

## **COMPARISON OF SOY MILK POWDER WITH SKIM MILK AND STEVIA WITH SUCROSE TOWARDS THE CHARACTERISTIC OF CHOCOLATE**

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### **ABSTRACT**

The aim of this research was to determine the proper comparison between soy milk powder with skim milk and stevia with sucrose in the manufacture of Chocolate Candy.

The experimental design used in this research was factorial pattern (3x3) in a randomized block design (RBD) with three replications. The design of the treatment carried out in this research consisted of two factors: the ratio of soy milk powder with skim milk (A), which consists of three levels which are a1 = 1:0 (soy milk powder : skim milk), a2 = 1:1 (soy milk powder : skim milk), and a3 = 0:1 (soy milk powder: skim milk) and a comparison of stevia with sucrose (B), which consists of three levels which are b1 = 1:0 (stevia : sucrose), b2 = 1:1 (stevia : sucrose), and b3 = 0:1 (stevia : sucrose). Therefore it has been obtained 27 experimental replication unit. Organoleptic response variables include taste, flavor, texture and aftertaste. Chemical analysis conducted was fat content, protein content, carbohydrate content, and moisture content as well as physical analysis which was conducted towards the toughness of the Chocolate Candy.

The results indicated that the best Chocolate Candy product which is with treatment a3b2 (comparison of soy milk with skim milk 0:1, and the comparison of stevia with sucrose 1:1) based on panelist responses on organoleptic test by 11.05% fat content, 13.44% protein content, 25.28% carbohydrate content, water content of 1.17% and has a toughness test value of 1.23 mm/sec/100gram.

### **INTRODUCTION**

#### **Background**

Cocoa is one of the plantation crops that can contribute to increase Indonesia's foreign exchange, other than that cocoa has high economic value. Cocoa production is increasing and as we know the utilization of cocoa are numerous, ranging from its seed until the fat can be utilized as products. As one of the cocoa producers, Indonesia should be able to improve the quality of cocoa beans

into a product that can compete with other cocoa-producing countries.

Cocoa products either in the form of cocoa powder, cocoa butter or cocoa paste is the raw material source of all chocolate based products. The composition of cocoa powder or chocolate pasta are polyphenols and flavonoids which acts as antioxidants and provide health benefits. The content of methyl santin (caffeine, theobromine, and theophylline) in the cocoa product is a stimulant of the central nervous system and strengthens the heart activity.

One of the processed products using cocoa beans as a base material of the manufacture is chocolate. These products becomes one of the preferred snack by many people. Indonesian people in general consume imported chocolate where its manufacturing process uses modern and sophisticated tools, making it a good product quality.

In general, there are three types of chocolate on the market, the three types are chocolate candies, pralines and truffles. Chocolate candy is a type of chocolate with the addition of filling material with a variety of fillers for example nuts or fresh fruits, while truffle is a type of other chocolate ingredients, such as biscuits, nuts and fresh fruit, but tends of not using molds. This is in contrast with praline chocolate candy which are using molds.

According to data from the Central Bureau of Statistics (2007) production results of chocolate in Indonesia are, unsweetened chocolate powder with the quantity of 11,039,647 kg, chocolate bar products by 3,106,336 kg, chocolate grain products by 5,648,891 kg, sweet chocolate powder products by 26,011,959 kg, liquid chocolate products by 415,320 kg, chocolate candy products by 2,453,306 kg, and other chocolate refined products to as much as 29,396,527 kg.

Chocolate bar is one of the public's preferred products, especially for children, because of its sweet taste. The business of chocolate production has a good potential in Indonesia because cocoa plants can grow almost in all parts of Indonesia. In addition, the fat contained in cocoa butter is quite unique because at room temperature (30oC) the shape remains solid with a melting point of about 33-34oC therefore it melts at oral cavity temperature (37oC). In general, the manufacture of chocolate production consists of cocoa fat, cocoa powder, milk

powder, sugar, and lecithin. Excessive amount of milk and sugar in the manufacture of chocolate can lead to health disorders, therefore the tested treatment in this research was the addition of soy milk powder and skim milk with varied comparison, as well as the addition of stevia sugar and sucrose also with varied comparison. Therefore, this research will perform a review towards the comparison of soy milk powder with skim milk and stevia sugar with sucrose in the manufacture of Chocolate Candy.

### **Problem identification**

Based on the description in the background of the research, the problem can be identified as follows:

1. How is the effect on the comparison of soy milk powder with skim milk towards the characteristics of chocolate candy?
2. How is the effect on the comparison of stevia with sucrose towards the characteristics of the chocolate candy?
3. How is the effect on the interaction between the comparison of soy milk powder with skim milk and stevia with sucrose towards the characteristics of chocolate candy?

### **Research purpose and objective**

This research aimed to determine the precise comparison between soy milk powder with skim milk and stevia with sucrose in the production of chocolate candies.

### **Research benefits**

The expected benefits of this research is to provide information regarding the comparison of soy milk powder with skim milk and stevia with optimum sucrose in the manufacture of Chocolate Candy. This is expected to enhance greater insight and information about processing

technology development in the manufacture of chocolate.

### Framework

According to Minifie (1997), substances used in the manufacture of chocolate bars includes cocoa powder, lecithin, milk powder, sugar, cocoa butter, and additional flavor. According to Yulia (2006), the introduction in the manufacture of chocolate, the formulation used are 36% cocoa fat, 17% chocolate powder, 18.1% skim milk, 28.4% starch sugar, 0.1% salt and 0.4% lecithin. With the addition of skim milk on chocolate candy products will increase the protein content.

According to Smanda (2011) chocolate bars had a distinctive taste, solid texture at room temperature, rapidly melts in the mouth, it becomes liquid and soft in the tongue. There are various ways to make chocolate, one of which includes the stages of: mixing, softening, refining (conching), tempering, and molding. The materials used to make chocolate are varied, amongst them are: pasta or cocoa liquor, refined sugar, milk, cocoa fat. The material is mixed with a certain ratio. Mixing ingredients in powder form is an important process in the manufacture of chocolate in this research. Chocolate powder serves as a filler and determines the quality of the resulting color and flavor of the product. Sugar serves as a sweetener, harden the texture, and as a natural preservative. Milk serves as a flavor enhancer and delicacy. Cocoa fat serves to homogenize the raw material in the mixing process, increases the levels of fat, and determines the density of chocolate which affects the texture of the product. White butter serves as a softener, stabilizer, and enhance the taste. Lecithin serves to homogenize all raw materials and auxiliary materials and stabilize the batter and lowering the viscosity of the batter.

According to Smanda (2008), two properties of chocolate that should be considered are flavor, and texture. Chocolate has a distinctive taste, solid texture at room temperature, rapidly melts in the mouth, it becomes liquid and soft on the tongue. There are various ways to process chocolate. One of them includes the steps of; mixing, softening, refining (conching), tempering, and molding.

According to Siregar et al (2007), conching assist in the improvement of taste, decrease the viscosity of the batter, reduce unpleasant odors and increase the distinctive aroma of chocolate.

According to Syamsir (2011) all chocolate products, ranging from cacao (raw) to other dairy products should be stored in cold, dry room with good indoor air circulation, protected from light and strong-smelling materials. Temperature of 10-12 ° C with a humidity of 55-65% is an ideal condition of chocolate storage space.

According to Saleh (2006), conching process is performed to remove volatile acids, thereby it reduces the acidity in the chocolate. Conching process would generate chocolates with good aroma, good fineness, making a homogeneous chocolate paste and causing the chocolate to have stable viscosity.

According to Desy (2011), based on a preliminary study with a time of 4 hours, 6 hours and 8 hours of conching time, it was obtained that the best treatment is for 8 hours at a temperature of 45C.

According to Zogina (2015), based on a preliminary study with a time of 6 hours, 8 hours and 10 hours of conching time, it was obtained that the best treatment is for 10 hours at a temperature of 60C.

The tempering process is a process for bonding arrangement of crystals in cocoa butter. After heating the fat, respective bond structure are released

according to the type of fat crystals and will form a bond of polymorphs  $\alpha$   $\beta$  and  $\beta'$ . B shape, is the most desirable form by the cocoa industry as it has a melting point of 29,5-36C and most stable at room temperature (Talbot, 1999).

According to Hui (1992), the colour of cocoa powder can affect the creation of chocolate bar, by using cocoa powder it will produce a brown-coloured chocolate. Meanwhile, using skimmed milk instead of chocolate powder in making chocolate will produce white-coloured chocolate, in addition, the use of chocolate powder is a source of protein, fat, carbohydrates, vitamins and minerals.

In the manufacture of chocolate, in terms of its thickness (viscosity) is one of the important factors according to Hartomo (1993). The addition of soy milk will also affect the texture of the chocolate and to prevent the possibility of clot when it is consumed.

According to Hartomo (1993), the addition of soy milk will also affect the texture of the chocolate and it can prevent the possibility of clumping when it is consumed. Therefore the addition of soy milk in the manufacture of Chocolate Candy are not only increasing the protein content, but the addition of soy milk on chocolate candies will also affect the texture of the chocolate itself.

According to Salim (2012), processed soy products are a source of vegetable protein, which is consumed by almost all levels of Indonesian society, thus this contributes to food security and improve the nutritional status of the community.

According to Radiyati (1992), soy milk proteins owns amino acids which is similar to cow's milk. Soy milk protein content reach out to 1.5 times the protein of cow's milk. Soy milk contains fat, carbohydrates, calcium, phosphorus, iron, vitamin A, vitamin B1, vitamin B2, and isoflapon. The content of unsaturated fatty

acids in soy milk are larger and contains no cholesterol. Therefore, soy milk are used in the manufacture of chocolate bars so the products have higher protein contents than the general chocolate candy.

The research of Akinwale (2002), stated that the preference level towards the ratio between the milk powder and soy powder in the manufacture of milk chocolate is at a ratio of 75% milk powder and 25% soy powder.

According to Zogina (2015), chocolate products with a ratio of soy powder to milk powder of 1: 1 is considered better. Based on the findings of the chocolate-making, therefore this research created the ratio of soy milk powder with skim milk in Chocolate Candy with 1:0, 1:1 and 0:1.

According to Dachlan (1984), generally sugar are capable of binding the flavor and retains volatiles flavor thus the produced flavor was strong.

According to Syarief and Anies (1988) who said that sugar plays an important role in the manufacture of chocolate candy, other than functioning as a sweetener but also as a filler material (texture). High sugar levels will solidify the chocolate candy.

According to Soraya (2010), stevia indicates marvelous sweet taste with the level of sweetness 300 times the sweetness of sucrose. In addition, stevia has a low calorific value, making it suitable for consumption on people with diabetes and those who are doing diets. Stevia is not toxic, so it is safe for consumption. Stevia sugar used in the manufacture of chocolate bars makes chocolate candy products with low sugar content but sweeter than the regular chocolate we usually consume therefore consumers should not be afraid to consume large quantities of chocolate.

The comparison of sucrose with stevia sugar in the manufacture of chocolate will affect the quantity of the

resulting chocolate paste. This is because in the manufacture of chocolate products, sucrose provides mass and viscosity that can not be replaced by other sweeteners. Sucrose accounted  $\pm$  one-third part of the resulted chocolate products mass. Research results of Andrae-Nightingale et al (2009) found that the mass of chocolate and sugar affects the matrix of chocolate products.

According Zoogina (2015), chocolate products with the addition of 1.49% lecithin are assessed better. Based on the research of chocolate bars production, therefore the chocolate are made with lecithin concentration of 1.49% in this research.

According to Winarno (1992), taste is affected by several factors such as chemicals, temperature, concentration, and the interaction of other components. According to Kartika, et al (1997), the sweet taste is caused by organic compounds containing hydroxyl group (OH), some amino acids, aldehydes, and glycerol.

### Research hypothesis

Based on the framework described above, the hypothesis proposed in this research could be expected as follows:

1. Comparison of soy milk powder with skim milk have an effect towards the characteristics of chocolate candy.
2. Comparison of stevia sugar with sucrose have an effect towards the characteristics of chocolate candy.
3. The existence of interactions between the ratio of soy milk powder with skim milk and stevia sugar with sucrose have an effect towards the characteristics of chocolate candy.

### Time and place of research

This research was conducted at the Laboratory of Food Technology, Faculty of Engineering, University of Pasundan,

which is located at Jalan Dr. Setiabudhi No. 193 Bandung, starting in May 2016 until completion

## MATERIALS, EQUIPMENT AND METHODS

### Research materials and devices used

The raw material used in this research is cocoa powder, cocoa fat, soy milk powder, skim milk and sucrose purchased from grocery store of PD Kijang Mas Bandung, stevia sugar purchased from Depok, and lecithin purchased from PT Brataco Chemical Bandung. The materials used for analysis is diethyl ether, petroleum ether, distilled water, 6N sulfuric acid solution, 1.5 grams of KI, sodium thiosulfate, 9.5 N of HCN solution, 10 N NaOH solution and the solution of schoolr Luft.

### Tools utilization

The tools used in the research was an electric scales (Mettler Toledo), conching tool (arfe), stainless steel pot for mixing the mixture, spatulas, molds, washcloth, and refrigerator. Tools for chemical analysis is weighing/porcelain bottle (Germani), exsiccator (Pyrex), soxhlet extraction tool (Pyrex), condenser (Pyrex), round basic flask (Pyrex), destilator (Pyrex), 100 ml flask, 10 ml pipette and 250 ml Erlenmeyer.

### Met Research methods

This research is divided into two parts, namely the preliminary study and the main study.

### Research introduction

The preliminary research was done by making chocolate candy products using chocolate powder with several brands: Tulip Bergundi, Delfi, and Bendsrop with the addition of cocoa fat, skim milk, sucrose, and lecithin. Furthermore, chocolate candy obtained

were then performed organoleptic testing using Hedonic scale that is transformed into a numerical scale. Panelists used were 30 people with the attributes assessed which was the taste, flavor, texture and aftertaste, afterwards the chocolate powder that was selected are used in the main study. In addition, the main ingredients used were also performed chemical analysis, including analysis of fat content with Soxhlet method, protein content with the method of kjedahl, and sugar level with Luft Schoorl method (Sudarmadji, 2010).

### Main research

Primary research conducted is a continuation of the preliminary research. This research performed the additional ratio of soy milk powder and skim milk by varied comparison, and the additional ratio of stevia and sucrose.

### Experiment description

Preliminary experiments carried out by making Chocolate Candy products by using variety cocoa powder with each cocoa powder brand which are Tulip Bergundi, Delfi, and Bendsrop therefore the formulation resulted the best cocoa powder in the products of Chocolate Candy.

Description of preliminary research experiment are as follows:

#### 1. Material Preparation

The materials used in the manufacture of Chocolate Candy products are several brands of cocoa powder: Tulip Bergundi, Delfi, and Bendsrop, cocoa butter, sucrose, skim milk, and lecithin. The materials that have been prepared are weighed in accordance to the predetermined basis.

#### 2. Mixing I

Cocoa powder and cocoa butter were mixed to obtain cocoa liquor. The tool

used was mixing device which is a mixer, used for 15 minutes and the temperature used is 60 ° C.

#### 3. Mixing II (conching)

Mixing I results, sucrose, skim milk, and lecithin is mixed using an agitator at 60 ° C for 8 hours.

#### 4. Tempering

The batter as result of mixing II were left for 20 minutes or until the batter has a temperature of 25oC.

#### 5. Printing

Batter of mixing II results were printed using a mold that has been provided, the batter has been printed.

#### 6. Cooling

Batter that has been cooled in the cooling process, is again re-cooled at a temperature of 5 ° C for 10 minutes in the refrigerator.

### Main Research Description

Procedures for making chocolate candy products on the main research are as follows:

#### 1. Material Preparation

The raw material used in this research is selected cocoa powder, cocoa butter, soy milk powder, skim milk, sucrose, stevia sugar, and lecithin. The materials that have been prepared are weighed in accordance to the predetermined basis.

#### 2. Mixing I

The selected cocoa powder and cocoa butter were mixed to obtain cocoa liquor. The tool used was mixing device which is a mixer, used for 15 minutes and the temperature used is 60 ° C.

#### 3. Mixing II (Conching)

Mixing I results, sucrose, skim milk, and lecithin is mixed using an agitator at 60 ° C for 8 hours.

#### 4. Tempering

The batter as result of mixing II were left for 20 minutes or until the batter has a temperature of 25oC.

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### 6. Cooling

Batter that has been cooled in the cooling process, is again re-cooled at a temperature of 5 ° C for 10 minutes in the refrigerator.

Observations response are imposed with fat content test, protein content test, carbohydrate content test, water content test qualitatively and quantitatively, toughness test and organoleptic test to 30 panelists by scoring attributes of flavor, taste, texture and aftertaste.

## RESULTS AND DISCUSSION

### Research introduction

The preliminary study that has been carried out aimed to determine cocoa powder that varies with each cocoa powder brand which are Tulip Bergundi, Delfi, and Bendsrop therefore the best formulation cocoa powder in Chocolate Candy products are produced and may represent the most preferred ones by the consumers. The best, selected Chocolate candy resulted from the organoleptic test by using hedonic test involving 30 panelists and the test parameters used for the product is the taste, flavor, texture and aftertaste.

Table. Organoleptic result of Hedonic Test

Chocolate Powder	Parameter				Average
	Taste	Flavor	Texture	Aftertaste	
Tulip (007)	2.35 (b)	2.31 (b)	2.10 (c)	2.20 (b)	2.24
Delfi (070)	1.95 (a)	2.00 (a)	2.09 (b)	1.70 (a)	1.94
Bendsrop (023)	2.023 (a)	2.25 (b)	2.00 (a)	2.12 (a)	2.10

Note: every alphabet indicates significant differences in the level of 5%

The table, as the observation result of hedonic test towards taste, flavor,

texture and aftertaste it can be determine that Tulip cocoa powder are mostly used compared with Bendsrop cocoa powder, and Delfi cocoa powder especially in terms of taste.

Hedonic test or fondness test is a test in which the panelists will address the response in the form of happy or unhappy about towards the characteristics of materials or products tested. In this test each panelist was asked to express their opinion spontaneously, without comparing with standard samples or samples tested previously (Kartika, 1988).

According to the Indonesian National Standard (SNI), cocoa powder is powder form of cocoa product obtained from cocoa mass after most of the fat is removed with or without alkalization treatment.

According to Smanda (2011), cocoa powder serves as a chocolate filler and determines the quality of the resulting color and flavor of the product. Sugar serves as a sweetener, strengthens the texture, and as a natural preservative. Milk serves as a flavor enhancer and delicacy. Cocoa fat serves to homogenize the raw materials in the process of mixing, binding fat content, and determine the density of chocolate that affects the texture of product.

According to Helmy (2008) flavor produced in chocolate candy comes from cocoa powder and other additives such as vanilla powder.

According to Vogt et al., (1994) chocolate powder or cocoa powder are made from oilcake or dregs of the cocoa bean that has been separated from the cocoa fat. This oilcake is dried and finely milled to form chocolate flour. There are two types of chocolate powder, namely through the natural process (non-alkalized cocoa powder) and the second through a dutch process (alkalized cocoa powder). Natural cocoa powder has a lighter color, while the Dutch cocoa powder has a

darker color. Most chocolate powder sold in the market is a kind of natural cocoa powder. Natural cocoa powder is made from the pulp of chocolate or dark chocolate block, by eliminating much of the fat down to 18% -23%. This type of chocolate powder, contains less fat, and tastes bitter.

The organoleptic test results towards the texture showed Tulip Bergundi cocoa powder significantly different with chocolate candies texture so that these results shows that the resulting texture on chocolate candy are preferred by consumers. In this research, chocolate candies texture point out the similarity with general chocolate candy products, which is in line with the research of Prasetya (2009), the texture is the most important thing in making Chocolate Candy. This is because a good chocolate should have a smooth texture (smooth and buttery) which can melt gently and slowly in the mouth with complex and enjoyable flavors. Chocolate should be melted in the mouth, which doesn't need to leave the tough impression when it is consumed. Waxy texture (waxy mouth feel) indicates that chocolate contains some fat. Chocolate is a dispersion of the particles that are blocked by fat crystals that act as an adhesive cement. Therefore the physical properties and sensory of chocolate directly associated with the crystallization of cocoa butter.

Texture is an important factor in determining the quality of Chocolate Candy products therefore samples with Tulip Bergundi chocolate powder is the selected sample and is used as a raw material in the main study.

### Raw Material Analysis

Raw materials analysis is performed to determine the level of fat, protein, and carbohydrates contained in the raw materials to be used in the manufacture of Chocolate Candy, namely

Tulip Bergundi cocoa powder to determine the levels of fat, protein, and carbohydrates in the raw material until it becomes the products which can be seen in the following table.

Table. Tulip Bergundi Chocolate Powder Analysis Results

No	Parameter	Analysis Result
1	Fat	10.01%
2	Protein	10.48%
3	Carbohydrate	52.09%

According to the Indonesian National Standard (SNI), cocoa powder is a powder form of chocolate product obtained from cocoa mass after most of the fat is removed with or without alkalization treatment.

Natural cocoa powder is made from the pulp of chocolate or bittersweet chocolate block, by eliminating much of the fat down to 18-23%. This type of chocolate powder, contains less fat, and tastes bitter. Many people use this type of cocoa powder as ingredients to make a cake.

Cocoa powder is a usual food consumed by Indonesian society. Cocoa powder contains an energy of 298 kilocalories, 8 grams protein, 48.9 grams carbohydrates, 23.8 grams fat, 125 milligrams of calcium. Other than that, cocoa powder also contained as much as 30 IU of vitamin A, 0.12 milligrams of vitamin B1 and 0 milligrams of vitamin C (Anonymous, 2001).

In connection with the data that has been obtained, the content of fat and protein in Tulip Bergundi chocolate powder are relatively low, while its carbohydrate content are relatively high. Tulip Bergundi cocoa powder included in the natural cocoa powder where most of the its fat content has been removed. So Tulip Bergundi cocoa powder is a source of protein, fats, and carbohydrates in the products of Chocolate Candy (Hui, 1992).



Results of preliminary research with variety of cocoa powder can be concluded that the selected products are Tulip Bergundi cocoa powder which will then proceed to the main research with two factors, namely the addition of a comparison between soy milk and skim milk as well as comparisons between stevia and sucrose.

### Main research

Main research is the advanced research from the preliminary research. The main research carried out the examination of chocolate candy using additional ingredients which is the comparison of soy milk and skim milk and the comparison of stevia and sucrose by using the best chocolate powder obtained from the preliminary research. Main research carried out are aimed to determine the effects on adding the varied comparison of soy milk and skim milk as well as stevia and sucrose towards the characteristic of chocolate candy, with the ratio between soy milk powder and skim milk of 1:0, 1:1 and 0:1, and the ratio between stevia and sucrose of 1:0, 1:1 and 0:1.

The chocolate candy produced carried out organoleptic test to determine the preference of the panelists towards the product with hedonic test methods with the usage of parameter, such as taste, flavor, texture and aftertaste. Afterwards, chemical analysis are carried out, which includes fat contents by soxhlet methods, protein contents by kjedahl methods, carbohydrate content by Luft Schoorl methods, and water content by gravimetri method qualitatively and quantitatively, on the best sample resulted from organoleptic test. Physical analysis are also carried out which is toughness test by penetrometer method.

### Organoleptic Test

#### Taste

Based on the results of statistical calculations, comparisons between soy milk with skim milk and stevia with sucrose have a significant effect towards the taste of chocolate candies, and there is interactions between each factor towards the taste of Chocolate Candy which can be seen in the following table.

Table. Interaction Effects on the Comparison of Soy Milk with Skim Milk and Stevia with Cucrose towards the Taste of Chocolate Candy

Factor A	Factor B		
	b1	b2	b3
a1	3.87	4.18	4.61
a2	4.38	4.35	5.89
a3	4.76	4.83	5.28

Note: lowercase indicates the significant differences on Duncan test at the level of 5%, uppercase indicates the significant differences on Duncan test at the level of 5%

The table, shows that the ratio between soy milk and skim milk, as well as comparisons between stevia and sucrose gives significant difference towards the taste of chocolate candies mainly on a2b3 factor which owns the highest average value.

In general, food ingredients or food products are not only consist of one flavor, but a combination of various flavors in an integrated manner so that it has a perfect flavor (Kartika, et al, 1987).

According to Winarno (1992), taste is affected by several factors such as chemicals, temperature, concentration, and the interaction of other components. According to Kartika et al (1997), the sweet taste is caused by organic compounds which contains hydroxyl group (OH), some amino acids, aldehydes, and glycerol.

Soy milk has a distinctive flavor; which is slightly sweet whereas skim milk tasted sweet because soy milk contains

monosaccharide that is naturally contained in soy and skim milk contains sucrose therefore both affects the taste of chocolate candy, especially if they are reviewed at the level of each treatment on the comparison between soy milk and skim milk which is quite different comparison, thus it contributes on providing the sweetness besides other material such as sugar powder to relieve bitterness in chocolate derived from cocoa powder. (Erlita, 2002).

The presence of carbohydrates contained in soy powder and sugar added in the manufacture of chocolate candy products will lead the carbohydrate to undergo degradation of protein and sugar which will form a new compound called Amadori compounds, namely i-amino-i deoxy- D-fructose. The formation of these Amadori compounds can impacts the taste of the processed chocolate products where more addition of soy milk will give more bitterness on the chocolate products (Widiantara, 2004).

Unsweetened chocolate product tastes bitter and even couldn't be eaten, hence the addition of sugar in the manufacture of chocolate products intended to give the flavor of sweet to the chocolate products. The savory flavor found can be caused by the presence of fat content apart from the chocolate fat, but it can also come from soy milk and skim milk.

Differences in taste of chocolate products allegedly cause by the chemical composition of foods that can cause taste, is a combination of various components of the integrated flavoring substances, which cause different taste of foods. Milk is one of the factors that leads to different taste in chocolate products because of the suspected use on the type of milk, which is soy milk and skim milk with the taste of milk, different composition of the milk, are expected to cause different taste in chocolate products produced.

The interaction between the ratio of soy milk with skim milk and stevia with sucrose exists because both factors have the same functions and contributions thus affects the taste of the chocolate bar.

Bitter flavor is natural, distinctive flavor in chocolate. The flavor comes from the components of alkaloid theobromine, caffeine, fenoik components, pyrazine of several peptides and free amino acids. The bitter taste of chocolate is often disconcerting with the astringent taste because people do not fully understand the different nature and taste between the two, especially tannins and polyphenols in chocolate as the most responsible component for the astringent and bitter taste (Armita, 2009).

**Flavor**

Based on the results of statistical calculations, comparisons between soy milk with skim milk and stevia with sucrose have a significant effect on the taste of Chocolate Candy, and interaction between each factor towards the taste of chocolate candy can be seen in the following table.

Table. The effect of Interaction on the Comparison of Soy Milk with Skim Milk and Stevia with Sucrose towards the flavor of Chocolate Candy

Factor A	Factor B		
	b1	b2	b3
a1	4.64	4.13	4.90
a2	4.48	4.39	5.49
a3	4.17	5.88	4.77

Note: lowercase indicates the significant differences on Duncan test at the level of 5%, uppercase indicates the significant differences on Duncan test at the level of 5%

The table shows that the ratio between soy milk and skim milk as well as comparisons between stevia and sucrose gives significant difference to the taste of chocolate candies mainly on a3b2

factor which owns the highest average value.

Flavor or odors may be defined as something that can be observed with the sense of smell. Flavor substances can evaporate, slightly insoluble in water and slightly insoluble in fats. The smell or flavor generated by food can determine the delicacies of the food (Winarno, 1997).

According to Minifie (1999), screening leads to the development of specific flavor in chocolate with the existence of Maillard reaction; sugar caramelization, protein degradation, and the formation of volatile components such as pyrazin which is one component of the desired flavor.

Flavors of chocolate products comes from volatile compounds contained in cocoa fruit, other than that flavor in chocolate products can be formed due to the addition of flavoring substances such as like milk, where the mixing of this additional substances will form decomposition of lactose in the fat of milk by the activity of microorganisms.

The distinctive flavor of soy milk, which is unpleasant smell, effects the aroma of chocolate candy even though the smell are not too oppressive just like other processed soy products. Because the flouring process of soybean undergo the inactivation of lipoxygenase enzyme which can hydrolyze unsaturated fatty acids to make volatile compounds that cause the reduction of unpleasant flavor, whereas the typical flavor of skim milk is sweet because there are no irregularities in the milk. If there is irregularities in the milk then its scent will probably change. This is because the nature of the milk are able to absorb the flavor of the environment around the milk. Therefore, these two materials has a distinctive and seared flavor therefore these are substances that makes the comparisons

between soy milk and skim milk affects the aroma (Erlita, 2002).

More concentration of soy milk in the ratio of soy milk and skim milk added, then the chocolate products produced will be disliked. This is caused because there is a slight of unpleasant scent from the soy milk even though it has undergone a process of heating and addition of sugar.

According to Dachlan (1984), generally sugar is capable of binding flavor and retains volatile flavor so that the resulting flavor was strong.

The interaction between each factor happens due to the same nature of both factors where soy milk and skim milk has a distinctive flavor which is the typical unpleasant smell of soy milk, and the typical sweet flavor of skim milk which can bound by sugar. Therefore each of the factors effects the aroma on Chocolate Candy.

According Prasetya (2009), chocolate flavor formed during roasting of cocoa beans which is a raw material in the manufacture of cocoa powder. Amino acids, peptides, sugars reducer and quinone are group compounds of alcohol, ether, furan, tiazoi, piron, acid, ether, ester, aldehidal, imine, amine, oksazoi, pyrazine, and pyrrole. This shows that the distinctive flavor of chocolate is not only determined by one component. But a function of hundreds constituent components. Compounds are formed during the process of preparing the seeds, especially during fermentation and drying. During the screening of compounds candidates, flavor formed react with each other to produce volatile components and unique flavor of chocolate.

### **Texture**

According to the results of statistical calculations, each of these factors do not affect the texture of chocolate candies, and there is no

interaction of each factor on the texture of chocolate candy.

The results showed that the observations towards organoleptic in terms of texture are not significantly different at the level of 5% with a mean value which is not so significant and there is no interaction on the comparison between soy milk and skim milk powder as well as, the comparison between stevia and sucrose. Soy milk used has a very smooth texture without rough yield so it does not affect the texture of chocolate candies, because the main factor which affects the texture of the chocolate candies is the conching process. This also resulted in the lack of interaction between each factor.

According to Minifie (1999), cocoa fat will contribute to the melting and crystallization characteristics so it rapidly melts at body temperature when consumed.

It was alleged that the use of soy milk in the manufacture of chocolate can produce smoother texture on chocolate products. This is because soy milk contains phosphatides, which contains 1.5-3% soy phosphatides, which acts as an emulsifier. Phosphatides will help the formation of oil emulsion in water as phosphatides will gather between the oil and water which will reduce the surface tension so that the emulsion can be formed. Therefore the more soy milk added to the comparison of skim milk used in the manufacture of chocolate products, will produce a smooth texture of chocolate products.

According to Prasetya (2009), a good chocolate should have a smooth texture (smooth and buttery) that could melt gently and slowly in the mouth with complex and fun flavor. Chocolate should be melted in the mouth, when it is consumed without leaving tough impression. Waxy texture (waxy mouth feel) indicates that chocolate contains some fat. Chocolate is a particle dispersion of chocolate powder and sugar

in a liquid phase of cocoa fat. In room temperature particles are blocked by fat crystals that act as an adhesive cement. Therefore, physical and sensory characteristics of chocolate directly associated with the crystallization of cocoa butter.

According to Smanda (2011) chocolate candy has a distinctive taste, solid texture at room temperature, rapidly melts in the mouth, it becomes liquid and soft on the tongue. There are various ways to process chocolate, one of which includes the stages of: mixing, softening, refining (conching), tempering, and molding. The materials used to make chocolate varies, including: pasta or cocoa liquor, refined sugar, milk, cocoa fat. The material is mixed with a certain ratio. In this research, mixing ingredients in powder form is an important process in the manufacture of chocolate. Chocolate powder serves as a filler and determine the quality of the resulting color and flavor of the product. Sugar serves as a sweetener, harden the texture, and as a natural preservative. Milk serves as a flavor enhancer and delicacy. Cocoa fat serves to homogenize the raw material in the mixing process, enhance the levels of fat, and determine the density of chocolate which affects the texture of the product.

Sifting process will affect the texture of the chocolate. Because the sifting itself can homogenize particle size found in cocoa powder, soy milk powder, skim milk, and sugar used so that uniform particle size will affect the soft and uniform shaped chocolate texture.

#### **Aftertaste**

Based on the results of statistical calculations, each of these factors do not affect the texture of chocolate candies, and there is no interaction of each factor on the aftertaste of chocolate candy.

Basically the most dominant flavor in chocolate candy is the bitter taste due to the raw material used; which is cocoa powder where stevia is also added where the two materials obtained alkaloid compound such as tannins with bitter and astringent taste, thus aftertaste obtained are almost the whole typical bitter taste of chocolate candy.

### Chemical Analysis

#### Analysis of Fat Content on the Selected Products of Chocolate Candy

The main study analyzed the fat content of chocolate candy products in the selected samples based on the results of organoleptic test. Results can be seen in the following table.

Parameter	Analys
Fat Content	11,05

The results of fat content analysis in chocolate candy products selected shows that the fat contained in chocolate candy has a fat content of 11.05%. The results of fat content analysis on the main research with the analysis of the preliminary study did not undergo any significant difference as seen from the usage of same cocoa powder which is Tulip Bergundi cocoa powder. There is an increase which are not too high because there is addition of other ingredients in the process such as skim milk, and lecithin as well as raw material, namely Tulip Bergundi cocoa powder that have a fat content of 10.01%. Fat contained in Chocolate Candy classified as good fats or healthy fats which are commonly referred to as HDL (High Density Lipoprotein) which is a series of unsaturated fat (single and double) so it is safe for consumption due to the nature of fat, which does not raise blood cholesterol.

According to the Indonesian National Standard (2009), cocoa butter is the fat obtained from cocoa mass obtained by

compression. The mass itself is a form of pasta product obtained from cocoa nib (pieces of cacao beans) through the mill without removing the fat content.

According to Winarno (2004), fats and oils contained are almost the whole food ingredients with different contents, but the fats and oils are often added intentionally into the food for various purposes.

In food processing, oil and fat functions as heat conductor media, such as cooking oil, shortening (white butter), fat (lard), butter and margarine. Other than that, the addition of fat is also intended to increase the calories and improve the texture and taste of food. As in cotton candy, the addition of shortening in baking and others.

Cocoa fat contains oleic, palmitic and stearic acid. Cocoa fat used in chocolate candy should have characteristics which includes; melts at a temperature of 32oC-35oC, has hard texture and slightly crumbly, not blurry in color and remains bright when it is mixed with other materials and solidify at room temperature. Retention time for storage must also be adapted to the chocolate condition, because otherwise it could cause the chocolate to be attached to the mold, resulting blurry color and cause blooming on the surface of the chocolate. Where the function of cocoa fats in the manufacture of chocolate is to solidify (Ketaren, 1986).

The heating process carried out in making Chocolate Candy will cause rupture of fat components into the production of volatiles such as aldehydes, ketones, alcohols, acids, and hydrocarbons with gives great influence on the formation of flavor.

Cocoa fats is an essential ingredient in chocolate, as well as sugar. Both provide very significant influence on the taste and texture. Dark chocolate contains a lot of cocoa fat and sugar, white chocolate owns only a bit while the

total in milk chocolate are amounted in between the two types of chocolate (Hoven 2008).

#### **Analysis of Protein Content on the Selected Products of Chocolate Candy**

The main research analyzed the fat content of chocolate candy products in the selected samples based on the results of organoleptic test. Results can be seen in the following table.

Table. Protein Analysis Result of Chocolate Candy

Parameter	Analysis
Protein contents	13,44%

Lecithin and proteins are the best emulsifier where the protein can be denatured and absorb nutrients thus forming stable characteristics. Protein serves to bind the hydrophobic on oil and hydrophilic on water. The best protein used as an emulsifier is egg yolk and milk because of the level of stability to form a good unity, and the eggwhite is the best foam maker protein. Eggs contains lipoproteins and phospholipids such as lecithin, known as micelles. The micelle structure of the lecithin is part of what makes the emulsifier works well (Hasenhuettl and Hartel, 2008).

In addition to carbohydrates and fats, the fulfillment of good nutrition for growth can be obtained by consuming foods that contains protein. Good protein quality derived from food ingredients that have good conditions, such as nuts, milk and others. Although it is common that very little protein contained in foods with big amount of fats, such as chocolate products.

Protein is a macronutrient food ingredients. Protein molecule contains special elements that are not contained in carbohydrates and fat which is nitrogen. Protein is essential for the body, because these substances functions as a fuel in the

body and also serves as a builder and regulators substance.

Chocolate are made with heat, protein in food ingredients will change and form compounds with other ingredients, such as amino acid as the results on the change of proteins with sugar reduction to form other compounds which might damage the protein when it is viewed from the point of nutrition (Sudarmadji, 1996).

#### **Analysis of Total Sugar Carbohydrates Levels on the Selected Products of Chocolate Candy**

The main research performed an analysis of carbohydrates level of chocolate candy products in the selected samples based on the results of organoleptic test. Results can be seen in the following table.

Table. Carbohydrate Analysis Results of Chocolate Candy

Parameter	Analys
Carbohydrate content	25,28

A3b2 samples are samples with 100% skim milk formulations without the use of soy milk that has the highest levels of carbohydrates, this is because the content of skim milk which is lactose; is a disaccharide that consist of glucose and galactose oligosaccharide.

According to Astawan (2011), the carbohydrate content in milk powder is 32.6 grams per 100 grams or 32.6%. The presence of a heating process performed on skim milk in processing Chocolate Candy will cause shrinkage of nutrients, especially with the nature of carbohydrates which occasionally are unaccompanied but accompanied by other nutrients such as protein, fat. With the high heat, carbohydrates, especially sugar will undergo caramelization (non enzymatic browning).

**Analysis of Water Content on the Selected Products of Chocolate Candy**

The main study analyzed the water content of the chocolate candy products in the selected samples based on the results of organoleptic test. Results can be seen in the following table.

Table. Water Analysis Results of Chocolate Candy

Parameter	Analysis
Water contents	1,17%

Protein (skim milk) serves as a filler that will bind the cocoa in chocolate candy products. Protein molecule tends to bind the oil (non-polar) and binds the water (polar) (Hasenhuettl and Hartel, 2008; Winarno, 2004).

Skim milk powder is a multifunctional product as it can provide emulsification, water binding, viscosity, color and flavor (Minifie, 1999).

The loss of water content in Chocolate Candy analyzed can be influenced by several factors, including the process of mixing 1 with a temperature of 60<sup>0</sup> C within 15 minutes which can affect the loss of water contained in the ingredients such as cocoa powder, skim milk, stevia and sucrose, then conching with temperature of 60<sup>0</sup> C within approximately 8 hours to reduce the water content contained in the chocolate because the high temperatures and long timing, in addition to the proteins in skim milk, lecithin, and soy milk powder serves as a binder of fat and non-fat fraction namely water, and as the link of polar and non-polar compounds.

**Physics Analysis Toughness Test**

Physical analysis for chocolate candy uses the penetrometer (hardness tester), which is a tool that can measure the hardness of Chocolate Candy texture itself, where the lowest score has the highest toughness.

Based on the results of statistical calculations, comparisons between soy milk with skim milk and stevia with sucrose gives significant effect towards the toughness of chocolate candy, and there is interaction between each factor towards the toughness of the chocolate candy which can be seen in the following table.

Table. The Effect of Interaction on the Comparison of Soy Milk with Skim Milk and Stevia with Sucrose towards the toughness of Chocolate Candy

Factor A	Factor B		
	b1	b2	b3
a1	1.91	1.69	2.91
a2	2.62	1.54	7.28
a3	1.95	2.03	1.23

Note: lowercase indicates the significant differences on Duncan test at the level of 5%, uppercase indicates the significant differences on Duncan test at the level of 5%

Physical and organoleptic response towards the texture has a distinctive difference where in the organoleptic response, it is known that the texture does not have any significant difference on every comparison of soy milk with skim milk and the stevia with sucrose used are different with the ones generated in the physical response where every comparison of soy milk with skim milk and stevia with sucrose have significant differences in 5% significance level which means that every comparison effects the toughness of Chocolate Candy.

Toughness is defined as the power or force needed to achieve the changes of shape. Analysis of toughness are performed because toughness is one of the most important quality criteria for the types of chocolate.

Muchtadi and Sugiyono (1992), stated that the degree of hardness texture of a food ingredients derived from 49 milk is determined by the amount of lactose crystals, the greater crystalline

lactose in milk therefore small amount of toughness or roughness of the foods can be easily perceived. In addition the level of softness on the chocolate produced is also influenced by the less maximum conching process because it is done manually, unlike the large industries which uses machines in order to produce chocolate with a smooth texture.

According to Purnamasari (2011), besides giving a sweet taste in chocolate, sugar effects the density of the chocolate. Sugar also affects the hardness texture of the chocolate, where the usage of more sugar will make the chocolate even harder.

Toughness in chocolate is very important with regard to consumer preferences which tends to eat a good texture on the product and as an indicator of the product which can be accepted by the society in general. Good chocolate is chocolate that has the characteristics of not too hard and not too soft and has a good chemical relationship and a positive effect on health.

The units used for hardness test is mm/sec/100 grams. This means that the figures used shows the ability of needling from measuring device to puncture the material to a specified depth every second. Thus the rising number of measurement results showed lower levels of toughness.

## CONCLUSIONS AND RECOMMENDATIONS

### Conclusion

Based on the results, it can be concluded as follows:

1. Based on preliminary research by organoleptic tests, the best cocoa powder is Tulip Bergundi cocoa powder. Analysis of fat, protein, and carbohydrates level in the main raw material, namely Tulip Bergundi cocoa powder which have a fat content of 10.01%, 10.48% of protein

content, and carbohydrate content of 52.09%.

2. Based on primary research, comparisons treatment between soy milk and skim milk (A) effects towards the organoleptic response which are flavor and taste of Chocolate Candy, comparison between stevia and sucrose (B) gives significant effect on the same organoleptic response by factor (A) which is taste, and flavor of Chocolate Candy. The interaction on the comparisons between soy milk with skim milk (A), and comparison of stevia with sucrose (B) significantly affects nearly all organoleptic responses except the texture and aftertaste of Chocolate Candy.

3. The best Chocolate Candy products from the overall response was obtained in organoleptic which is the sample of a3b2 (ratio of soy milk and skim milk 0: 1). (Comparison of stevia and sucrose 1: 1). As seen from an organoleptic test is the sample panelists preferred the most with the fat content of 11.05%, 13.44% of protein content, carbohydrates of 25.28%, water content of 1.17% and has a hardness value at 1.23 mm/sec/100gram.

### Suggestion

1. It is necessary to conduct a research on the effect of conching towards the particle size of chocolate
2. It is necessary to conduct further research on the storage power and the right packaging for chocolate products

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