The Effect of Ca(OH)2 Addition and Cooking Process to Chemical Characteristic of Palm Sap Sugar (Arenga pinnata) Produced by Crytallisator

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Abstract. Palm sap is the liquid extracted from the sap-producing tree which is obtained by tapping. Palm sap is processed into palm sap sugar to increase its selling value and quality. The process of making palm sap sugar is time consuming, therefore the innovation of palm sap sugar, which is processed into powder form, produces a product that is more practical to use. A simple technology that can be used to make palm sap sugar is a crystallizator. In this study, the manufacture of sugar was carried out using the palm sap heating method with variations in pH (6, 7, 8) and cooking temperature (92, 98, 104, 110)°C. From several treatments conducted, the preferred results were 1,02 % water content, 1,80 % ash content, 87,81 % sucrose content, and negative Pb metal content which met the Indonesian National Standards.

Keywords: Palm Sap Sugar, Palm Sap, Crystallizator

1. INTRODUCTION

Indonesia is an agricultural country where the majority of its people live in the agricultural sector. These agricultural products have an important role in people's lives. One of them is as raw material in industry, from micro, small and medium enterprises (MSMEs) to large industries. In this case, one of the highlights is agricultural products such as palm sap which is used as an ingredient for making brown sugar.

Annually, the demand for brown sugar in South Sumatra increases. However, the quality of palm sap sugar is still relatively low. From the results of observations, it was found that the molded sugar sold in market was not fulfilled the hygiene standard and the water content was still quite high. To improve the quality of palm sap sugar is to process molded palm sap sugar into powder form (ant sugar). The advantages of ant sugar include; longer storage, easy to carry, attractive packaging, and high selling price (Susi & Millati, 2021).

The ant sugar production process still mostly utilized manual technology with human power in the process, therefore it is very time consuming. This can have a fairly large impact on production costs. From previous research regarding the production of ant sugar, entitled "Effectiveness of Making Ant Sugar Using Conventional and Modern Methods" it can be concluded that the manufacturing process for making ant sugar requires quite a long time, approximately 5 hours or 329 minutes for the sap cooking process, crystallization, sieving and drying which mainly conduct manually by using human power (Agraini et al., 2022).

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To minimize the production process, in this research, a simple crystallizer conducted to streamline production time, obtain quality product results, and produce more products. A crystallizer is a powder making tool that is useful for producing food ingredients in various sizes. This tool has several advantages, namely short production time, non human labor especially to stir the ingredients, and produces higher quality ant sugar products compared to molded sugar.

2. LITERATURE REVIEW

Palm sap sugar is collected from different varieties of palm trees. It has a wide range as an alternative sweetener in the Indonesian market because its natural origin. It is an alternative to unhealthy cane sugar and is also more beneficial for farmers (Sarkar et al, 2023). Indicators commonly used to evaluate the quality of palm resin are pH which indicates the acid content in the juice and color which indicates the quality and hygiene level of the juice (Ansar et al., 2022). This quality indicator is very sensitive and easily damaged by temperature effects. The reduced pH quality of palm sap is due to acid fermentation which quickly converts it to alcohol. Natural palm sap contains the enzyme amylase which is then converted into alcohol (Ansar et al., 2022). The density and particle size of palm sugar are lower and less uniform than sucrose, respectively (Saputro et al., 2020).

Some sugars in palm sap have a variety of physicochemical properties due to differences in raw materials and processing methods used by sugar manufacturers (Hartono, 2019). The extent of non-enzymatic reactions that occur during sugar production, specifically the Maillard reaction and caramelization reaction, is theoretically responsible for the varying levels of crude protein and reducing sugars present in palm sap sugar (Saputro et al., 2020). Currently, the traditional way of processing palm resin has lower yields and higher costs. There is great potential in the field of developing processing techniques (traditional processing, spray drying, membrane technology and vacuum drying) to optimize palm sugar production (Sarkar et al, 2023).

3. RESEARCH METHOD

Palm sap was filtered and added with $Ca(OH)_2$ until reached determined pH (6~8). Each sample was cooked to obtain viscous texture and then cooled until slightly hardened. Continuous mixing was conducted using crytallizator equipment (Fig. 1) to convert the texture of palm sap sugar into crystal or powder form. Crystallized palm sap sugar was then sieved manually to homogenize the size of crystal followed with drying process under the sun for 30 minutes to reduce water content.

Figure 1. Crystallizator Equipment

Each sample with different amount of Ca(OH)2 addition (Fig. 2, pH 6 8) was then evaluated for their chemical characteristics.

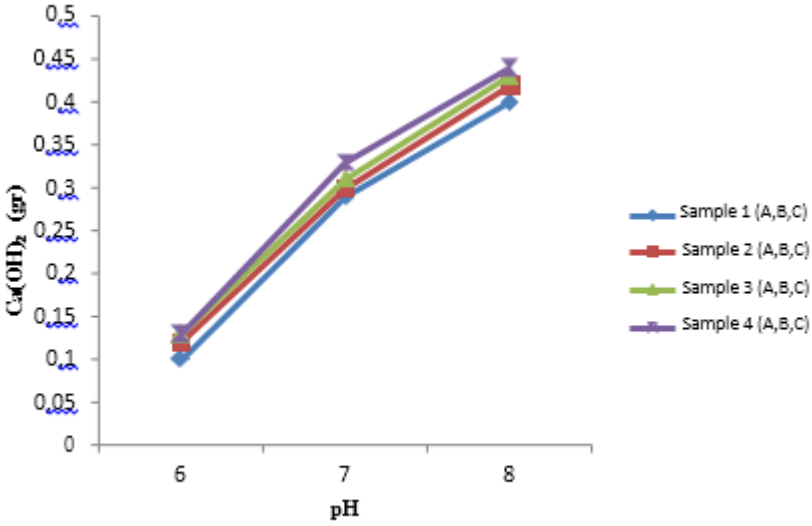

Figure 2. The amount of $Ca(OH)_2$ to Different pH of Palm Sap Sugar Obtained (Sample A, B, C)

4. RESULTS AND DISCUSSION

Natural fermentation can occur before sugar processing, leading to physical and microbiological changes. The fermentation process consists of three stages, first is lactic fermentation, followed by alcoholic fermentation and finally acetic fermentation (Sarkar et al., 2023). This condition leads to decrease of pH. The addition of $Ca(OH)_2$ increases pH of palm sap sugar (Sudarmaji & Saroso, 2023). It is known that the initial pH of palm sap sugar freshly extracted from palm sap was in range of 5-5.3. Based on Fig. 2, 0.44 g of $Ca(OH)_2$ was able to adjust the pH into 8. The pH quality of palm sap has decreased significantly ($p<0.05$) since tapping. Ansar et al. (2022) evaluated that the pH quality of palm resin decreased after 10 hours of storage.

Furthermore, recent research has investigated the effect of cooking temperature to percentage of crystal forming of palm sap sugar. Based on Figure 3, result showed that higher temperature cooking produced higher percentage of palm sap sugar crystal. The highest crystal formed was 94% for sample B (pH 7). It is also exhibited that pH above 7 disrupted the forming of crystal that sample C was showed the lowest crystal percentage for each cooking temperature. High pH was known to unstabilize the forming of crystal.

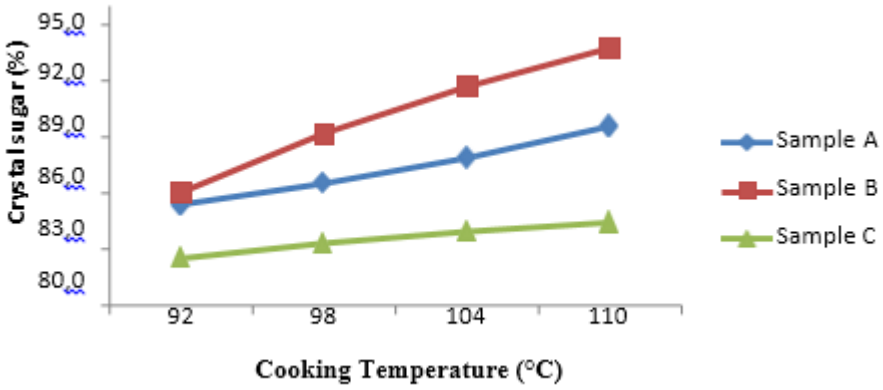

Figure 3. The Effect of Cooking Temperature to Percentage of Crystal Sugar

The SNI 3743:2021 of palm sap sugar water content is maximum of 3% (BSN, 2021). All samples was fulfilled the standard for cooking temperature above 95°C in the range of 1,02-2.17% (Figure 4). The cooking temperature below 95°C was not sufficient to evaporate water from palm sap sugar crystal. Ash content, on the other hand, represents the mineral content, which is undesirable in palm sap sugar products. It can define whether the manufacturing process is properly conducted (Fikriyah & Nasution, 2021).

The analysis of ash content showed result as presented in Figure 4 (right). Refer to SNI 3743:2021, ash content is determined to maximum of 2.5% for ant sugar.

Based on Figure 4, all samples have fulfilled the standard, which is in range of 1,23 % - 2,06 %. It also can be seen form the result that higher pH will result to higher ash content due to the addition of $Ca(OH)_2$. It is in agreement with Yuwana dkk. (2022). In this research, $Ca(OH)_2$ was used to reduce acidity of palm sugar (Sriwahyuni dkk., 2022).

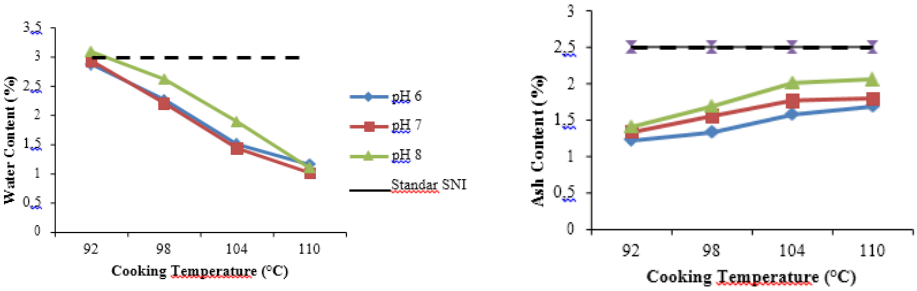

Figure 4. The Effect of Temperature and pH to Water Content (left) and Ash Content (right) of Palm Sap Sugar Crystal

Figure 5 showed the sucrose content of palm sap sugar produced. It was in range of 84,32 – 87,81 %. These sucrose content result was higher than national standard (SNI 3743:2021). The nutritional composition of palm sap sugar varies widely depending on factors such as species, genus, geographical area of growth, time of exploitation and variety (Sarkar et al.,2023). Of the total sugar content in palm tree sap, sucrose accounts for the largest amount, followed by glucose, fructose, inositol and raffinose in small amounts. Pontoh (2019) stated that sucrose content was highly affected by pH value and the amount of organic acid produced by microorganism in ant sugar. Therefore, the effect of higher pH plays an important role in this research. The hygiene and proper method was proven well conducted in the manufacturing process thus the contamination can be minimized.

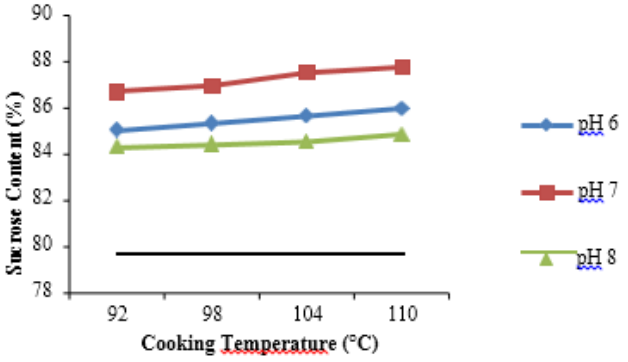

Figure 5. The Effect of Temperature and pH to Sucrose Content of Palm Sap Sugar Crystal

Cooking temperature, on the other hand, did not affect significantly to the sucrose content. Nearly stable result was shown for each sample in different cooking temperature. However, other researc showed that high temperature might release amino acid substrates which may catalyze sucrose to monosaccharides (Sarkar et al., 2023). Temperature also has effect on the decrease of pH parameters which decrease sucrose stability in the sap (Ansar et al., 2022).

Final analysis was the evaluation of heavy metal content, that is lead (Pb). Pb is heavy metal that have a harmful effect on human health. All samples showed negative result on Pb analysis. It can be stated that the equipment utilized in the research has reached standard of inexistence of harmful heavy metal contamination.

5. CONCLUSION

Palm sap sugar was successfully produced using crystallizator equipment. Best treatment was the addition of 0,31 gram $Ca(OH)_2$ for reaching pH 7. Cooking process at temperature 110°C was the optimum condition for producing palm sap sugar. The chemical characteristic of the product was water content of 1,02 %, ash content of 1,80 %, negative Pb analysis and sucrose content of 87,81 %, which fulfilled the standard of SNI 3743:2021

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