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# Physical, Chemical and Sensory Properties of Liquid Palm Sugar With The Addition of Canvas Seeds and Coconut Oil

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**Abstract :**
The common form of palm sugar is usually in solid form and needs to be dissolved before use. To facilitate utilization, palm sugar is processed into liquid palm sugar. One of the issues encountered during the production of liquid palm sugar is the formation of foam, which can decrease the quality of the liquid palm sugar. Therefore, measures are needed to anticipate foam formation, including the addition of candlenut seeds and coconut oil. This study aims to determine the influence of the addition of candlenut seeds and coconut oil on the physical and chemical characteristics of liquid palm sugar, identify the optimal levels of candlenut seeds and coconut oil that meet the national standard (SNI) for liquid palm sugar, and produce a liquid palm sugar product preferred by consumers. The research employed a Randomized Complete Block Design (RCBD) with a single factor and six treatment levels of candlenut seeds and coconut oil (0%, 0.1%, 0.3%, 0.5%, 0.7%, and 0.9%). Data analysis was conducted using Analysis of Variance (ANOVA). Based on the research results, the addition of candlenut seeds and coconut oil significantly influenced the viscosity of liquid palm sugar but had no significant effect on its color and moisture content. The addition of candlenut seeds and coconut oil had a significant impact on the chemical quality of liquid palm sugar, affecting ash content and total insoluble solids but showing no significant effect on pH and total dissolved solids. The treatment with 0%, 0.1%, and 0.3% additions of candlenut seeds and coconut oil met the quality requirements for moisture content, while the ash content in the 0%, 0.1%, and 0.3% treatments also complied with the standards. The addition of 0.9% candlenut seeds and coconut oil resulted in liquid palm sugar that met both SNI standards and consumer preferences.

**Keywords** : Candlenut Seed, Coconut Oil, Liquid Palm Sugar

## 1. Introduction

Traditionally, people process sap into palm sugar, which is generally produced in solid sugar form, but some is also produced in liquid sugar form. Palm sugar has many advantages, such as a much higher price and a more fragrant aroma compared to granulated sugar in general. Palm sugar in solid form is dissolved first before use, this is an inefficient practice for both consumers and producers of palm sugar. To make it easier to use and diversify its uses, palm sap can be processed into liquid sugar. Processing liquid sugar from palm sap can also reduce production costs because it shortens production time and saves workers' energy (Lubis et al., 2013)

The food and beverage industry uses liquid sugar a lot because it has several advantages, including that liquid sugar does not crystallize, is easier to process because it dissolves more easily, is more practical, and has an attractive appearance compared to sugar in general (Ratna & Yulistiani, 2015). The problem that often occurs during the process of making liquid sugar is the appearance of foaming or foam that is white to yellowish in color, this can cause a decrease in the quality of the liquid sugar itself.

Research conducted by (Marsigit, 2005) on the use of sap additives and the quality of molded palm sugar produced in several production centers in Bengkulu, proved that the addition of candlenut seeds and coconut oil was 2.54 g and 1.28 mL of coconut oil/L Palm sap produces the best red palm sugar by

producing 8.6% water content, 1.3% ash content, 1.7% insoluble solids, 8.6% reducing sugar, 85.3% sucrose, with the longest shelf life of 89.5 days compared to other additives such as castor beans and detergent.

Issoesetyo and Sudarto (2001) stated in research (Marsigit, 2005) that the addition of oil and fat found in candlenut seeds and coconut oil in the sugar processing process functions to reduce foaming in sugar. Therefore, candlenut seeds and coconut oil were chosen as anti-foam during the process of making liquid sugar and as a sugar preservative medium to inhibit the growth of bacteria in liquid sugar. However, the amount of candlenut kernels and coconut oil added to make liquid sugar is not yet known. In this research, candlenut seeds and coconut oil were used as additional ingredients in the process of making liquid palm sugar with the aim of observing the effect of adding candlenut seeds and coconut oil used on the physical, chemical and organoleptic quality of the liquid palm sugar, determining the addition of candlenut seeds and coconut oil. which can produce quality liquid palm sugar according to SNI, as well as produce liquid and organoleptic palm sugar products that consumers like.

## 2. Research Methods

### Materials

The tools used in this research were a gas stove, frying pan, stirrer, filter, glass bottle, pan, Kern 440-35N analytical balance, Memmert oven, desiccator, porcelain cup, ATC pH meter, Munsell color chart for plant tissue, Erlenmeyer Pyrex, Pyrex beaker, measuring cup, stir bar, ATC hand refractometer, Ostwald viscometer, dropper pipette, filter paper. The main ingredients used in this research are palm sap obtained from Pagu City Village, Rejang Lebong Curup Regency, candlenut seeds, coconut oil and distilled water.

### Research Design

The experiment used a randomized block design (RAK) with the basis of grouping being the day of manufacture. Grouping considerations were based on the length of the process of producing liquid palm sugar and the distance to collect the liquid palm sugar raw materials. This research uses one factor with 6 levels of the addition of candlenut seeds and coconut oil (0%, 0.1%, 0.3%, 0.5%, 0.7%, and 0.9%) and 3 replications.

### Preparation of Candlenut Seeds

The candlenut seeds must be in good shape with no defects. The candlenut seeds were peeled from their shells completely. The whole candlenut seeds were washed, dried and ground by grating, pounding or blending.

### Preparation of Coconut Oil

Coconut oil was produced using the wet method. The coconut flesh was grated and extracted using warm water (ratio grated coconut : water = 1:1). Then the coconut extract was heated to break the emulsion using high temperature initially and gradually increased. The oil was separated from its cakes by filtration and pressing the remaining cakes (Aminah & Supraptini, 2010). This method will produce oil that smells good, but the color is less clear due to the use of heat in the processing process.

### Preparation of Liquid Palm Sugar

Liquid palm sugar was made from palm sap obtained from farmers, filtered and cooked for 1 hour at a temperature of 100$^{o}$C. During the cooking process the sap will produce foam, then add candlenut seeds and coconut oil as anti-foam. After 1 hour the temperature was reduced to a temperature of 90$^{o}$C, stir continuously until the sap turned into desired viscosities. The liquid was cooled and stored in a bottle.

### Water Content

The water content of liquid palm sugar is determined by drying in a vacuum oven. The aluminum cup was dried at 105oC for 30 minutes then cooled in a desiccator and weighed using an analytical balance. A total of 3 g of sample was placed in the cup and then heated in a vacuum oven at a temperature of 70$^{o}$C, 25

mmHg for 2 hours then cooled in a desiccator and then weighed. Heating is repeated until a constant weight is obtained (AOAC, 2005).

Water content is calculated by the equation:

$$\text{Water content (\%)} = \frac{W-(W_1-W_2)}{W}\ x\ 100\%$$

Note:
W = Weight of sample before drying (g)
$W_1$ = sample weight + cup after drying (g)
$W_2$ = weight of empty dry cup (g)

**Color**

Color was observed using the Munsell Color Chart for Plants Tissue by comparing the sample color with the Munsell Color for Plants Tissue color. The numbers listed on Munsell Color for Plants Tissue are a color spectrum of three variables, namely: (1) hue, (2) value, and (3) chroma. Hue is a color spectrum (red, green, or yellow) with its wavelength. Value indicates how dark a color is according to the amount of light reflected. Chroma is defined as a gradation of purity from the degree of color differentiation/color intensity (Winarno, 2002).

**Viscosity**

Viscosity was determined using an Ostwald viscometer by inserting the sample into the Ostwald viscometer through tube P. Then the sample is sucked into tube Q until it passes mark a, and allowed to flow through the boundary. The time was counted when the liquid flows past the upper limit (mark a) to the lower limit (mark b). The time required for the fluid to pass from the upper boundary to the lower boundary is recorded. To avoid errors in practice, it is necessary to carry out calibration using a reference fluid. The fluid most often used is distilled water. For two different liquids with the same measurement tool, it can be calculated by equation below (Apriani et al., 2013).

$$\frac{\eta_1}{\eta_2} = \frac{\rho_1\, x t_1}{\rho_2 x t_2}$$

Note:
$\eta_1$ = Viscosity of reference fluid (cP)
$\eta_2$ = Viscosity of sample fluid (cP)
$\rho_1$ = Comparative Density (g/ml)
$\rho_2$ = Sample Density (g/ml)
$t_1$ = Comparison Time (s)
$t_2$ = Sample Time (s)

**pH**

Determination of pH is carried out using a pH meter which is measured at room temperature. Previously, the pH meter was calibrated using standard buffer solutions at pH 4.0 and pH 7.0. 2 g of the sample to be measured is poured into a 10 mL beaker and then the pH is measured by dipping the pH electrode in the sample. Reading the pH value in a pH meter is carried out when the pH value is constant and has not changed (AOAC, 2005).

**Ash Content**

Ash content analysis was carried out using the oven method. The principle is the burning or ashing of organic materials which are broken down into water ($H_2O$) and carbon dioxide ($CO_2$). The substances, which are not burned, are inorganic substance called ash. The ash content analysis procedure is as follows: the cup to be used is first oven-treated for 30 minutes at a temperature of 100-105$^oC$, then cooled in a

desiccator to remove water vapor and weighed (A). The sample was weighed in 2 g of a dried cup (B) then burned over a burner flame until there was no smoke and continued with ashing in a furnace at a temperature of 550 -600ºC until complete ashing. The ash was further cooled in a desiccator and weighed (C). The combustion stage in the furnace was repeated until a constant weight was obtained. Ash content was calculated using the equation below (AOAC, 2005).

$$\% \text{ Ash Content} = \frac{C-A}{\text{B}-\text{A}} x\ 100\%$$

Note:
A = Weight of empty cup expressed in grams
B = Weight of cup + initial sample expressed in grams
C = Weight of cup + dry sample expressed in grams

**Total Dissolved Solids**

The total dissolved solids of liquid palm sugar in this study were determined using a refractometer. Calculation of total dissolved solids was carried out by weighing 1 g of the material, dissolving it in 3 mL of distilled water. Then the solution is taken using a dropper pipette, the substrate is dropped on the hand refractometer glass and the light and dark points are seen. Total dissolved solids are expressed as 0Brix by multiplying the retail factor (Sudarmadji, 1997).

**Total Insoluble Solids**

The total insoluble solids in this study were determined by weighing 50 g of the material, then placing it in a 400 ml beaker, then adding 200 ml of hot water, stirring until dissolved. After that, when hot, pour the sample into empty filter paper which has been weighed, then the part that is not dissolved in the filter paper is placed in the oven at 1050C for 2 hours, cool and weigh until the weight remains (BSN, 1992).
Calculation:

$$\text{Part that is insoluble in water} = \frac{W_1-W_2}{W}\ x\ 100\%$$

Note:
W = Sample weight
W1 = Sample weight + oven-baked filter paper
W2 = Weight of empty filter paper

**Organoleptic Test**

This research was carried out using a hedonic test on a scale of 1-5 (very dislike, dislike, neutral, like and very like) to determine the level of consumer preference for color, aroma, texture, taste and overall resulting from the research (Setyaningsih, et.al., 2010).

**Data Analysis**

The data obtained were analyzed statistically using ANOVA in the SPSS 22 application program with a significance level of 5%, then if there was a real effect between treatments, it was continued with Duncan Multiple Range Test (DMRT) analysis at the same significance level.

## 3. Results and Discussion

**Reducing Liquid Palm Sugar Froth**

The results of the analysis of observations of the reduction in foam in liquid palm sugar showed that the highest reduction in foam in liquid palm sugar was found in the addition of candlenut seeds and coconut oil, namely 0.9% to 45.50%. Meanwhile, the lowest analysis result was found in the addition of candlenut seeds and coconut oil, namely 0% because it had no effect on reducing the foam of liquid palm sugar. The results of the analysis of observing the reduction in foam in liquid palm sugar can be seen in Figure 1.

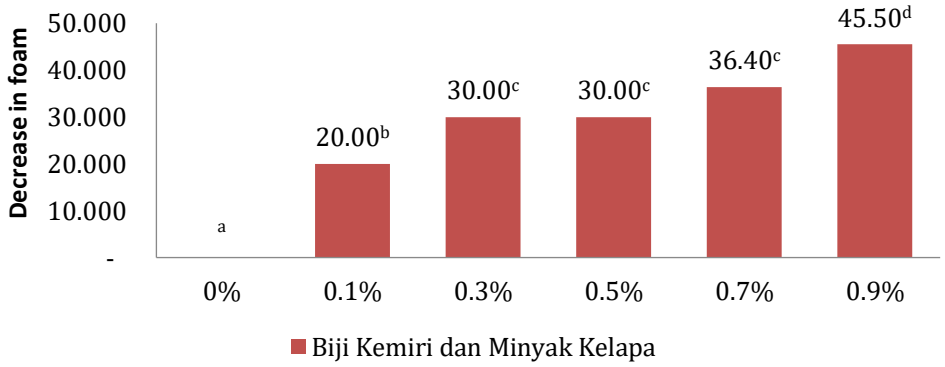


Figure 1. Decrease in the height of liquid palm sugar foam with various additions of candlenut seeds and coconut oil.

The results of the 5% Analysis of Variances (ANOVA) showed that the grouping of days for making liquid palm sugar had no significant effect on the reduction in liquid palm sugar foam with a significant value of 0.89 greater than 0.05 and each treatment of adding candlenut seeds and coconut oil had a significant effect on decrease in liquid palm sugar foam with a significant value of 0.00, smaller than 0.05. Figure 1 shows that the more candlenut kernels and coconut oil are added, the decrease in foam in liquid palm sugar increases, whereas without the addition of candlenut kernels and coconut oil in making liquid palm sugar there is no effect on the reduction in liquid palm sugar foam. Adding oil can reduce the foam that forms. The more oil you add, the higher the foam will decrease (Yanto & Naufalin, 2012).

**Water content**

The results of the water content analysis showed that the highest water content of liquid palm sugar was found in the treatment with the addition of candlenut seeds and coconut oil, namely 0% to 12.00%. Meanwhile, the lowest analysis results were found in the treatment with the addition of candlenut seeds and coconut oil, namely 0.9% and 5.33%. The results of the analysis of the water content of liquid palm sugar can be seen in Figure 2.

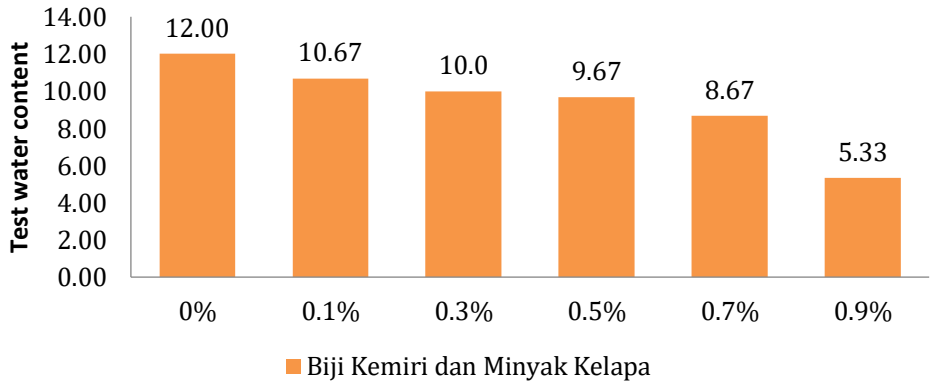


Figure 2. Water Content of Liquid Palm Sugar in Various Additions of Candlenut Seeds and Coconut Oil.

The results of the 5% Analysis of Variances (ANOVA) show that the grouping of days for making liquid palm sugar has no significant effect on the water content of liquid palm sugar with a significant value of 0.94 which is greater than 0.05 and for each treatment the addition of candlenut seeds and coconut oil also has no effect. significant to the water content of liquid palm sugar with a significant value of 0.50, greater than 0.05. The results of the research show that the water content of liquid palm sugar in this study meets the quality requirements ranging from 5.33% -12.00% and does not exceed the maximum standard, so this liquid palm sugar has good quality. The water content in a material plays a role in chemical reactions, enzymatic changes or the growth of microorganisms. This generally occurs at high water levels and will influence

environmental factors such as pH and temperature. Water content affects the overall quality and stability of the product (Zohratun, 2017).

**Color**

Testing the color of liquid palm sugar uses Munsell color charts for plant tissues, color testing can be expressed using notations (symbols), color notations can be expressed using quantitative language. The value value shows the darkness of the color, the smaller the number, the darker the color, chroma shows the intensity of the color, the higher the number, the brighter the color.

Table 1. Color Test Results for Liquid Palm Sugar Using Munsell Color Charts for Plant Tissues

| Treatment | Sugar color | Color Munsell color | Value Munsell color |
|---|---|---|---|
| Addition of candlenut kernels and 0% coconut oil |  | | 5Y 9/3 |
| Addition of candlenut kernels and 0.1% coconut oil |  | | 5Y 8/6 |
| Addition of candlenut kernels and 0.3% coconut oil |  | | 5Y 7/6 |
| Addition of candlenut kernels and 0.5% coconut oil |  | | 5Y 7/8 |
| Addition of candlenut kernels and 0.7% coconut oil |  | | 5Y 6/6 |
| Addition of candlenut kernels and 0.9% coconut oil |  | | 5Y 5/6 |

The results of color test research on liquid palm sugar using the Munsell color chart for plant tissues show that the more candlenut seeds and coconut oil are added in the process of making liquid sugar, the browner the color will be, as well as the organoleptic test results for liquid palm sugar, the more candlenut seeds and coconut oil, the resulting color becomes browner and the panelists' liking for the color increases. In the discussion of organoleptic tests, the darker (brown) the color of liquid palm sugar, the level of preference for the color increases. The brown color of liquid palm sugar occurs due to non-enzymatic browning reactions that occur during the manufacturing process, namely caramelization and Maillard. The Maillard reaction is a reaction that occurs between amino acids and reducing sugars when heated together to produce melanoidin compounds (Sukoyo et al., 2014).

**Viscosity**

The results of the viscosity analysis showed that the highest viscosity of liquid palm sugar was found when adding candlenut seeds and coconut oil, namely 0.9%, 98.29 cp. Meanwhile, the lowest analysis results were found in the addition of candlenut seeds and coconut oil, namely 0% (without additional ingredients) amounting to 48.77 cp. The results of the viscosity analysis of liquid palm sugar can be seen in Figure 3.

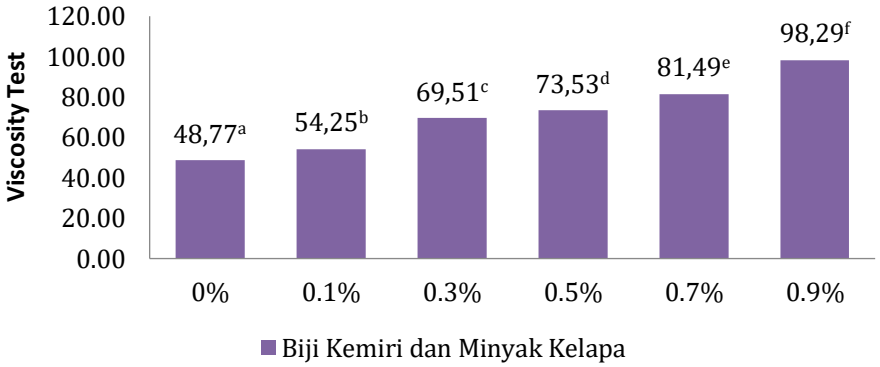


Figure 3. Viscosity of Liquid Palm Sugar with Various Additions of Candlenut Seeds and Coconut Oil

The results of the 5% Analysis of Variances (ANOVA) show that the grouping of days for making liquid palm sugar has no significant effect on the viscosity of liquid palm sugar with a significant value of 0.70 greater than 0.05 and each treatment with the addition of candlenut seeds and coconut oil has a significant effect on viscosity. liquid palm sugar with a significant value of 0.00 which is smaller than 0.05. Based on research (Sukoyo et al., 2014) it is stated that the higher the Brix degree value will cause an increase in viscosity. The longer the evaporation time will cause an increase in viscosity. This is because more and more water will evaporate and the total dissolved solids will increase, so that the viscosity will increase (Diniyah et al., 2012).

**pH of Liquid Palm Sugar**

The results of the pH analysis of liquid palm sugar showed that the highest pH of liquid palm sugar was obtained in the treatment with the addition of candlenut seeds and 0.9% coconut oil, namely 7.03. Meanwhile, the lowest pH of liquid palm sugar was obtained in the treatment with the addition of candlenut seeds and 0% coconut oil, namely 6.83. The results of the analysis of the pH value of liquid palm sugar can be seen in Figure 4.

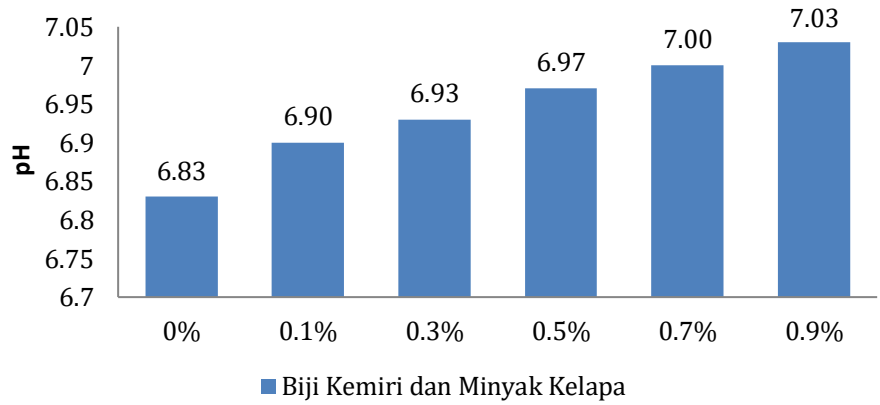


Figure 4. pH of Liquid Palm Sugar with Various Additions of Candlenut Seeds and Coconut Oil

The results of the 5% Analysis of Variances (ANOVA) showed that the grouping of days for making liquid palm sugar had an insignificant effect on the pH of liquid palm sugar with a significant value of 0.62, greater than 0.05 and each treatment with the addition of candlenut seeds and coconut oil also had an insignificant effect. on the pH of liquid palm sugar with a significant value of 0.16, greater than 0.05. Figure 4 shows that the more candlenut seeds and coconut oil are added, the higher the pH will be. This is caused by the more added candlenut seeds and coconut oil, the higher the antimicrobial content so that it can prevent inhibition of microbial growth. This is in accordance with the statement (Tanra et al., 2019) that the higher the concentration of natural preservatives, the higher the pH of the sap. .

**Ash Content**

The results of the analysis of the ash content of liquid palm sugar showed that the highest ash content of liquid palm sugar was obtained in the treatment with the addition of candlenut seeds and 0.9% coconut oil, namely 1.83%. Meanwhile, the lowest ash content of liquid palm sugar was obtained in the treatment with the addition of candlenut seeds and 0% coconut oil, namely 0.67%. The results of the liquid palm sugar ash content test analysis can be seen in Figure 5.

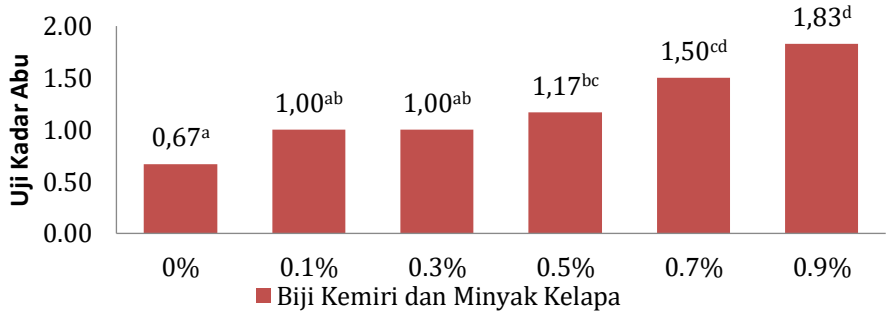


Figure 5. Ash content of liquid palm sugar in various additions of candlenut kernels and coconut oil

The results of the 5% Analysis of Variances (ANOVA) show that the grouping of days for making liquid palm sugar has a significant effect on the ash content of liquid palm sugar with a significant value of 0.00 which is smaller than 0.05 and each treatment with the addition of candlenut seeds and coconut oil also has a significant effect on The ash content of liquid palm sugar with a significant value of 0.00 is smaller than 0.05. According to SNI standards, the maximum ash content in glucose syrup is 1%. The ash content of liquid palm sugar that meets the requirements in this research is the treatment with the addition of candlenut seeds and coconut oil of 0%, 0.1% and 0.3%, while the one that does not meet the quality standards is the treatment with the addition of candlenut seeds and 0.5% coconut oil. , 0.7% and 0.9%. The ash content does not meet the quality requirements because the greater the amount of candlenut kernels added to the liquid palm sugar, the more minerals will be produced.

**Total Dissolved Solids`**

Total dissolved solids analysis aims to measure the amount of solids dissolved in water. The results of the analysis of the total dissolved solids of liquid palm sugar with the addition of candlenut seeds and coconut oil showed that the total dissolved solids value was between 61.33% -68.13% Brix. The results of the total dissolved solids analysis can be seen in Figure 6.

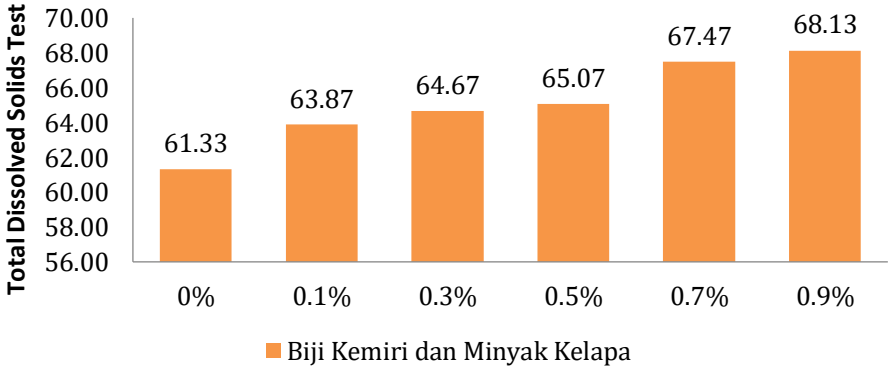


Figure 6. Total Dissolved Solids of Liquid Palm Sugar with Various Additions of Candlenut Seeds and Coconut Oil

The results of the 5% Analysis of Variances (ANOVA) showed that the grouping of days for making liquid palm sugar had an insignificant effect on total dissolved solids with a significance value of 0.18 greater than 0.05 and the treatment of adding candlenut seeds and coconut oil also had an insignificant effect on the value. the significance of 0.58 is greater than 0.05. Figure 6 shows that the more candlenut kernels and coconut oil are added, the higher the total dissolved solids will be. Even though it had no real effect, the addition of candlenut kernels and coconut oil tended to increase the total dissolved solids of liquid palm sugar. This addition can inhibit fermentation by very active yeast where fermentation will not stop until the sap has been converted. The total dissolved solids in liquid palm sugar decreases with the lesser amount of candlenut kernels and coconut oil used.

**Total Insoluble Solids**

The results of the analysis of the total insoluble solids of liquid palm sugar show that the highest total insoluble solids of liquid palm sugar was obtained when adding candlenut seeds and 0.9% coconut oil, namely 3.40%. Meanwhile, the lowest total insoluble solids of liquid palm sugar was obtained when adding candlenut seeds and 0% coconut oil, namely 1.07%. The results of the total dissolved solids analysis can be seen in Figure 7.

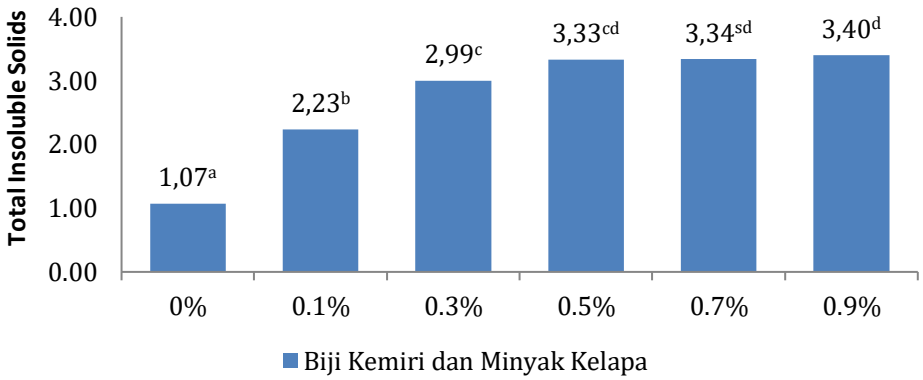


Figure 7. Total Insoluble Solids of Liquid Palm Sugar in Various Additions of Candlenut Seeds and Coconut Oil

The results of the 5% Analysis of Variances (ANOVA) showed that the grouping of days for making liquid palm sugar had no significant effect on the total insoluble solids of liquid palm sugar with a significant value of 0.17 greater than 0.05 and each treatment with the addition of candlenut seeds and coconut oil had an effect. significant to the total insoluble solids of liquid palm sugar with a significant value of 0.00 which is smaller than 0.05. According to Faesal (1986) in research (Marsigit, 2005) stated that the water-insoluble solids in palm sugar consist of protein, high polymer carbohydrates and wax. The insoluble solids content in palm sugar which exceeds this standard is probably caused by the protein content, high polymer carnohydrates and wax derived from sap, candlenut kernels and coconut oil.

**Color**

The results of the organoleptic test showed that the panelists liked the color of the liquid palm sugar produced with an average value ranging between 3.08 (neutral to like it) – 4.04 (like it to really like it). The highest level of liking for the color of liquid palm sugar is found in the addition of candlenut seeds and coconut oil as much as 0.9%, namely 4.04 (like to very like), while the lowest value is found in the addition of candlenut seeds and coconut oil as much as 0% (without additional ingredients ) namely 3.08% (neutral to like). The organoleptic test results for the color of liquid palm sugar can be seen in Figure 8.

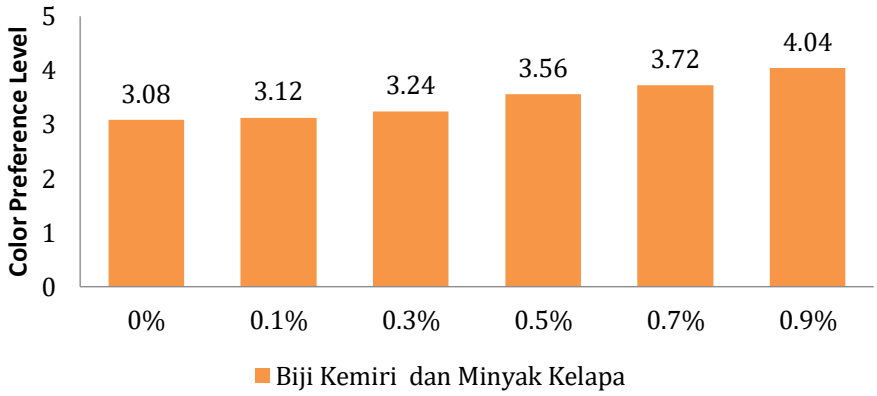


Figure 8. Color of Liquid Palm Sugar with Various Additions of Candlenut Seeds and Coconut Oil

The results of the Analysis of Variances (ANOVA) showed that the treatment with the addition of candlenut seeds and coconut oil had no significant effect on the level of panelists' liking for the color of the liquid palm sugar produced with a significant value of 0.89 which was greater than 0.05. The results of the organoleptic test showed that the panelists liked the color of the liquid palm sugar produced with an average value ranging between 3.08–4.04. The presence of foam when tapping or cooking sap into sugar causes imperfect browning, in accordance with the statement of Issoesetyo and Sudarto (2001) in research (Marsigit, 2005) stating that the addition of oil and fat ingredients in the sugar processing process functions to reduce foam. So in this study, the more candlenut seeds and coconut oil were added during the cooking process of liquid palm sugar, the less foam there was and the resulting liquid palm sugar color was preferred by the panelists (brown).

**Aroma**

The results of the organoleptic test showed that the panelists liked the aroma of the liquid palm sugar produced with an average value ranging between 3.40 (neutral to like) – 3.60 (neutral to like). The highest level of liking for the aroma of liquid palm sugar was found in the addition of candlenut seeds and coconut oil as much as 0.9%, namely 3.60 (neutral to like), while the lowest value was found in the addition of candlenut seeds and coconut oil as much as 0% and 0.1%. namely 3.40 (neutral to like). The results of the organoleptic test for the aroma of liquid palm sugar can be seen in Figure 9.

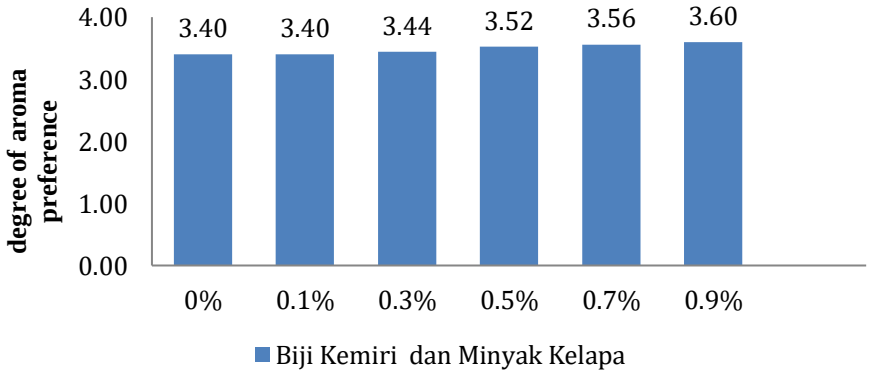


Figure 9. Aroma of Liquid Palm Sugar with Various Additions of Candlenut Seeds and Coconut Oil

The results of the Analysis of Variances (ANOVA) showed that the treatment with the addition of candlenut seeds and coconut oil had no significant effect on the level of panelists' liking for the aroma of the resulting liquid palm sugar with a significant value of 0.88 which was greater than 0.05. The results of the organoleptic test showed that the panelists' liking for the aroma of the liquid palm sugar produced was with

an average value ranging between 3.40–3.60, this is because the aroma of the sugar produced in this treatment was more dominant than the other treatments.

**Texture**

The organoleptic test results show the level of panelists' liking for the texture of the liquid palm sugar produced with an average value ranging between 3.52 (neutral to like) – 3.72 (neutral to like). The highest level of liking for the texture of liquid palm sugar was found in the addition of candlenut seeds and coconut oil as much as 0.9%, namely 3.72 (neutral to like). Meanwhile, the lowest value was found in the addition of candlenut seeds and 0% coconut oil (without additional ingredients), namely 3.52 (neutral to like). The results of the organoleptic test for the texture of liquid palm sugar can be seen in Figure 10.

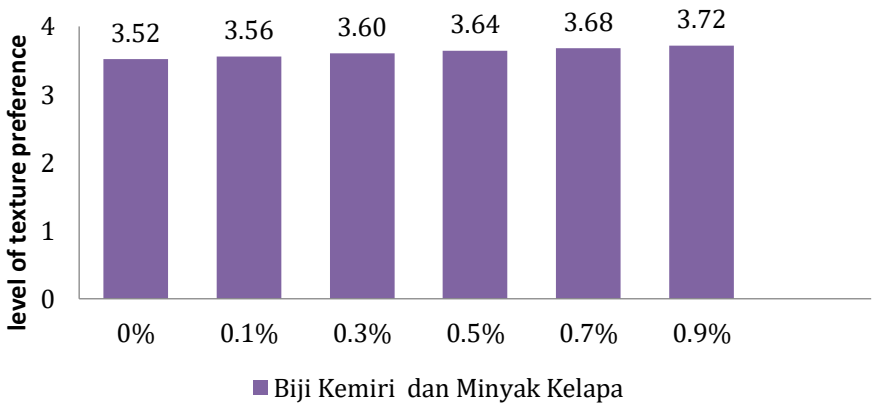


Figure 10. Texture of Liquid Palm Sugar with Various Additions of Candlenut Seeds and Coconut Oil

The results of the Analysis of Variances (ANOVA) showed that the treatment with the addition of candlenut seeds and coconut oil had no significant effect on the level of panelists' liking for the texture of the liquid palm sugar produced with a significance value of 0.90 which was greater than 0.05. The results of the organoleptic test showed that the panelists preferred the texture of the liquid palm sugar produced with an average value ranging from 3.52 to 3.72. The lower the water content, the better the quality of the liquid glucose because the viscosity value is high so the texture of the liquid glucose will be thicker.

**Flavor**

The results of the organoleptic test showed that the panelists' liking for the taste of liquid palm sugar was produced with an average value ranging between 3.52 (neutral to like) – 4.28 (like to very like). The highest level of liking for the taste of liquid palm sugar was found with the addition of candlenut seeds and coconut oil at 0% (without additional ingredients), namely 4.28 (liked to very like) while the lowest value was found for the addition of candlenut seeds and coconut oil at 0.9%. namely 3.52 (neutral to like). The results of the organoleptic test for the taste of liquid palm sugar can be seen in Figure 11.

The results of the Analysis of Variances (ANOVA) showed that the treatment with the addition of candlenut seeds and coconut oil had a significant effect on the level of panelists' liking for the taste of the liquid palm sugar produced with a significance value of 0.04, which was smaller than 0.05. The results of the organoleptic test showed that the panelists' liking for the taste of liquid palm sugar was produced with an average value ranging between 3.52–4.28. The graph of the panelists' preference for taste decreased with the addition of candlenut seeds and coconut oil because liquid palm sugar had a slightly bitter taste, it is suspected that this is the taste that the panelists did not like. Candlenut seeds contain chemical compounds in the form of saponins and tannins which have a bitter taste. Therefore, the more candlenut seeds and coconut oil added to liquid palm sugar, the more it gives a bitter taste so that the panelists' assessment of the organoleptic taste also tends to decrease.

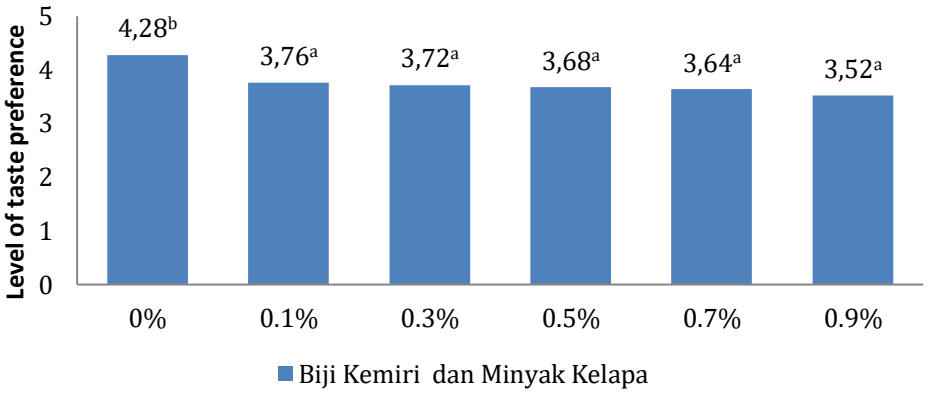


Figure 11. Taste of Liquid Palm Sugar with Various Additions of Candlenut Seeds and Coconut Oil

**Overall**

The overall organoleptic test is a combination of the previous parameters, namely color, aroma, texture and taste with an average liking value ranging from 3.44 (neutral to like) - 4.12 (like to very like) overall. The organoleptic test results for liquid palm sugar can be seen in Figure 12.

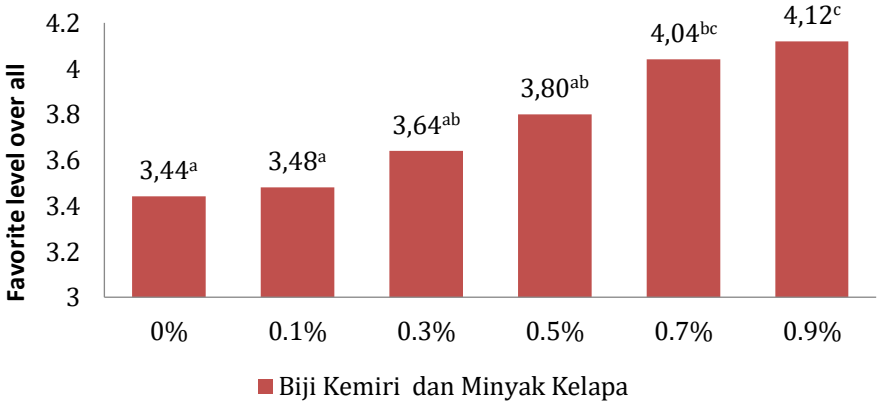


Figure 12. Over All Liquid Palm Sugar with Various Additions of Candlenut Seeds and Coconut Oil

The results of the Analysis of Variances (ANOVA) showed that the treatment with the addition of candlenut seeds and coconut oil had a significant effect on the level of panelists' preference for the overall liquid palm sugar produced with a significance value of 0.00 which was smaller than 0.05. The overall level of liking for organoleptic parameters including color, aroma and texture is increasing. The highest overall score for liquid palm sugar was the addition of candlenut kernels and 0.9% coconut oil which were liked by the panelists.

**Conclusion**

The addition of candlenut kernels and coconut oil to liquid palm sugar has a significant effect on the physical quality of viscosity, while the physical quality of water content and color has no significant effect. The addition of candlenut kernels and coconut oil to liquid palm sugar had a significant effect on the chemical quality of ash content and total insoluble solids, while the chemical quality of pH and total soluble solids had no significant effect. The treatment of adding candlenut kernels and coconut oil produces liquid sugar quality that complies with SNI 01-2978-1992, namely the treatment of adding candlenut kernels and coconut oil to the water content test. Meanwhile, the ash content test with the treatment with the addition of candlenut seeds and 0%, 0.1% and 0.3% coconut oil met the quality requirements but in the treatment with the addition of candlenut seeds and coconut oil 0.5%, 0.7% and 0, 9% do not meet quality requirements. The addition of candlenut kernels and coconut oil to liquid palm sugar for the panelists had a significant effect on

taste and overall, while the effect on color, aroma and texture was not significant. However, overall, from all levels of organoleptic preference, the panelists preferred liquid palm sugar with the addition of candlenut kernels and 0.9% coconut oil.

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