**THE EFFECT OF COMPARISON OF BROCCOLI PUREE (*Brassica oleracea L*.) WITH CUCUMBER PUREE (*Cucumis sativus L*.) AND THE TYPE OF STABILIZER TO THE CHARACTERISTICS OF VEGETABLE SORBET**

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# ABSTRACT

*The research in two phase, which are the preliminary research and primary research. The purpose of preliminary research is to analize antioksidan activity in fresh broccoli and decide the best ratio of broccoli and water that will be used in the primary research. In addition, the primary research is to decide the best concentration of comparison broccoli puree with cucumber puree and type of stabilizer. The program used in this research is the completely randomized block design which consisted of 2 factors with 3 x 3 factorial patterns amd 3 times repetition. The variable of comparison broccoli puree with cucumber puree and type of stabilizer are:variable a comparison broccoli puree with cucumber puree, a1 (1:1), a2 (1:2), a3 (2:1) and variable b type of stabilizer, b1 (CMC 0,75%), b2 (gelatin 0,6%), b3 (gum arab 0,3%).*

*Based on the result of this research the comparison broccoli puree with cucumber puree affects the vitamin c, levels of fiber rude, % overrun, melting time, total dissolved solid and the aroma of vegetable sorbet, however it does not have any effect on total sugar, texture, colour, and taste of vegetable sorbet. Type of stabilizer affects the % overrun, melting time, color, texture and aroma of vegetable sorbet but does not affects vitamin C, total sugar, levels of fiber rude, total dissolved solid and taste of vegetable sorbet.*

*The interaction between comparison broccoli puree with cucumber puree and type of stabilizer affect the levels of fiber rude,% overrun, and texture of vegetable sorbet, but does not affects on vitamin C, total sugar, melting time, total dissolved solid, color, aroma and taste of vegetable sorbet. The sample that is chosen from this research is sample a3b1 with the addition of 2:1 comparison broccoli puree with cucumber puree and CMC 0,75%. The chosen vegetable sorbet contains 104,097 mg vitamin c per 100gr ingredient, 3,67% levels of fiber rude, 19,38% total sugar, 14178,40 ppm antioxidant activity, 60,69% overrun, melting time 55 minutes 48 second and 14,37% total dissolved solid. Antioxidant activity of selected sampels vegetable sorbet classified as an antioxidant weak.*

*Keyword : Vegetable sorbet, comparison broccoli puree with cucumber puree, type of stabilizer,CMC, Vitamin C, levels of fiber rude, total sugar, antioxidant activity, % overrun, melting time and total dissolved solid.*

**INTRODUCTION**

According to Sudarminto (2015), the trend of consumption patterns of our modern society began to shift, not only to satiate the stomach, but also make the body healthy. So, people are now starting to multiply to consume vegetables that have high nutritional content. One of them is broccoli. The demand for broccoli in Indonesia from year to year has increased mainly from the restaurants, hotels and modern markets. According to USAID data, the demand for broccoli in Indonesia has increased by 15 - 20% per year. Indonesian broccoli production is about 113,941 ton ha-1 (BPS, 2012 in Multazam 2014).

Broccoli is a vegetable that is rich in nutrients and micronutrients such as protein, vitamin A, B6, C, D, E, K, thiamin, riboflavin, niacin, folate, and several other micronutrients. Similar to broccoli, cucumber (Cucumis sativus L.) is a vegetable that is widely consumed by society because it is a source of nutrition, vitamins and minerals that the body needs and has various benefits for the health of the body, especially can lower blood pressure.

Although both are vegetables that are often consumed by the community. Some people there who do not like the taste of broccoli because it tastes bitter and slightly smelly, so that the broccoli can be combined with a cucumber that has a good taste and fresh. One of the most favored by the community as a kind of dessert like sorbet. In addition, broccoli is a vegetable that is easily damaged, does not have a long shelf life. Therefore, broccoli is quickly processed to be consumed in the long run.

Sorbet is often interpreted as a dessert made from crushed fruit (puree) or juice that also functions as a flavoring agent, sucrose, and stabilizer, the texture is rougher than ice cream, refreshing and does not contain dairy products (non-dairy). The type and amount of stabilizer is one of the factors affecting texture especially for products with total solids and low fat content (Padaga and Sawitri, 2006). The type of stabilizer used in ice cream also used for making sorbet. The types of stabilizers such as CMC (Carboxy Methyl Cellulose) is a stabilizer that is often used in food because it improves the texture and ice crystals are formed more smoothly. Gelatin is a stabilizer which is capable of forming the gel on the mixture during storage, cooling process, and until after the product is frozen placed in the freezing room. As well as gum arabic is a stabilizer material that is hydrophilic in order to form colloidal solution or form gel so it can improve the viscosity and texture of foodstuff especially frozen dessert.

In this study sorbet is made from a mixture of vegetables that are broccoli and cucumber, while usually sorbet made from fruit crushing. This difference in raw materials may affect some characteristics of the sorbet, therefore it should require consideration for the resulting product in accordance with the quality of the existing sorbet. Overall, sorbet made from vegetables may affect some characteristics of sorbet, so in this study tested the effect of comparison broccoli puree with cucumber puree and type of stabilizer in making vegetable sorbet.

**Identification of Problems**

Based on the above background, can be identified research problems are as follows:

1. How do the comparison broccoli puree with cucumber puree on the characteristics of vegetable sorbet?
2. How does the type of stabilizer affect the characteristics of the vegetable sorbet?
3. How to influence the interaction between the comparison broccoli puree with cucumber puree and type of stabilizer on the characteristics of vegetable sorbet?

**Research Objectives**

The purpose of this study is to determine the factors that affect the characteristics of vegetable sorbet. The purpose of this research is to know the effect of comparison broccoli puree with cucumber puree and stabilizer type to the characteristic of vegetable sorbet.

**The Significance of Research**

The research is expected to be useful as information in the processing of vegetable sorbet that has good characteristics and as an effort to diversify food with high nutrient content and increase the nutrient intake of vegetables that are safe for consumption for various age groups.

**Theoretical Framework**

Sorbet is a frozen product made from refined fruit and added with sugar or honey and modified with the addition of a stabilizer (Puteri, 2015). According to Arbuckle (1986), sorbet composition is generally 10% sucrose, fruit juice solids 8.50%, stabilizer 0.40%, water 57.40% and other ingredients up to 100%. Sorbet has an overrun between 25-45%, 25-35% sugar content and coarse texture.

One of the important parameters in the dessert frozen food industry is the melting power. Melting power is identical with time which required ice cream to melt perfectly at room temperature. Good quality ice cream products show high resistance to melting (Marshall and Arbuckle 1996). Padaga and Sawitri (2006) states that the stabilizer has a function to increase the viscosity of the product before it is frozen and also able to increase the ability to absorb water so that the product becomes not easy to melt.

According to Maryam (2008 in Rahmawati 2017), preliminary research of sorbet mix of strawberries and aloe vera using sugar concentration 15%, 20%, and 25% so that the selected sugar concentration is 15% with the ratio of strawberries with aloe vera 1: 1 and type of stabilizer gum arabic as much as 0,2%.

According to Wahyuni (2012), in the main study showed that good stabilizer type in sorbet soursher is a type of stabilizer CMC with a concentration of 0.75% affect the levels of vitamin C, total sugar levels, and overrun. The variation of water ratio with soursop in the sorbet sours was 1: 2, 1: 1 and 2: 1 determination of the best fruit puree was done by testing the sensory test of hedonic against organoleptic response (color, flavor, taste and texture) using 15 people panelists.

Characteristics of a good sorbet can be seen from overrun, texture, melting time and taste. Sorbet looks like ice cream but coarse texture, like the grains of ice crystals shaved with a taste that tends to fresh acid. Good quality ice cream is when melted ice cream has properties similar to the original dough. Good quality on ice cream is having a melting time of about 10-15 minutes (Hubeis, 1995). In addition, one can assess a good sorbet of organoleptic properties including color and aroma.

According to Buckle (1987) the melting time is strongly influenced by the total solid material contained in the ice cream. According to Claudia (2016), the highest value of liquid velocity is obtained by coconut water sorbet product with the addition of higher pumpkin juice. This is because the yellow pumpkin has a high water content of 91.2% so it can increase the crystallization of ice and cause ice products to melt longer. The difference between fruit and vegetables is sugar content. This sugar content affects the total amount of solids from sorbet. Total solids may affect product viscosity which affects the melting properties of sorbet.

In addition, the stabilizer type may affect the sorbet's melting power. According to Situmeang (2009), the higher the concentration of CMC (Carboxy Methyl Cellulose) then the percentage of melting from the coconut water sorbet will decrease. According to Claudia (2016), the concentration of gelatin as a stabilizer in coconut water sorbet product also has an influence on melting speed value. The higher the concentration of gelatin then the value of the melting speed of the coconut water sorbet product will be lower. In the Harefa study (2015), the higher the concentration of gum arabic, then the melting speed of the cane juice sorbet longer.

The comparison of broccoli puree and cucumber puree can affect the texture of sorbet. Texture can also affect the melting time of the sorbet. The raw material used in the sorbet is a solid that affects the total solids in the sorbet. Total dissolved solids can form a certain viscosity that will create a distinctive texture. High-selling sorbet is a soft textured sorbet and has a small ice crystal that easily dissolves in the mouth. Soft ice crystals can be obtained if a mixture of sugar syrup with fruit juice or fruit puree fits and shuffle the dough constantly to freeze. According to Situmeang (2009), The higher concentration of mango puree then total dissolved coconut milk sorbet will increase.

The sorbet texture can also be affected by the number of stabilizer types. The stabilizer serves to increase the viscosity of the processed product, may extend the shelf life as it can prevent the formation of crystallization of ice during storage and can increase the ability to absorb water so it becomes not easy to melt. According to Situmeang (2009), the higher the concentration of CMC (Carboxy Methyl Cellulose), the organoleptic value of coconut water sorbet texture will increase. According Silalahi (2013), the higher the concentration of gum arabic then the value of organoleptic test texture will also be higher.

According to Situmeang (2009), the higher concentration of mango pulp then the organoleptic value of coconut water sorbet color will increase. According to Situmeang (2009), the higher the concentration of CMC (Carboxy Methyl Cellulose), the organoleptic value of coconut water sorbet color will increase. The highest color score values were obtained on the sorbet product with the highest gelatin concentration addition. This is because gelatin can also be used to coat the surface to prevent physical damage to the product due to processing, so that product quality can be maintained (Claudia 2016). According to Harefa (2015) the addition of gum arabic with a higher concentration is able to maintain the color derived from the raw materials used.

According Situmeang (2009), the higher concentration of mango pulp then the organoleptic value of coconut water sorbet aroma will increase. This type of stabilizer also affects the aroma sorbet. CMC is a stabilizer that can affect the sorbet aroma. According to Situmeang (2009), the higher the concentration of CMC (Carboxy Methyl Cellulose) the organoleptic value of coconut water sorbet scent will increase, because CMC (Carboxy Methyl Cellulose) is an odorless stabilizer, so it does not disturb the distinctive aroma of mango that is formed from coconut water sorbet.

The taste of the sorbet may affect the panelist's acceptance of the product. Raw materials are factors that affect taste. According Situmeang (2009), the higher concentration of mango puree then the organoleptic value of coconut water sorbet taste will increase. This type of stabilizer may also affect the sorbet taste. According to Situmeang (2009), the higher the concentration of CMC (Carboxy Methyl Cellulose) then the organoleptic value of coconut water sorbet taste will increase. In addition to the organoleptic aspect, the stabilizer type may also affect the vitamin C content contained in the ingredients. According to Situmeang (2009), the higher the concentration of CMC (Carboxy Methyl Cellulose) then the level of vitamin C sorbet coconut water will increase.

## **Research Hypothesis**

Based on the above framework can be taken the hypothesis as follows:

1. Suspected concentration of stabilizer types effect on the characteristics of vegetable sorbet.
2. Suspected comparison of broccoli puree with cucumber puree have an effect on the characteristics of vegetable sorbet.
3. Suspected interaction between stabilizer concentration and comparison of broccoli puree with cucumber puree have an effect on the characteristics of vegetable sorbet.

**Place and Time of Research**

 The research was conducted in May 2017 until finished in Food Technology laboratory, Food Technology Department, Faculty of Engineering, Pasundan University Bandung, Jl. Dr. Setiabudi No.193.

**MATERIALS AND TOOLS RESEARCH**

**Materials Research**

The raw materials used for the manufacture of vegetable sorbet are broccoli green king varieties with the assessment of the quality of dark green color fresh and not rotten obtained from the market of Gegerkalong Tengah, local cucumber varieties with a green color in the presence of yellowish white lines and not rotten from the market of Gegerkalong Tengah and other ingredients such as raw honey, Al-Kham flowers, CMC, Gum Arabic, and Gelatin.

The chemicals used for analysis on vitamin C testing by iodimetry method were an amylum, solution of I 2, in testing of crude fiber by gravimetric method was 1.25% H2SO4, 3.25% NaOH, 96% ethanol and aquadest, on testing total sugar content by the method of luff schoorl using luff schoorl solution, H2SO4 6N, solid KI, HCl 9.5 N, phenolpthaelin, NaOH 9.5 N Na2S2O3 0.1 N and starch while in antioxidant analysis by DPPH method using 0.5 mM DPPH solution.

**Research Tools**

The tools used for making vegetable sorbet are pot, blender, ice cream maker, refrigerator, freezer, scales, spoon, basin, label, ice cream cup, and measuring cup. The tools used for chemical analysis are erlenmeyer flask, burette, gourd flask, 10 ml pipette,drop pipette, titration tool and spectrometers.

**Research Method**

Implementation of research in making vegetable sorbet is divided into two stages, namely preliminary research and primary research.

Preliminary research was conducted to determine the best ratio of broccoli and water. The first stage is to test the broccoli raw material to determine the antioxidant activity in whole broccoli. Furthermore, making vegetable sorbet with the ratio of broccoli and water as much as 1: 1, 1: 2 and 2: 1. Selection of concentration between broccoli and water based on research conducted by Wahyuni (2012). Comparison of broccoli and water used to make broccoli puree then mixed with cucumber puree with ratio 1: 1. After the addition of honey 10% (b/b), pusteurization and add gelatin 0.6% (b/b). Further agitation with ice cream maker to produce vegetable sorbet. Determine the ratio of broccoli: the best water is done by hedonic test using 30 panelists. The best result of broccoli comparison: water from organoleptic test is chemically analyzed in the form of crude fiber test and vitamin C.

The primary research is a continuation of preliminary research which aims to know the effect of comparison of broccoli puree with cucumber puree and stabilizer type, which then tested organoleptic test using hedonic test by 30 panelists. The primary research consists of treatment design, experimental design, analytical design and response design.

The experimental design model used in this study was Randomized Block Design (RAK) consisting of 2 factors with each 3 levels, ie comparison of broccoli puree with cucumber puree (A) and type of stabilizer (B) as follows:

Factor 1. Comparison of broccoli puree: cucumber puree (A):

 a1 = 1:1 a2 = 1:2 a3 = 2:1

Factor 2. Type of stabilizer (B):

 b1 = CMC 0,75% (Wahyuni 2012)

 b2 = Gelatin 0,6% (Claudia 2016)

 b3 = Gum arabic 0,3% (Silalahi 2014)

The response is researched namely chemical response includes the analysis of vitamin C with iodimetri method, crude fiber analysis by gravimetric methods (SNI 01-2891-1992) and total sugar content Luff-Schoolr methods (AOAC, 1970). Physical responses include Overrun measurements (Abuckle 1986), test time of melting sorbet and total test of dissolved solids. Organoleptic response includes hedonic test with color parameters, taste, aroma, and texture. Additional analysis of the best samples included antioxidant analysis with DPPH method (2,2-diphenyl-1-picrylhydrazyl).

**Research Procedure**

Procedure of the process of making vegetable sorbet conducted in the study as follows:

1. Trimming

Trimming aims to separate between the parts used and the discarded. The trimming process is done by using a knife manually. The broccoli portion that can be used like broccoli flowers and cucumber part is removed like the top and bottom part of the cucumber.

1. Washing

This washing process aims to remove contamination or dirt which still linger on broccoli and cucumber vegetables. The washing process uses clean water. Then after the washing process is done slicing so that water contained in the material can be reduced. In broccoli vegetables, after washing then do soaking with salt water to remove contaminants in broccoli.

1. Blanching

The blanching process aims for enzyme inactivation, intercellular gas reduction, and decreased microbial count. Blanching method is hot water blanching with temperature 70oC for 2-3 minutes. Blanching process is only done on vegetable broccoli.

1. Crushing

The process of crushing is done by using a blender. Crushing of broccoli and cucumber is done separately and done for about 3 minutes until obtained broccoli puree and cucumber puree.

1. Weighing

This weighing aims to determine the weight of broccoli puree and cucumber puree to be used for making of sorbet. Weighing is done using a digital scales.

1. Mixing

In this mixing process broccoli puree and cucumber puree will be mixed with ratio (1: 1), (1: 2), and (2: 1), then added honey and selected concentration with various types of stabilizer:

1. CMC
2. Gelatin
3. Gum arabic

The stabilizer is dissolved by cucumber puree bit by bit so that the stabilizer does not agglomerate and then insert into the pan.

1. Pusteurization

Cucumber puree which has been mixed with stabilizer then heated for 3 minutes at 700C. This heating process is done by using pots and stoves. During heating, stirring is done to speed up the process of homogenizing the material. The purpose of heating is to kill all pathogenic bacteria that are not heat resistant, so that the taste, natural aroma, and nutritional value can be further maintained and prolong the shelf life.

1. Temperring

Temperring is done to lower the temperature of the cucumber puree which has been heated. Temperring is done by soaking the pan containing the cucumber puree solution into a large basin. Temperring is done until the temperature drops to 40oC.

1. Aging

Aging is done at 40C for 4 hours. This process aims to produce a thicker, smoother, and improved mixture of textures. Aging is the process of ripening the dough by storing in a closed container in the refrigerator for 4 to 12 hours.

1. Agitation with Ice Cream Maker

This process is done by using Ice Cream Maker up to temperature (-180C) for 30 minutes to 1 hour or until obtained ice cream half frozen. Freezing should be done quickly ie with a sign of the formation of soft ice crystals in the dough, then count the overrun vegetable sorbet produced.

1. Frozen Storage

Freezing is the final step in the sorbet making process. The freezing of the sorbet is carried out at a temperature of -5 to -200C for 24 hours. Freezing is done to produce a good product, improve the texture and to freeze the dough and catch air into the dough. Measurement of dough volume is done to know the volume by using overrun calculation*.*

1. Vegetable Sorbet Analysis Testing

 Vegetable sorbet analysis test aims to analyze Vitamin C content by using iodimetry method, analyzing sugar content, coarse fiber, organoleptic test, and antioxidant test for best sample.

**RESULTS AND DISCUSSION**

**Preliminary Research**

Preliminary research aims to determine the ratio of broccoli and the best water and test the antioxidants on broccoli raw materials.

Analysis of raw materials conducted to determine the antioxidant activity in fresh broccoli. The results of antioxidant analysis can be seen in table 9. The result of antioxidant activity analysis in Table 9 shows that in fresh broccoli the average value of IC50 is 1942,20 ppm. IC50 is a dampening antioxidant concentration or inhibit 50% of free radicals (Damayanti, 2010).

ble 9. Results of Antioxidant Analysis of Fresh Broccoli

|  |  |  |  |
| --- | --- | --- | --- |
| Sampel | Repetition of reading | IC50 value (ppm) | Average IC50 value (ppm) |
| Fresh Broccoli | 1 | 1942,26 | 1942,20 |
| 2 | 1942,13 |

Determination comparison broccoli and the best water are tested by organoleptic analysis in the form of flavor, color, texture and aroma. The effect of comparison of broccoli and water to organoleptic response can be seen in table 10.

**Table 10. The Effect of Comparison Broccoli and Water to The Organoleptic Vegetable Sorbet**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Comparison of broccoli: water | Average taste | Average color | Average texture | Average aroma |
| 1 : 1 | 2.75 a | 3.90 a | 3.57 a | 3.11 a |
| 1 : 2 | 3.08 b | 4.10 a | 3.38 a | 3.26 a |
| 2 : 1 | 2.77 a | 4.30 a | 3.63 a | 3.19 a |

Description: Each different letter indicates a real difference at a rate of 5%

Table 10 shows the comparison of broccoli puree with water significantly affect the taste of vegetable sorbet but no significant effect on the color, texture and aroma of vegetable sorbet. In the preliminary study of making vegetable sorbet added cucumber puree with a uniform concentration so that the color and aroma of vegetable sorbet has no effect. The comparison of broccoli and water has no effect on the texture of vegetable sorbet because the addition of the same stabilizer can form a uniform vegetable sorbet texture. Table 10 shows that the taste of vegetable sorbet produced from the ratio of broccoli and water with broccoli and water ratio of 1: 2 is preferably panelist compared to the taste of vegetable sorbet with the ratio of broccoli and water 1: 1 and 2: 1. This is because the vegetable sorbet with the ratio of broccoli and water 1: 1 and 2: 1 has a bad taste. Broccoli contains glucosinolate. Glucosinolate in broccoli vegetables gives a bitter taste when eaten. In another study known sinigrin is a component that includes glucosinolate which is responsible for giving a bad taste in broccoli vegetables both raw and cooked (Drewnowski in Jalasena, 2015).

Determination of selected product in preliminary study seen from parameter which give response have real effect to comparison of broccoli with water. From organoleptic test result, it was found that taste response with broccoli ratio with water 1: 2 had significant effect with 5% level. Selected products tested vitamin C levels and crude fiber. Based on the analysis, vitamin C levels in selected products of preliminary research were 63.47 mg vitamin C / 100 g samples and a crude fiber content of 2.78%.

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## **Primary Research**

### **Chemical Response**

#### **Vitamin C Level**

 Based on the calculation of ANAVA (Appendix 9) shows that the comparative factor of broccoli puree with cucumber puree has significant effect on vitamin C levels of vegetable sorbet, while the factor of the type of stabilizer and the interaction has no significant effect on vitamin C levels of vegetable sorbet. The effect of comparison of broccoli puree with cucumber puree to vitamin C levels of vegetable sorbet can be seen in table 11.

Based on table 11 shows that the comparative factor of broccoli puree with cucumber puree give effect to vitamin C content of vegetable sorbet. Comparison of broccoli puree with cucumber puree 2: 1 (a3) had the highest average vitamin C level of 100.93 mg / 100 g, while in comparison of broccoli puree with cucumber puree 1:2 and 1:1 had decreased vitamin C levels.

Table 11. The Effect of the Comparison Broccoli Puree with Cucumber Puree to Vitamin C Levels of Vegetable Sorbet

|  |  |
| --- | --- |
| The Comparison Broccoli Puree : Cucumber Puree | Vitamin C Level (mg/100 g) |
|
| Comparison of 1: 1 (a1) | 91.8511 a |
| Comparison of 1 : 2 (a2) | 99.0798 b |
| Comparison of 2 : 1 (a3) | 100.9379 b |

Description: Average values marked with the same letter show no significant difference at the 5% level according to Duncan's advanced test.

This is because the higher the ratio of broccoli puree, then vitamin C content contained in the vegetable sorbet will be higher because broccoli is a vegetable source of vitamin C. According to USDA, broccoli has vitamin C content of 89.2 mg per 100 grams of broccoli. With the addition of cucumber, vegetable sorbet has a high vitamin C content. Levels of vitamin C in the primary research product had an increase from the previous one on selected product preliminary research 63.47 mg vitamin C / 100 g sample.

#### **Levels of The Coarse Fibers**

The data of ANOVA calculation (attachment 9) shows that the comparison of broccoli puree with cucumber puree and type of stabilizer has a significant effect on crude fiber content of vegetable, while the type of stabilizer (Factor B) has no significant effect on the crude fiber content of the vegetable sorbet. Interaction between the comparison of broccoli puree with cucumber puree and type of stabilizer can be seen in table 12.

Table 12. The Effect of Interaction the Comparison of Broccoli Puree with Cucumber Puree and Type of Stabilizer to Crude Fiber Content (% fiber) of Vegetable Sorbet

|  |  |
| --- | --- |
| The Comparison of Broccoli Puree with Cucumber Puree | Type of Stabilizer |
| b1(CMC 0,75%) | b2(Gelatin 0,6%) | b3(Gum arabic 0,3%) |
| a1 (1 :1) | 3,17 A | 3,05 A | 2,84 A |
| a | a | a |
| a2 (1 :2) | 3,14 A | 3,36 A | 3,53 B |
| a | a | a |
| a3(2 :1) | 3,67 B | 2,91 A | 3,44 B |
| b | a | b |

Description: Values marked with the same letters show no real difference at a rate of 5% according to Duncan Advanced Test. The uppercase notation is read vertically, the lowercase notation is read horizontally

Based on table 12 shows that vegetable sorbet with a ratio of broccoli puree with cucumber puree 2: 1 (a3) and the type of CMC stabilizer 0.75% (b1) had the highest crude fiber content compared with the crude fiber content of vegetable sorbet with the ratio of broccoli puree with puree cucumber 1: 1 (a1) and 1: 2 (a2) and gelatin stabilizers 0.6% (b2) and gum arabic 0.3% (b3). The less the puree broccoli ratio, then the coarse fiber content gets smaller. This is because broccoli is a high fiber vegetable source, at 100 grams of raw broccoli there is 2.60 grams of dietary fiber.

Based on Table 12 it is known that the type of stabilizer 0.75% CMC produces higher crude fiber content compared with other types of stabilizers in the ratio of broccoli puree with puree cucumber 1: 1 and 2: 1. While the ratio of broccoli puree with puree cucumber 1: 2 has high fiber content with 0.3% gum arabic stabilizer.

In the manufacture of vegetable sorbet using broccoli puree and cucumber puree which treatment is not done filtering so the fibers in the vegetables are not lost. In addition, the type of stabilizer and interaction both affect the level of crude fiber of vegetable sorbet. This is because CMC is a cellulose derivative product. Adding cellulose to foods enables a large increase and fiber content without a major impact on taste. (Mulyana, 2016)

#### **Total sugar content**

Based on ANAVA calculation data (Appendix 9) showed that the comparison of broccoli puree with cucumber puree, type of stabilizer, and interaction between the ratio of broccoli puree with cucumber puree and type of stabilizer did not significantly affect the total sugar content of vegetable sorbet. The average total sugar content of vegetable sorbet was 18.93% to 20.40%. The total sugar content is influenced by the amount of sugar or honey added to the product. In the manufacture of vegetable sorbet, honey is used constantly for each treatment so that the total sugar content of the vegetable sorbet is not affected by both factors and interactions.

### **Physical Response**

#### **% Overrun**

The data of ANAVA calculation result (appendix 10) shows that the comparison of broccoli puree with cucumber puree, type of stabilizer, and interaction between the comparison of broccoli puree with cucumber puree and type of stabilizer have a significant effect on vegetable sorbet overrun. The interaction effect of the comparison of broccoli puree with cucumber puree and type of stabilizer to % overrun vegetable sorbet can be seen in table 13.

Table 13. The Effect of Interaction the Comparison of Broccoli Puree with Cucumber Puree and Type of Stabilizer to % Overrun of Vegetable Sorbet

|  |  |
| --- | --- |
| The Comparison of Broccoli Puree with Cucumber Puree | Type of Stabilizer |
| b1(CMC 0,75%) | b2(Gelatin 0,6%) | b3(Gum arabic 0,3%) |
| a1 (1 :1) | 36,11 A | 35,20 A | 46,56 A |
| a | a | a |
| a2 (1 :2) | 62,50 B | 55,13 B | 39,55 A |
| b | b | a |
| a3(2 :1) | 60,69 B | 52,67 B | 45,11 A |
| b | b | a |

Description: Values marked with the same letters show no real difference at a rate of 5% according to Duncan Advanced Test. The uppercase notation is read vertically, the lowercase notation is read horizontally

Based on table 13 shows that vegetable sorbet with the ratio of broccoli puree with cucumber puree 1: 2 (a2) and type of stabilizer CMC 0.75% (b1) had the highest% overrun compared to% vegetable overrun sorbet with broccoli puree ratio with cucumber puree 1: 1 (a1) and 2: 1 (a3) and gelatin stabilizers 0.6% (b2) and gum arabic 0.3% (b3). Vegetable sorbet with stabilizer CMC 0.75% has a higher % overrun on the comparison of broccoli puree with cucumber puree 1: 2 and 2: 1. While the comparison of broccoli puree with cucumber puree 1: 1 the highest % overrun value is found on the vegetable sorbet with the stabilizer type gum arabic 0.3%.

One of the factors affecting overrun is viscosity. According to Arbuckle (1981), if the dough density increases then the development power (overrun) will decrease further. Water bound in the molecular structure causes the dough to become thicker. The thicker the dough, the surface tension of the dough becomes higher. As a result the air is difficult to penetrate the surface of the dough and the product is more difficult to inflate. In a vegetable sorbet, the comparison of broccoli puree with cucumber puree 1: 1 resulting a thicker dough because the puree ratio is used equally so the % overrun generated has a low value.

This type of stabilizer also affects the product's viscosity. According to Dahlberg (2005) in Zahro and Nisa (2015), the stabilizer increases the viscosity of the dough by forming a gel matrix and holding the liquid phase dispersed. Different types of stabilizers can produce different dough viscosity. This shows that the addition of CMC 0.75% produces a maximum % overrun on the vegetable sorbet. CMC has a role in forming a colloidal dispersion system and increasing viscosity.

#### **The Melting Time of Vegetable Sorbet**

According to data of ANAVA calculation result (appendix 10) shows that the comparison of broccoli puree with cucumber puree, type of stabilizer has a significant effect on the melting time of vegetable sorbet. While interaction between the comparison of broccoli puree with cucumber puree and the stabilizer type had no significant effect on the melting time of vegetable sorbet. The effect of comparison of broccoli puree with cucumber puree the melting time of vegetable sorbet can be seen in table 14.

Table 14. The Effect of the Comparison of Broccoli Puree with Cucumber Puree to the Melting Time of Vegetable Sorbet

|  |  |
| --- | --- |
| The Comparison Broccoli Puree : Cucumber Puree | The Melting Time of Vegetable Sorbet (minute.second) |
|
| Comparison of 1 : 1 (a1) | 56.2300 b |
| Comparison of 1 : 2 (a2) | 53.8700 a |
| Comparison of 2 : 1 (a3) | 59.3656 c |

Description: Average values marked with the same letters show no real difference at a rate of 5% according to Duncan's advanced test.

Based on table 14 it shows that vegetable sorbet with the comparison of broccoli puree with cucumber puree 2: 1 (a3) has the longest melting time compared to the melting time of vegetable sorbet with the comparison of broccoli puree with cucumber puree 1:1 (a1) and 1:2 (a2). The lowest melting time is is found in the vegetable sorbet with the comparison of broccoli puree and cucumber puree 1:2, namely 54 minutes 27 seconds. This is because in the comparison there is a little solid so the sorbet will quickly melt. According to Dewi (2010) in Silalahi (2013) explained more solid content making the dough to become thicker so that when freezing will lower the freezing point and the product becomes more solid it makes the sorbet slow to melt. The melting time is strongly influenced by the total solid material contained in the ice cream (Buckle et al., 1987). Good quality ice cream is when melted ice cream has properties similar to the original dough. Good quality on ice cream is having a melting time of about 10-15 minutes (Hubeis, 1995).

Table 15. The Effect of Type of Stabilizer to the Melting Time of Vegetable Sorbet

|  |  |
| --- | --- |
| Type of Stabilizer | The Melting Time of Vegetable Sorbet (minute.second) |
|
| CMC 0,75% (b1) | 53.3611 a |
| Gelatin 0,6% (b2) | 55.7867 b |
| Gum arabic 0,3% (b3) | 60.3178 c |

Description: Average values marked with the same letters show no real difference at a rate of 5% according to Duncan's advanced test.

The above data shows that the stabilizer type has a significant effect on the melting time. The type of gum arabic stabilizer has the longest melting time ie 60 minutes 31 seconds. This is because gum arabic has the ability to bind water in large enough quantities. The addition of gum arabic lowers the water content because of its ability to bind water to make the ice cream modification becomes more dense so melting time becomes longer (Oksilia, 2012 in Silalahi 2013).

#### **Total Dissolved Solids**

The data of ANAVA calculation (attachment 10) shows that the comparison of broccoli puree with cucumber puree has significant effect to the total dissolved solids of vegetable sorbet. While the type of stabilizer and interaction materials between the comparison of broccoli puree with cucumber puree and type of stabilizer have no significant effect to the total dissolved solids of vegetable sorbet. The effect of comparison of broccoli puree with cucumber puree to the total dissolved solids of vegetable sorbet can be seen in table 16.

Table 16. The Effect of the Comparison of Broccoli Puree with Cucumber Puree to Total Dissolved Solids of Vegetable Sorbet

|  |  |
| --- | --- |
| The Comparison Broccoli Puree : Cucumber Puree | Total Dissolved Solids (%) |
|
| Comparison of 1 : 1 (a1) | 14.3283 b |
| Comparison of 1 : 2 (a2) | 13.7557 a |
| Comparison of 2 : 1 (a3) | 14.7709 b |

Description: Average values marked with the same letters show no real difference at a rate of 5% according to Duncan's advanced test.

Based on table 16 shows that the comparative factor of broccoli puree with cucumber puree gave effect to the total dissolved solids of vegetable sorbet. The comparison of broccoli puree with cucumber puree 2:1 (a3) has the highest average namely 14.77% to the total dissolved solids of vegetable sorbet. The more the broccoli ratio, then the total dissolved solids will be higher.

This is because broccoli has a higher carbohydrate content than the content of cucumber. Broccoli has a carbohydrate content of 6.64 grams per 100 grams while the cucumber has a carbohydrate content of 3.63 grams per 100 grams. Soluble solids closely related to the content of carbohydrates in vegetables where according to Tjahjadi (2008) carbohydrates in vegetables and fruits consisting of monosaccharides, oligosaccharides and polysaccharides which dissolves in the liquid vegetable cells.

## **Organoleptic response**

#### **Color**

The data of ANAVA calculation (attachment 11) shows that the stabilizer type has a significant effect on the color of the vegetable sorbet. While the comparison of broccoli puree with cucumber puree and interaction between the comparison of broccoli puree with cucumber puree and type of stabilizer did not affect the color of vegetable sorbet. The effect of stabilizer type to the color of vegetable sorbet can be seen in table 17.

Table 17. The Effect of Type of Stabilizer to the Color of the Vegetable Sorbet

|  |  |
| --- | --- |
| Type of Stabilizer | Average Treatment |
|
| CMC 0,75% (b1) | 4.4037 c |
| Gelatin 0,6% (b2) | 3.8741 b |
| Gum arabic 0,3% (b3) | 3.6741 a |

Description: Average values marked with the same letters show no real difference at a rate of 5% according to Duncan's advanced test.

Table 17 shows that the stabilizer type factor has an effect on the color of the vegetable sorbet. Material type CMC 0.75% (b1) has the highest average of 4.4037 to the color of vegetable sorbet compared to the type of gelatin stabilizer 0,6% (b2) and gum arabic 0,3%. The comparison of broccoli puree with cucumber puree did not give a real effect to the color of vegetable sorbet because both have the same color that is green color. So there is no real difference to the comparison of broccoli puree and cucumber puree added.

From table 16 it can be seen that the treatment with the addition CMC 0,75% provides the highest favorite value to the color of vegetable sorbet. This is because CMC is one of the stabilizers with strong connective data. So with the addition of CMC, the binding strength will be stronger, including the binding power to the dyestuff which is found in broccoli and cucumber. This causes the color of the vegetable sorbet to be increasingly favored by the panelists.

#### **Texture**

The data of ANAVA calculation shows that the type of stabilizer and interaction between the comparison of broccoli puree with cucumber puree and type of stabilizer have a significant effect on the texture of vegetable sorbet. While the comparison of broccoli puree with cucumber puree does not affect the texture of vegetable sorbet so it needs to do further test Duncan. The effect of interaction comparison of broccoli puree with cucumber puree and stabilizer type to the texture of vegetable sorbet can be seen in table 18.

Table 18 shows that the texture of vegetable sorbet with the ratio of broccoli puree with cucumber puree 2:1 (a3) and type of stabilizer CMC 0,75% (b1) most preferably panelists compared to the texture of vegetable sorbet with the ratio of broccoli puree to cucumber puree 1:1 (a1) dan 1:2 (a2) and other types stabilizer of gelatin 0,6% (b2) and gum arabic (b3). The less the puree broccoli ratio, then the texture of vegetable sorbet is increasingly disliked by panelists.

Tabel 18. The Effect of Interaction the Comparison of Broccoli Puree with Cucumber Puree and Type of Stabilizer to the Texture of Vegetable Sorbet

|  |  |
| --- | --- |
| The Comparison of Broccoli Puree with Cucumber Puree | Type of Stabilizer |
| b1(CMC 0,75%) | b2(Gelatin 0,6%) | b3(Gum arabic 0,3%) |
| a1 (1 :1) | 4,07 A | 3,91 C | 3,18 B |
| c | b | a |
| a2 (1 :2) | 4,10 A | 3,42 B | 3,58 C |
| c | a | b |
| a3(2 :1) | 4,29 B | 3,22 A | 2,94 A |
| c | b | a |

Description: Values marked with the same letters show no real difference at a rate of 5% according to Duncan Advanced Test. The uppercase notation is read vertically, the lowercase notation is read horizontally.

On the comparison of broccoli puree with cucumber puree a1 (1:1) and a3 (2:1), the texture of a vegetable sorbet has increased a significant preference to the stabilizer type b1 (CMC 0,75%) and b2 (gelatin 0,6%). While on the comparison of the type of stabilizer b3 (gum arabic 0,3%) does not increase significantly. On the comparison of broccoli puree with cucumber puree a2 (1:2), the texture of the vegetable sorbet has a significant increase in the type of stabilizer b1 (CMC 0,75%) and b3 (gum arabic 0,3%). While on the type of stabilizer b2 (gelatin 0,6%) does not increase significantly.

Favorite tendency of panelists which increases at the level of concentration of the stabilizer used. This shows that a high stabilizer makes the dough thick. High concentrations of CMC in solution may result in an increase in the viscosity of the dough. With increasing viscosity, the more free water is bound, so that the formation of rough ice crystals can be avoided and the resulting texture becomes soft (Graham, 1977 in Puteri, 2015).

**Aroma**

Data of ANAVA calculation result (appendix 11) shows that the comparison of broccoli puree with cucumber puree and type of stabilizer have an effect on the aroma of vegetable sorbet. While interaction between the comparison of broccoli puree with cucumber puree and type of stabilizer did not affect the aroma of vegetable sorbet.

Based on table 19 shows that the comparative factor of broccoli puree with cucumber puree has an effect on the aroma of vegetable sorbet. The comparison of broccoli puree with cucumber puree 1:2 (a2) has the highest average of 3.55 to the aroma of vegetable sorbet. From table 19 can be seen the higher the number comparison of cucumber puree added, then the favorite value of vegetable sorbet aroma is higher. Cucumber has a fresh smell and more sting than broccoli. The vegetable aroma is caused by various volatile ester compounds.

Table 19. The Effect of the Comparison of Broccoli Puree with Cucumber Puree to Aroma of Vegetable Sorbet

|  |  |
| --- | --- |
| The Comparison Broccoli Puree : Cucumber Puree | Average Treatment |
|
| Comparison of 1 :1 (a1) | 3.2852 b |
| Comparison of 1 : 2 (a2) | 3.5519 c |
| Comparison of 2 : 1 (a3) | 3.0481 a |

Description: Average values marked with the same letters show no real difference at a rate of 5% according to Duncan's advanced test.

Table 20. The Effect of Type of Stabilize to Aroma of Vegetable Sorbet

|  |  |
| --- | --- |
| Type of Stabilize | Average Treatment |
|
| CMC 0,75% (b1) | 3.7889 b |
| Gelatin 0,6% (b2) | 3.0259 a |
| Gum arabic 0,3% (b3) | 3.0704 a |

Description: Average values marked with the same letters show no real difference at a rate of 5% according to Duncan's advanced test.

 Based on table 20 shows that the type factor of the stabilizer gives effect to the aroma of the vegetable sorbet. Vegetable sorbet with stabilizer type CMC 0,75% (b3) has the highest average of 3.78 to the aroma of vegetable sorbet. Table 20 shows that the CMC stabilizer provides the highest panelist preference rating to the aroma of vegetable sorbet. This is because the CMC is an odorless stabilizer. So it does not disturb the distinctive aroma of cucumber formed from vegetable sorbet. The more CMCs are added, then the strength will be stronger to bind the organic acids that make up a distinctive aroma to the sorbet (Deviwings, 2008 in Puteri 2015).

**Taste**

The data of ANAVA calculation shows that the comparison of broccoli puree with cucumber puree, type of stabilizer and interaction between the comparison of broccoli puree with cucumber puree and type of stabilizer did not affect the taste of vegetable sorbet*.*

Honey produces sweetness in a vegetable sorbet candy. Vegetable sorbet is made with the addition of the same amount of honey. Type of stabilizer does not give a big effect to the taste of vegetable sorbet. This is because the stabilizer type is not tasteless so it does not have a major effect on the taste of vegetable sorbet.

##

## **The Determination of Selected Treatment**

 The determination of selected products by the different levels of Duncan's advanced test on chemical, physical and organoleptic responses in the main study can be seen in Table 21.

Based on Table 21, the chemical response consisting of the analysis of vitamin C content, coarse fiber and total dissolved solids showed that sempel a3b1 has high levels of vitamin C ie 104,097 mg/ 100 g, fiber content levels which is quite high at 3.67% and total sugar content of 19.38%. In the physical response seen that% overrun 60.69%, melting time 55 minutes 48 seconds, and total dissolved solids 14.34%. Furthermore in the organoleptic response can be seen that the sample a3b1 has the highest average value which shows most preferred by 30 panelists.

The determination of selected products in the main study can be used as further test samples such as antioxidant analysis. Further analysis in selected products can be used to provide additional information regarding the presence of antioxidant content in vegetable sorbet products that are useful for the health of the body.



Figure 5. Selected product of vegetable sorbet

**Table 21. The Real Level of Response to Vegetable Sorbet Product**

|  |  |  |  |
| --- | --- | --- | --- |
| Sample | Chemical Response | Physical Response | Organolepic Response |
| Vitamin C | Coarse Fiber | Total Sugar | % Overrun | The MeltingTtime | Total Dissolved solid | Color | Texture | Aroma | Taste |
| a1b1 | 92.63 a | 3.17 abc | 18.93 a | 36.1 a | 52.87 a | 14.63 a | 4.34 a | 4.07 d | 3.66 a | 3.62 a |
| a1b2 | 90.03 a | 3.05 ab | 19.12 a | 35.21 d | 55.59 a | 14.20 a | 3.92 a | 3.91 c | 3.18 a | 3.10 a |
| a1b3 | 92.89 a | 2.84 a | 19.39 a | 46.56 abc | 60.23 a | 14.15 a | 3.61 a | 3.18 b | 3.02 a | 3.51 a |
| a2b1 | 102.5 a | 3.13 abc | 19.13 a | 62.50 a  | 51.73 a | 13.62 a | 4.37 a | 4.10 d | 4.00 a | 3.48 a |
| a2b2 | 98.92 a | 3.37 bcd | 20.40 a | 55.13 bcd | 53.01 a | 13.54 a | 3.77 a | 3.42 b | 3.38 a | 3.67 a |
| a2b3 | 95.81 a | 3.53 d | 19.02 a | 39.55 a | 56.87 a | 14.10 a | 3.84 a | 3.58 c | 3.28 a | 3.44 a |
| **a3b1** | **104.1 a** | **3.67 d** | **19.38 a** | **60.69 cd** | **55.48 a** | **14.34 a** | **4.50 a** | **4.29 d** | **3.71 a** | **3.69 a** |
| a3b\2 | 99.05 a | 2.91 a | 19.76 a | 52.67 bcd | 58.76 a | 14.84 a | 3.93 a | 3.22 b | 2.52 a | 2.91 a |
| a3b3 | 99.66 a | 3.44 cd | 19.97 a | 45.11 ab | 63.86 a | 15.13 a | 3.57 a | 2.94 a | 2.91 a | 2.98 a |

 **Analysis of antioxidant activity**

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The amount of antioxidant activity on the material is expressed by IC50. IC50 is a concentration of antioxidants that can reduce or inhibit 50% of free radicals (Damayanti et al 2010). Analysis of antioxidant activity was performed on broccoli raw materials as well as selected samples from the main study, namely the sample using a comparison of broccoli puree with cucumber puree 2:1 and type of stabilizer CMC 0,75%. Result of analysis of antioxidant activity of broccoli raw material and vegetable sorbet products can be seen in Table 22.

Table 22. Antioxidant Activity Data Sample of Vegetables Sorbet

|  |  |  |  |
| --- | --- | --- | --- |
| Sample | Repetition of reading | IC50 Value(ppm) | Average IC50 Value(ppm) |
| Raw Broccoli | 1 | 1942,26 | 1942,20 |
| 2 | 1942,13 |
| Vegetable Sorbet | 1 | 14179,22 | 14178,40 |
| 2 | 14177,59 |

Results of analysis of antioxidant activity in table 22 showed that on broccoli raw material value of IC50 is of 1942.20 ppm and on vegetable sorbet products IC50 value is 14178,40 ppm. It shows that the antioxidant activity on broccoli raw material has decreased after processed into a vegetable sorbet product. This decrease can be caused by the process of boiling, destruction, freezing, and storage. This is in accordance with the opinion Dhany (2014) who said that factors affecting antioxidant activity are the process of heating, reducing the size of the material, and the extraction process. Antioxidants are susceptible to heating process so that the heating treatment can accelerate the oxidation of antioxidants and cause degradation of antioxidant compounds contained in the system of natural materials and result in decreased antioxidant activity of different levels and strongly influenced by the types of components that play a role in the antioxidation process and the content of these materials. The destruction of antioxidant compounds affects antioxidant activity.

The lower IC50 values indicate that antioxidant activity is higher. This is in line with the opinion of Molyneux (2004) who said that the smaller the value of IC50 shows the higher the antioxidant activity. The high content of antioxidants is also influenced by the amount of antioxidant content in raw materials and low total solids in the material (Huse, et al 2010). The classification of antioxidant strength of the test compound using DPPH can be classified according to IC50 in Table 23.

Table 23. Level of Antioxidant Strength with DPPH Method

|  |  |
| --- | --- |
| Intensity | IC50 Value(ppm) |
| Very strong | < 50 |
| Strong | 50 – 100 |
| Medium | 101 – 150 |
| Weak | > 150 |

Source: Armala (2009)

Based on Table 23 it is shown that the vegetable sorbet with the comparison broccoli puree with cucumber puree 2:1 and type of stabilizer CMC 0,75% have weak antioxidant activity.

In vegetable sorbet products, raw materials are broccoli and cucumber. The content of broccoli which act as antioxidant is vitamin C, vitamin E and mineral (Ca, Mg, Se dan K). Cucumber is a source of vitamin C with a fairly high content, and also contains flavonoids. It is known that vitamin C and flavonoids have the effect of antioxidants by breaking the reaction of highly reactive free radicals that tend to form new radicals.

#

# CONCLUSION AND RECOMMENDATION

## **Conclusion**

 Based on research results the effect of comparison of broccoli puree (Brassica oleracea L.) with cucumber puree (Cucumis sativus L.) and the type of stabilizer to the characteristics of vegetable sorbet can be drawn conclusion as follows:

1. The comparison of broccoli puree with cucumber puree have an effect on vitamin C, coarse fiber content,% overrun, time of melting sorbet, total dissolved solids and aroma of vegetable sorbet, but does not affect the total sugar content, texture, color, texture and taste of vegetable sorbet.
2. Type of stabilizer effect on % overrun, time of melting sorbet, color, texture and aroma of vegetable sorbet, but has no effect on vitamin C, coarse fiber content, total sugar content, total dissolved solids and taste of vegetable sorbet.
3. The interaction between the comparison of broccoli puree with cucumber puree and type of stabilizer effect on the content of coarse fiber,% overrun, and the texture of vegetable sorbet, but no effect on vitamin C, total sugar content, melting time, total dissolved solids, color, aroma and taste of vegetable sorbet.
4. The selected products of vegetable sorbet are a3b1 samples namely the product with the ratio of broccoli puree with cucumber puree 2:1 and type of stabilizer CMC 0,75%. The selected product of vegetable sorbet has vitamin C level 104,097 mg / 100g, coarse fiber content 3,67%, total sugar content 19,38% and antioxidant activity 14178,40 ppm,% overrun 60,69%, melting time 55 minutes 48 seconds , and total dissolved solids 14.34%.

## **Recommendation**

Based on the evaluation of the research that has been done, the recommendations that can be given are:

1. Further research is needed to find out the storage power of vegetable sorbet products so it obtained expiry time limit on vegetable sorbet products.
2. Adding additional ingredients to make the taste of vegetable sorbet more popular.

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