The effect of sodium metabisulfite concentration and drying time on the quality of coconut sugar

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Abstract. A study on the effect of sodium metabisulfite and drying time on the quality of coconut sugar has been conducted. The objectives of this research were to determinate the effect of metabisulfite dan drying time to obtain optimum characteristic of coconut sugar. The research method includes the preparation of tapping coconut sap, processing crystal, and drying using modified oven method. The study used a randomized block design of two factors. The first factor is addition of sodium metabisulfite in several concentration (0,1%, 0,2%, 0,3%) and the second factor is drying time (air drying, 15 minutes, 30 minutes) in 3 repetitions. Parameteres being analyzed were moisture, ash content, reduced sugar content, and yield. Sensory analysis measured color, taste, aroma, texture. The best results are addition of sodium metabisulfite 0,2% and drying time in 15 minutes. The best treatment showed that the contains 2,41% moisture, 1,77% total ash, 3,34% sugar reduction, yield 82%. Sensory analysis showed that had likely score for color, taste, and aroma. Keywords: coconut sugar, drying time, sodium metabisulfite

1. Introduction

Coconut sugar was the kind of sugar in powder which made from coconut sap. The advantages of coconut sugar were it dissolved easily so that it was more practical in serving, easy to pack and carry, and relatively longer shelf life than molded sugar because of it had lower water content.

The production results of coconut sugar at the level of coconut sugar craftsmen generally did not have the same quality, because the processing had not been implemented properly so that the quality of the products produced was not consistent. The production results generally had a high water content which were characterized by a soggy texture and the product was easy to melt, so it had a shorter shelf life. To overcome this problem, coconut sugar craftsmen usually add Sodium metabisulfite on coconut sap, without considering the impact on product quality. They added sodium metabisulfite in exaggerated dosage and the dosage is not yet known to get best quality of coconut sugar. As an educational step to the craftsmen, efforts were made to prevent a decrease in quality by conducting studies on addition the concentration of sodium metabisulfite (Na₂S₂O₅). The addition of this substance was to increase the pH which would affect the crystallization process in order to determine the level of reducing sugar in the product. By decreasing the reducing sugar level, it would be able to bind water so that it had a lower
water content. Decreased coconut sugar water level can be obtained by drying process. Coconut sugar craftsmen often use modified oven to accelerate the drying process and gain a better quality of coconut sugar. But, the correct drying time is not confirmed yet. The treatment by combining drying time dan metabisulphite concentration were expected to reduce the water content and to get the best quality of coconut sugar according to the standard. The purpose of this study was to determine the effect of added Sodium Metabisulfite concentration and drying time on the quality of coconut sugar.

2. Material and methods
2.1. Materials
The materials needed in this study were coconut sap and Sodium Metabisulfite obtained from desa Wonosobo, Kecamatan Srono, Kabupaten Banyuwangi. The chemicals used were standard sugar, nelson solution, reagent arsenomolybdate, buffer 4, buffer 7, distilled water, and filter paper.

2.2. Equipments
The equipments were used such as a frying pan for the evaporation of sap, crystallizer, coconut sugar dryer, scales, stirrer, thermometer. Some equipments for analysis such as a spectrophotometer, analytical scale, oven, desiccator, furnace, weigh bottle, porcelain exchange, and several other glassware.

2.3. Research Design
The design of this research used a completely randomized design with 2 factors. Factor 1 consisted of 3 levels and factor 2 consisted of 3 level with 3 repetitions.
Factor 1: The concentration of Sodium Metabisulfite (N)
N1 = 0.1 %
N2 = 0.2 %
N3 = 0.3 %
Factor 2: Drying Time
P 1 = 0
P2 = 15 minutes
P3 = 30 minutes

Making process:
The harvested coconut sap was collected and observed for discoloration, aroma, and viscosity level. Then, the coconut sap was heated until it changed into thicken and a light brown color change occurred and a distinctive aroma of sugar appeared, so this heating process was reduced. To ensure that the heating process was ended, a spoon test was carried out by taking a sample of liquid sugar with a spoon and then dropping it into a bowl of water. If there was a change in shape to solid, then it was time to continue the process with crystallization by using an coconut sugar crystallizer. This tool was equipped with a rotating mixer so that over time the sugar will turn into coarse grains. The next step was drying by using a modified oven method dryer. After the product was dry, a grinding process was carried out to equalize the size of the coconut sugar grains.

3. Result and discussion
3.1. Chemical properties
3.1.1 Water Content. Based on the results of the analysis sugar water content by treating the addition of Sodium Metabisulfite concentration and drying time ranged from 2.30 to 4.12 %. The relationship between the addition of sodium metabisulfite and water content showed the highest test results were in N1 treatment (0.1%) and the lowest was N3 treatment (0.3%) showed on Figure 1. The higher Na2S2O5 concentration, the lower water content. This was presumably due to an increase in the pH of coconut sugar which results in an increase of reduced sugars which are able to bind more water because the OH-component binds H⁺ from the air. The correlation between drying time and water content showed that P1 (0 minutes) had the highest and lowest water content in P3 treatment (30 minutes). The longer the drying time decreased the water
content of the coconut sugar, this was due to the increasing amount of water vapor that was released, especially the mass of water on the surface of the material. Based on the study conducted by [2], the water content was 2.31% in 1 hour drying time at 60°C.

![Figure 1](image)

**Figure 1** Water Content of Coconut Sugar in Various Treatments
Addition of Na2S2O5 Concentration and Drying Time

3.1.2. Reduction Sugar. The addition of Na₂S₂O₅ and drying time had a significant effect on the reducing sugar levels of coconut sugar. The interaction relationship between the addition of sodium metabisulfite concentration and drying time can be seen in Figure 2. The mean values ranging from 2.92 to 4.84% and according to the SNI requirements for a maximum of 6%.

![Figure 2](image)

**Figure 2** Reducing Sugar Content of Coconut Sugar in Various Treatments
Addition of Na2S2O5 Concentration and Drying Time

From the Figure 2, it showed that there was a decrease in reducing sugar levels along with the addition of sodium metabisulfite concentration and an increase of drying time. This was presumably because an increase in the concentration of sodium metabisulfite could increase the pH so that to prevent sugar inversion. Sugar inversion occured due to acidic conditions and an increase of drying temperature which
results in the breakdown of sucrose into glucose and fructose, which had high solubility so that it was difficult to form sugar crystals. In addition, the drying time would cause the decrease of water content, thereby reducing the reducing sugar level.

Reducing sugar content of coconut sugar determined the quality of the sugar produced so that it affected the level of purity. By setting the addition of Na$_2$S$_2$O$_5$ would be able to increase the pH value. The more sodium metabisulfite was added, the reducing sugar level would decrease. This was the same thing that was conveyed by Shalenberger (1987), in order to avoid unsuccessfulness in sugar manufacture, the breakdown of sucrose into reduced sugar had to be minimized.

3.1.3. Ash Content. Ash content is one of the determining factors for sugar quality. The higher ash content, the lower sugar quality. The highest ash content of all treatments was 1.9% and met the SNI standard at a maximum of 2%. Increasing the concentration of sodium metabisulfite and drying time had an effect on ash content.

The relationship between the addition of sodium metabisulfite and the drying time showed an increase of ash content along with the increase of sodium metabisulfite concentration and drying time. This was presumably because the more concentration of sodium metabisulfite increased, the number of sodium ions and carbonate compounds which were inorganic salts was also increasing.

![Figure 3 Ash Content of Coconut Sugar in Various Treatments Addition of Na2S2O5 Concentration and Drying Time](image)

The ash content was determined by the type of material and how it was dusted. Ash content which was a constituent of minerals consisted of organic and inorganic salts. Organic salts consisted of malic, acetic, pectic acids, while inorganic salts included phosphate, carbonate, and chloride salts. The drying time would further reduce the moisture contents, it would increase the ash content of the material.

3.1.4. Production Yield. The addition of sodium metabisulfite concentration and drying time had a significant effect on the yield of coconut sugar. The results of the analysis of the average yield of coconut sugar ranged from 81 - 83%, can be seen in the following Figure 4.
Figure 4. Rendemen of Coconut Sugar in Various Treatments
Addition of Na2S2O5 Concentration and Drying Time

Based on Figure 4, it could be seen that the yield was influenced by the addition of sodium metabisulfite concentration and drying time. The higher metabisulfite concentration was added, the crystallization process would immediately occur and the reducing sugar would be lower. In addition, the combination of drying time would reduce the water content. It could be concluded that the lower water content, the lower reducing sugar content, resulting in a high yield of coconut sugar.

The yield of sugar was also influenced by the making process, when the crystallization process was difficult because of the sugar inversion, the coconut sugar did not crystallize quickly and stick to the crystallizer so it would decrease the yield value. In addition, during the drying process, if the sugar inversion had occurred, the sugar melt easily and contains high water, so it did not dry out quickly. This would have an impact on the milling process (size reduction) so that it did not pass the 20 mesh sieve and this was not counted as a yield value.

3.2. Organoleptic properties

3.2.1. Color. The results of the color preference level of the coconut sugar with the addition of sodium metabisulfite and drying time ranging from 3 - 4.5 which could be seen in the following figure 5

Figure 5. Color Preference of Coconut Sugar in Various Treatments
Addition of Na2S2O5 Concentration and Drying Time

The heating process caused a browning reaction between the sugar components and amino acids which was causing the color changes of the coconut sugar products. The addition of sodium metabisulfite would increase the pH and accelerate the crystallization process so that the process would
be shorter and long contact with heat could be avoided. This would prevent the browning process or other reactions that caused a discoloration.

3.2.2. Taste. The level of preference for the panelists to the taste of coconut sugar showed a mean value between 3.5-4.3, which was between somewhat like to like it can be seen in Figure 6. The addition of sodium metabisulfite with a concentration of 0.1% to 0.3% did not have a significant effect on taste, this was presumably due to the use of a relatively small concentration range of sodium metabisulfite and a low concentration interval. In general, giving an excess concentration of sodium metabisulfite could cause a bitter taste.

![Figure 6. Taste Preferens of Coconut Sugar](image1)

![Figure 7. Aroma Preferens of Coconut Sugar](image2)

3.2.3. Aroma. The aroma of coconut sugar produced ranged from 3.5 and 4.2, which meant between slightly like to like, it could be seen in Figure 7. The heating process of coconut sap became thick sugar, causing a caramel aroma. The cooking process caused both enzymatic and non-enzymatic browning which was able to produce a caramel aroma that is liked by the panelists. The addition of sodium metabisulfite concentration did not affect the resulting aroma because the nature of this material was odorless so that it did not affect the resulting aroma, but it had limitations. The use of sodium metabisulfite had relatively no effect on taste, color and aroma.

4. Conclusion
The best treatment according to chemical and organoleptic properties was obtained from the treatment of coconut sugar with the addition of 0.2% sodium metabisulfite concentration and 15 minutes of drying time. The best coconut sugar with water content of 2.41%, reducing sugar content of 3.34% and ash content of 1.77 and 82% yield. Organoleptic properties on color, taste, aroma was at the same value.

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