Characteristics of water solubility and color on edible film from bioselulosa nata nira siwalan with the additional of glycerol

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Abstract. Indonesia entered the ranks second in the world as a producer of plastic waste into the sea after China. Most of the plastic packaging is causing environmental pollution, unbiodegradable, expensive in recycling and contamination of foodstuffs packaged due to certain substances that migrate into the food. Edible film is a thin layer of transparent and made of materials that can be eaten very prospective and secure to provide selective detentions against the transfer of gas, steam, water and dissolved materials as well as protection against mechanical damage. Product development nata much utilized as raw material for paper and edible film, nata contains bioselulosa which is produced by the bacterium Acetobacter xylinum. So the researchers develop alternative modification of cellulose from nata nira siwalan. Glycerol is one of plasticizer selected researchers to be added in the manufacture of edible film. The purpose of this research is to know the concentration of glycerol that is most appropriate to get the edible film solubility characteristics bioselulosa nata nira siwalan and to find out the optimum concentration of glycerol that is most appropriate to get the characteristics of colors edible film made from bioselulosa nata nira siwalan which is optimum. The research was carried out in December 2016-June 2017. Methods this study used a randomized complete design with four treatments and three replicates. The results of this study is the most appropriate concentration to get characteristics of water solubility on edible film bioselulosa nata nira siwalan is on treatment D with the addition of glycerol 30% of 0.42% and on the characteristics of color by value L (77.45), a (0.723) and b (9.96).

1. Introduction
Kementerian Lingkungan Hidup dan Kehutanan (KLHK) assessing the problems of garbage is already troubling. Indonesia entered the ranks second in the world as a producer of plastic waste into the sea after China. It has to do with data from KLHK that plastic from 100 store or member of Asosiasi Pengusaha Ritel Indonesia (APRINDO) within one year, have already reached 10.95 million pieces of rubbish plastic bags. That number turns out to be equivalent to the total area of 65.7 hectares of plastic bags or around 60 times the size of a football field [1]. Most of the plastic packaging is causing environmental pollution, unbiodegradable, expensive in recycling and contamination of foodstuffs packaged due to certain substances that migrate into the food.

Plastic packaging cannot be maintained broadly its use so that it takes the raw material plastic packaging that is easy to decompose (organic), available in nature in bulk, and cheaper but capable of producing the packaging with the same strength of plastic packaging that exist today [2]. Edible film is a thin layer of transparent and made of materials that can be eaten very prospective and secure to provide selective detentions against the transfer of gas, steam, water and dissolved materials as well as protection against mechanical damage [3].
Product development nata much utilized as raw material for paper and edible film, nata contains bioselulosa which is produced by the bacterium Acetobacter xylinum. So the researchers develop alternative modification of cellulose from nata nira siwalan. Nata nira siwalan contain lots of fiber cellulose as it does on nata de coco. The main constituent content of nata nira siwalan bioselulosa of 0.11399% ± 0.000099% each 100 grams of nata wet. Bioselulosa has an advantage where higher purity than the cellulose plants because it contains no lignin and other extracts, compounds have a high attraction force, elastic, and are biodegradable [4]. The three components of a basic constituent of edible film that is hidroklorid (proteins, Polysaccharides, a Alginat, cellulose, modified cellulose, starch, lipids, in order that (fatty acids, acyl glycerol, candle and wax) and composite (a mixture of hidroklorid and lipids) [5]. Bioselulosa is one of the derivatives of cellulose which included hidrokoloid and can be used to form the matrix movies. Edible film made from hidrokoloid gives the characteristics of the good, and produce a more powerful film. Bioselulosa is one of the derivatives of cellulose which included hidrokoloid and can be used to form the matrix movies. Edible film made from hidrokoloid gives the characteristics of the good, and produce a more powerful film [6]. The use of single materials on edible film still has some drawbacks such as the nature of the brittle and stiff, this can be overcome by the addition of plasticizer [7]. Glycerol is one of plasticizer selected researchers to be added in the manufacture of edible film. Glycerol digestible, not toxic as a food wrapping that direct contact with consumers who can provide suppleness and hardness of the wrappers, since 1959 glycerol is recognized as one of the ingredients that are safe by the Food and Drug Administration and metabolism shared in carbohydrates [8]. Glycerol is capable of affecting physical properties of edible films such as thickness because it has a hydrophilic properties so that will increase the thickness of the edible film and the power of attraction because it is soluble in some polymer and will raise the temperature of the transition and make the edible film that is formed will be the harder and the strength of the attraction will be the lower [9].

The purpose of this research is to know the concentration of glycerol that is most appropriate to get the edible film solubility characteristics bioselulosa nata nira siwalan which is optimum and knowing the concentration of glycerol that is most appropriate to get the color characteristics of edible film made from bioselulosa nata nira siwalan which is optimum.

2. Methods

2.1 Location and time study

The location of the research carried out in the Laboratory of Biology Education Universitas PGRI Semarang in the manufacture of nata nira siwalan and edible film, for the measurement of the thickness of the edible film conducted in Laboratory physics education of Universitas PGRI Semarang and measurements of the strength of the appeal conducted in Food Science Laboratory at Universitas Katholik Soegijapranata during the month of December 2016 – June 2017

2.2 Tools and Materials

Tools used in this study is measuring cup, beaker glasses, stir, stove, filters, fermentation, tray pan, boiled pan, pH meter hotplate, thermometer, oven, 9 cm diameter petri dish, laver and Digital color meter test. The materials used in this study is siwalan water, fertilizer ZA, acetic acid, Acetobacter xylinum starter, 1% NaOH, CMC (CarboxyMetyl Cellulose), glycerol, aquadest.

2.3 Experimental Design

This study used a Randomized Complete Design with four treatments and three times in Deuteronomy. The addition of glycerol to 0%, 10%, 20%, 30% and 200 grams of bioselulosa nata nira siwalan

2.4 Research Procedure

2.4.1 The making of a starter

Adding fertilizer ZA as much as 2.5 grams/liter into siwalan water and add acetic acid as much as 2 ml/liter siwalan water, stirred and heated to a boil. Then pour the solution of siwalan water into bottle as much as 500 ml each bottle. Close the mouth of the bottle has been filled with heated siwalan water
using newsprint paper and the cover is fastened with a rubber band and then refrigerate up to 6 hours. Add 100 ml of a solution of *Acetobacter xylinum* seedlings after siwalan water solution become cold, close the bottle again in the next few days let the appropriate treatment so that it occurs the process of incubation the bacteria in a bottle starter.

### 2.4.2 The making of nata nira siwalan
Filter the siwalan water and put into boiled hotplate with a certain size. Adding fertilizer ZA as much as 2.5 grams/liter of water siwalan and acetic acid technical as much as 2 ml/liter water siwalan. Stirring and heats the solution into boiled. After that, pouring a solution of water siwalan into the tray fermentation. Close tray fermentation that has filled with heated water siwalan with newspaper and tie with a string of Raphia in order for newsprint cover does not open. After the main solution has been cold (3 hours later) then open the paper cover and add the solution starter into appropriate treatment tray and then dozens of fermentation and put the tray back in the room with a temperature of 28-30°C.

### 2.4.3 The making of Edible film
Wash the nata nira siwalan further heats into the water in order to reduced acid characteristic. Purify nata nira siwalan in ways to boil with 1% NaOH to remove non component cellulose, and then wash again with water until neutral pH is making bioselulosa. Cut bioselulosa in the form of gel and add water with a blender until smooth then formed a paste (Slurry) silence during 24 hours, Bioselulosa in the form of slurry into the basic ingredients of making edible films. Dissolving CMC 0-1.5% in the aquades little by little while stirring in the top of the heater at the temperature 80 oC then add glycerol in accordance with treatment (10%,20% and 30%). Add the slurry had been silenced for 24 hours while stirring over the heater until it is homogeneous then degassing (the exhaust air) for 5 minutes. Adding up to a total volume of aquades back into a 600 ml, stirred until homogenized and then dumbs the air for 5 minutes. Next print with the method of casting and drying in an oven at a temperature of 40°C for 6 hours. Take off the edible films that have dried from the mold carefully. Storing Edible film and hanged in a sealed container for 24 hours.

### 2.4.4 Measurement of Water Solubility
Test the water solubility of edible films in water is carried out by means of inserting a sheet of plastic film with a size of 2x10 cm into the vessel that contains water while stirring it manually. The solubility in water is declared the film section of the percentage of the soluble in water after soaking for one week [10].

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\text{Percent Solubility} = \frac{(a - (c-b))}{a} \times 100\%
\]

### 2.4.5 Color measurement
Digital color meter test (T 135) is used as a tool for measuring the value of edible color film L, a and b. color values L = 0 (black) to 100 (white); a =-60 (green) to + 60 (red), and b =-60 (blue) to + 60 (yellow). The tool is calibrated in advance with standard white (calibration value of L=94.76, a = 0.795-, and b = 2.200) before use [11-13].

### 3. Results and discussion

#### 3.1 Water Solubility
The most appropriate concentration to get the characteristics of the water solubility is at the treatment D that is 0.42%. Solubility of edible film is a very important factor in the packaging material. Solubility influenced by hydrophilic and hydrophobic components, in this study the properties of glycerol is hydrophilic while the bioselulosa is hydrophobic. The average result of the solubility of edible film made from bioselulosa nata nira siwalan is 0-1.3%. This research has decreased solubility of water along with the addition of glycerol, this is due to the nature of bioselulosa that is hidrofobik. It should increase the solubility due to the hydrophilic nature of glycerol but results are inversely proportional. Higher value of a hydrophilic material then the solubility will be higher, and the higher value of an hydrophobic material then the solubility will be even lower[14]. Cellulose has three
hydroxyl groups thus enabling cellulose to form many of the hydrogen bonds. This hydrogen bonds cause stiffness and style between a high cellulose chains are not soluble in water [15]. The higher solubility then biodegradable characteristic will also be high, this is because there is a hydrophilic components in water and soil. The higher solubility values then the ability of biodegradable film has resistance to water is getting lower. The value of low solubility in biodegradable film very good used as a material packaging [16].

Figure 1: the solubility of edible film made from bioselulosa nata nira siwalan

3.2 Color of edible film
Color characteristics of edible film is one of the physical properties that is very important because it will affect the appearance of the products. Three important aspects in food acceptance is the color, flavor, and texture. The experts argued that the color is the most important factor in terms of acceptance. Increasingly bright of edible film, the better quality of edible films [17]. Characteristics result of edible film color can be seen in table 1 below.

Measurement of color on this research (color detection tool) is based on the measuring value with the hunter system L (0 = black, 100 = white), a (= green-60, + 60 = red), and b (-60 + 60 = blue = yellow). The average color of the edible films produced with the addition of glycerol treatment as a plasticizer is color values L (0-82.59), color a (0 – (917) and color b (0-9.96). Brightness level (L) on the addition of 10% glycerol concentrations showed higher brightness than glycerol concentrations of 20% and 30% are likely to produce a low brightness level. The low levels of plasticizer in edible film (<15%) can produce high transparency, at the time of plasticizer levels exceeding 15% happen various changes and increased mobility of the bond, whereas at the moment the plasticizer reaches 30% humidity environment resulting in increased tissue expands, the decrease in the style of intermoleculer and polymer matrix absorbs a lot of water, as a result the edible films lose transparency and brighter than the other [18].

| Treatment(Addition of glycerol) | L    | a    | b    |
|-------------------------------|------|------|------|
| A (0%)                        | 0    | 0    | 0    |
| B (10%)                       | 82.59| -0.433| 5.57 |
| C (20%)                       | 78.66| -0.917| 8.43 |
| D (30%)                       | 77.45| -0.723| 9.96 |

Description: L (Brightness value) = 0 (Hitam) to 100 (white)
      a = -60 (green) to +60 (red)
      b = -60 (blue) to +60 (yellow)
4. Conclusion
The results of research that has been done can be concluded as follows: the most appropriate Concentration to get water solubility characteristics of edible film from bioselulosa nata nira siwalan is on treatment D that is with the addition of glycerol 30% of 0.42%, concentration which is most appropriate to get the color of edible film from bioselulosa nata nira siwalan is on treatment D that is with the addition of glycerol 30% with a value of L (77.45), a (-0.723) and b (9.96).

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