackerel fish gelatin is one source of protein needed in order for water binding and emulsify. The protein in ice cream serves to stabilize the fat emulsion, help to foam, add flavor, stabilize and increase the water-binding capacity that affects the thickness of the ice cream, affects the viscosity, and produce soft ice cream (Oksilia, 2012).

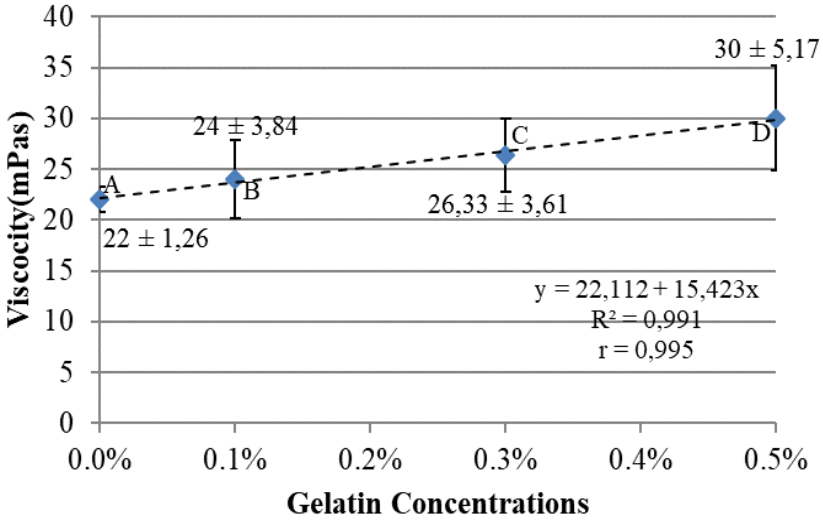

Figure 3. Relationship Curve between Concentration of Mackerel Fish Gelatin and Ice Cream Viscosity

3.4. Organoleptic Properties

Color

One important aspect in consumer acceptance of a food product is color. The color of a product can be a measure of the quality of the product. The ranking test results (Table 1) show that treatment A produced the whitest ice cream color among all treatments. As for the preference test result by the panelists for the color of each treatment that has the same properties indicated that the panelists can prefer the color of the ice cream produced. The average range of color preferences is between 3.53 - 4.06 (moderately preferred - moderately to strongly preferred).

The observation indicated that the higher concentration of gelatin, the greater value/rank given by the panelists. Value/rank states the quality of the color of ice cream, where the higher the value/rank the more yellow/darker color. Based on observations, the higher the concentration of gelatin added the more yellow/darker the colors of ice cream. The yellowish color of the ice cream resulted from the addition of mackerel fish bone gelatin, where the physical properties of gelatin itself have a transparent or bright yellow color.

Table 1. The Result of Ranking Preferability to the Ice Cream Color

Treatments	Total Ranking		Hedonic Average*
	Total	Ranking	
A (0%)	21	1	4.06[a]
B (0.1%)	25	2	4.06[a]
C (0.3%)	46	3	3.66[a]
D (0.5%)	58	4	3.53[a]

*Hedonic average values followed by the same letter are not significantly different by Duncan's multiple range test ($p<0.05$)

Flavor

The flavor is the overall impression or sensation that is received by the human senses, especially by the smell and taste when drink or food is consumed (Fardiaz, 2006). The ranking test results (Table 2) show that treatment A did not have fish flavor between treatments B, C and D. As for the results of the preference test, the treatment A did not have fish flavor, while treatment D had the most fish flavor. So that the flavor of each treatment has properties that are not significantly different and the panelists can still like the flavor of the ice cream produced. The average range of preferences for flavor is between 3.13 - 3.73 (moderately preferred).

Based on the observation, the higher the concentration of gelatin, the greater the value/rank given by the panelists. Value/rank states the quality of the ice cream flavor, where the higher the value/rank the more fish flavor is felt. Based on observations, the higher the concentration of fish flavor added the more it feels. The resulting flavor can also be influenced by the fat content in ice cream, fat in ice cream, in addition to increasing flavor can also help produce a soft texture and can affect the nature of melting ice cream (Violisa et al., 2012).

Table 2. The Result of Ranking Preferability to Ice Cream Flavor

Treatments	Total Ranking		Hedonic Average
	Total	Ranking	
A (0%)	23	1	3.73[a]
B (0.1%)	32	2	3.4[a]
C (0.3%)	41	3	3.26[ab]
D (0.5%)	54	4	3.13[b]

*Hedonic average values followed by the same letter are not significantly different by Duncan's multiple range test ($p<0.05$)

Softness

The high-quality ice cream can be indicated by a soft texture of ice cream due to the small ice crystals produced, small ice crystals can be caused by the high-fat content in ice cream (Hartatie, 2011). The results (Table 3) show that treatment D has the softest softness among all treatments. As for the results of the preference test by the panelists on the softness of treatment A has the least softness, while treatment D is the softest.

Based on observations, the higher the concentration of gelatin added the softer the texture of ice cream. The texture of ice cream is strongly influenced by the gelatin used, as well as from the fat content present in ice cream. The gelatin in ice cream help control the formation of the rough texture in ice cream due to the formation of ice crystals or can inhibit the growth of crystals (Marshall et al., 2000).

Table 3. The Result of Ranking Preferability to the Ice Cream Softness

Treatments	Total Ranking		Hedonic Average
	Total	Ranking	
A (0%)	51	4	3^{b}
B (0.1%)	46	3	3.26^{b}
C (0.3%)	30	2	4.2^{a}
D (0.5%)	23	1	4.53^{a}

*Hedonic average values followed by the same letter are not significantly different by Duncan's multiple range test ($p<0.05$)

Aftertaste

The aftertaste is an impression that can still be felt later after stimulation is given as some types of food still leave an impression even though the food has been swallowed. This aftertaste illustrates an impression that still can be felt, even though stimulation has not been given anymore. The results (Table 4) shows that treatment A does not have the aftertaste of fish left behind compared to the treatments of B, C and D. As for the test of preference for aftertaste, treatment A does not have the aftertaste of fish left behind, while treatment D had the most pronounced aftertaste of fish left behind.

Based on observations, it can be concluded that the higher the concentration of gelatin added the more fish aftertaste is left behind from the ice cream. Winarno (2008) stated that the aftertaste is influenced by interactions with other taste components. Aftertaste parameters can also play a role in determining the level of panelist acceptance of a material (Fennema, 1985).

Table 4. The Result of Ranking Preferability to Ice Cream Aftertaste

Treatments	Total Ranking		Hedonic Average
	Total	Ranking	
A (0%)	22	1	3.6^{a}
B (0.1%)	31	2	3.26^{a}
C (0.3%)	42	3	3^{ab}
D (0.5%)	55	4	2.6^{b}

*Hedonic average values followed by the same letter are not significantly different by Duncan's multiple range test ($p<0.05$)

4. Conclusion

Gelatin concentration of Spanish mackerel fish bones has a very strong close relationship to the physical characteristics for making ice cream, the value of overrun, melting power, and viscosity with a correlation coefficient of 0.94; 0.91 and 0.99. Organoleptic test results showed that the higher the gelatin concentration of mackerel fish bones added, the higher the level of panelists' preference for the softness of ice cream, while the panelists were less likely to like color, flavor, and aftertaste.

References

AOAC Internasional. (2000). *Official Methods Of Anlysis, 17th ed.* AOAC Internasional, Gaithersburg.

Arbuckle, W.S. (1986). *Ice Cream*. Second Edition. The AVI Publishing Company.Westport.Connecticut.

Badan Standardisasi Nasional. (1995). SNI 01-3713-1995: Syarat Mutu Es Krim. BSN, Jakarta.

Fardiaz. (2006). *Kimia Flavour I*. Jurusan Kimia, Fakultas Teknik. Medan: Universitas Sumatera Utara.

Fennema, O. R. (1985). *Food Chemistry*. Second Edition. New York: Basel & Marcel Dekker,Inc.

Goff, H. D. & Hartel, R. W. (2013). *Ice cream 7th edn*. New York (NY) USA: Springer.

Harper, W. J. & Hall, C. W. (1976). *Dairy Technology and Enginering*. The AVI Publishing Co. Inc. Westport. Connecticut.

Hartatie, E. S. (2011). Kajian Formulasi (Bahan Baku, Bahan Pemantap) dan Metode Pembuatan terhadap Kualitas Es Krim. *J GAMMA*, *7*(1): 20-26.

Lampert, L. M. (1970). *Modern Dairy Products*. New York: Chemical Publishing Comp. Inc.

Manual Laboratory Brookfield Viscometer. (2006). *More Solutions To Sticky Problems : A Guide to Getting More from Your Brookfield Viscometer*. Middleboro, USA: Brookfield Engineering Labs., Inc.

Marshall, R. T. & Arbuckle, W. S. (2000). "*Ice cream*". 5th Edition. Gaithersburg, Maryland: Aspen Publisher,Inc.

Muse, M. R. & Hartel, R. W. (2004). Ice Cream Structural Elements that Affect Melting Rate and Hardness. *Journal of Dairy Science*, *87*(1): 1-10.

Oksilia, Merynda, I. Syafutri & Lidiasari, E. (2012). Karakteristik Es Krim Hasil Modifikasi dengan Formulasi Bubur Timun Suri (*Cucumis melo* L.) dan Sari Kedelai. *Jurnal Teknologi dan Industri Pangan*, *23*(1): 17-22.

Padaga, Masdiana & Sawitri. (2005). *Membuat Es Krim yang Sehat*. Surabaya: Trubus Agrisarana.

Setyaningsih, D., Apriyantono, A. & Sari, M. P. (2010). *Analisis Sensori untuk Industri Pangan dan Agro*. Bogor: IPB Press.

Susilorini, T. E. (2006). *Produk Olahan Susu*. Depok: Penebar Swadaya.

Susrini. (2003). Pengantar Teknologi Pengolahan Susu. Malang: Fakultas Peternakan UB.

Violisa, A., Nyoto, A & Nurjanah, N. (2012). Penggunaan Rumput laut Sebagai Stabilizer Es Krim Susu Sari Kedelai. *Jurnal Teknologi dan Kejuruan*, *35*(1): 103-114.

Winarno, F. G. (2008). Kimia Pangan dan Gizi. Bogor: M-Brio Press.

Zahro, C. (2015). Pengaruh Penambahan Sari Anggur (*Vitis vinifera L.*) dan Penstabil Terhadap Karakteristik Fisik, Kimia, dan Organoleptik Es Krim. *Jurnal Pangan dan Agroindustri*, *3*(4): 1481-1491.