

## THE EFFECT OF KURUT WOOD (*Dysoxylum parasiticum*) AND JACKFRUIT WOOD (*Artocarpus heterophyllus*) ON THE NATURAL FERMENTATION OF PALM JUICE AND PALM SUGAR QUALITY

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**Abstract:** This study aims to determine the effect of the concentration of kurut wood and jackfruit wood on the yield, pH, and percentage of reducing sugars of palm sugar. This experiment used a completely randomized design (CRD) which consists of 6 treatments, i.e., 0 g/L, 3 g/L, 4 g/L, 5 g/L, 6 g/L, and 7 g/L. The data were analyzed by Analysis of Variance (ANOVA) using Co-Stat software and posthoc analysis for chemical score using Orthogonal Polynomial Method (MOP). Statistical analysis of chemical value shows that the increase in the concentration of kurut wood and jackfruit wood (0 g/L – 7 g/L) significantly affects the decrease of the total microbe and percentage of reducing sugars, and the increase of the amount of yield, palm juice, and sugar pH. The 7 g/L treatment was the best, with different analysis results for kurut wood and jackfruit wood. In kurut wood, the total microbes counted 5.46 CFU/ml; yield 495.33g; pH 6.72; and reducing sugar 0.96. In jackfruit wood, total microbes counted 5.6 CFU/ml; yield 386.33g; pH 6.68; and reducing sugar 0.85.

**Keywords:** *Jackfruit Wood, Kurut Wood, Palm Juice, Palm Sugar.*

### INTRODUCTION

The palm or palm tree (*Arenga pinnata*) is a plant that produces industrial materials that we have known for a long time. According to [1], almost all parts of the palm tree are useful and can be used for various needs, starting from the physical part (roots, stems, leaves, palm fiber) as well as the production results (sap, starch/flour, and fruit). One widely used is sap, which can be processed into sugar. Nira is a sweet liquid obtained from the stem juice or sap of flower bunches of plants such as sugarcane, beets, sorghum, maple, siwalan, dahlia flowers, and plants from the palm family such as sugar palm, coconut, nipa palm, sago, dates and so on [2]. The main components of palm sap consist of water, sucrose, reducing sugar, and other organic materials such as carbohydrates, proteins, fats, vitamins, and minerals [3].

The process of palm juice into palm sugar is a small business that has become the livelihood for some people in West Lombok Regency. Based on data from the Central Bureau of Statistics the province of West Nusa Tenggara in 2015, the production of palm sugar in the Province of West Nusa Tenggara from 2009 to 2014 was 258.30 tons; 220.25 tons; 217.41 tons; 225.79 tons; 227.08 tons and 211.3 tons, and the area planted with palm trees was 1070.43 Ha; 1075.80 Ha; 2038.10 Ha; 1015.51 Ha; 1007.57 Ha and 966.3 Ha. Especially for West Lombok Regency, palm sugar production was 39.1 tons, and the planting area was 210.3 hectares in 2014.

Nira is very easy to damage. The fermentation event causes this due to the growth of the yeast *Saccharomyces cerevisiae*, which comes from the air. The tapping and other contaminants contaminate the

palm sap on this roof during tapping [4]. Fermentation is a process of chemical change in an organic substrate through the activity of enzymes produced by microorganisms. In general, fermentation can be done in two ways: spontaneous and non-spontaneous. Microorganisms do not add spontaneous fermentation in the form of a starter or yeast in the manufacturing process. In contrast, non-spontaneous fermentation is added by a starter or yeast in the manufacturing process. Microorganisms grow and develop activities to change the fermented material into the desired product in the fermentation process [5]. Various air, food, raw materials, and water microorganisms can contaminate the sap. On continuous use of equipment for a long period, the initial microorganisms will multiply and continue to contaminate the sap. So it is very necessary to prevent contamination does not occur in the sap and maintain the quality of the sap during the tapping process [6]. In addition, the types of bacteria that cause damage are *Enterobacter aerogenes* and *Leuconostoc*, which cause the formation of a thread-like substance in the sap, *Pseudomonas fluorescens*, *Alcaligenes*, and *Flavobacterium* (which causes cloudy and greenish color), *Micrococcus*, *Escherichia* and *Acetobacter* sp. (acid cause). Yeast consists of *Saccharomyces cerevisiae* and *Monillia*. All these bacteria and yeast or yeast can grow and reproduce at the pH of fresh sap (pH 6-7) so that the sap ferments and produces alcohol and acid [7]. Palm farmers usually use natural preservatives to maintain the quality of the sap, including chopped kurut wood (*Dysoxylum*

parasiticum) and jackfruit wood (*Artocarpus heterophyllus*), which are added to the jerrycan before the tapping process is carried out. Tappers usually add several natural preservatives to inhibit fermentation in sap, including safat fruit, castor beans, hazelnut seeds, coconut oil, mangosteen rind, mangosteen rind, and langsung rind, olive bark, jackfruit wood/sap, papaya sap, and others [4]. Based on the results of a survey conducted on several sugar palm farmers in the West Lombok area, it was stated that the accuracy of the concentration of preservatives for both kurut and jackfruit wood affected the quality of the sap, which in turn also affected the quality of palm sugar. However, all this time, farmers use natural preservatives with estimates passed down from generation to generation, so the quality of the sap produced varies.

Based on conditions, it is necessary to research to determine the right concentration of kurut wood or jackfruit wood so that the resulting sugar products have consistently good quality. The good quality of sugar will increase consumer interest so that it can increase the selling price of the sugar. It prompted researchers to research the effect of kurut wood (*Dysoxylum parasiticum*) and jackfruit wood (*Artocarpus heterophyllus*) on the natural fermentation of palm juice and palm sugar quality.

## RESEARCH METHODS

This research is experimental, namely by giving treatment of various concentrations of natural ingredients of kurut wood and jackfruit wood on palm sap during the tapping process. Kurut wood and jackfruit wood were obtained from Kekait Village, Gunungsari District, West Lombok Regency, and sugar palm farmers. The sample is taken from the fresh branch. Tapping palm sap is done in the afternoon and taken in the morning. The chopped kurut and jackfruit wood was put into each jerrycan with the specified concentration, namely 3 g/L, 4 g/L, 5 g/L, 6 g/L, and 7 g/L.

Calculation of total microbes using the total plate count (TPC) method according to SNI 01-2332.3-2006 [8], which are as follows:

1. Take 1 mL of the sample with a sterile pipette and put it into 9 mL phosphate buffer solution to obtain a 10-1 dilution. Prepare the next dilutions (10-2, 10-3, 10-4, 10-5, 10-6) by taking 1 mL of sample in each previous dilution.
2. Take 1 mL of the last 3 dilutions into each petri dish in duplicate.
3. Pour Plate Count Agar (PCA) media into each cup containing the sample. Rotate the cup back and forth and left and right, or form a figure of eight to mix the sample and media perfectly.
4. Incubate the plates upside down in the incubator for  $\pm$  48 degrees at 34 - 37°C.
5. Counting colonies on plates with a range of 25-250 CFU/ml colonies.

Yield calculation is calculated based on the ratio of the final weight (weight of palm sugar

produced) to the initial weight (weight of the sap used) multiplied by 100% [9], which are as follows:

$$\text{Yield} = \frac{\text{grams of sugar}}{\text{grams of sap}} \times 100\%$$

Calculation of the percentage of reducing sugars was analyzed using the Luff Schrool method [10], which is as follows:

1. Refine the sample, weigh as much as 3g, and put it in a 250 ml beaker; add distilled water until exactly 250 ml.
2. Put 25 ml of the solution into the Erlenmeyer, then add 25 ml of Luff Schrool solution.
3. Make a blank, namely 25 ml of Luff Schrool solution plus 25 ml of distilled water.
4. Add 3-5 boiling stones, connect the Erlenmeyer to the cooler, and boil for 30 minutes.
5. Add 15 ml of KI and carefully add 25 ml of H<sub>2</sub>SO<sub>4</sub>.
6. Titrate with 0.1 N Na-thiosulfate solutions using a starch indicator; the titration ends when a milk cream color appears.

Reducing sugar content can be calculated by the formula:

$$\text{Reducing sugar content} = \frac{(\text{blank titration} - \text{sample titration}) \times \text{FP1}}{\text{sampel (mg)}} \times 100\%$$

While the pH analysis used a pH meter, namely by comparing the pH of each treatment with the control pH in both sap and palm sugar [11], which are as follows:

1. Weigh 10 grams of the sample and dissolve it in 50 ml of distilled water in a beaker glass.
2. Add distilled water up to 100ml, then stir until evenly distributed.
3. Measure the pH of the solution with a standardized pH meter. The pH meter is standardized using a pH 4 buffer solution, then a pH 7 buffer.
4. Insert the electrode rinsed with distilled water into the sample solution.
5. Record the number shown by the pH meter.

## RESULTS AND DISCUSSION

The results showed that increasing the concentration of kurut wood and jackfruit wood had an effect on increasing the yield value, and pH of sap and sugar and also had an effect on reducing the percentage of reducing sugars.

### Total microbes

The effect of the concentration of kurut wood and jackfruit wood on total palm sap microbes can be seen in Figure 1 and Figure 2.

The statistical analysis results showed that the treatment significantly affected the decrease in total microbes. The decrease in total microbes can be caused by chemical compounds found in kurut wood and jackfruit wood. The phytochemical screening tests of currants (*Dysoxylum parasiticum*) contained alkaloids, glycosides, flavonoids, tannins, and saponins [12]. The chemical compounds in *Artocarpus* are

phenolic compounds, flavonoids, stilbenoids, arylbenzofurans, carotenoids, volatile acid sterols, and tannins [13].

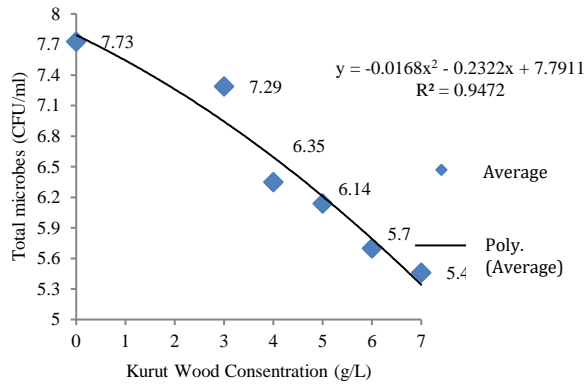


Figure 1. Effect of kurut wood concentration on total palm sap microbes

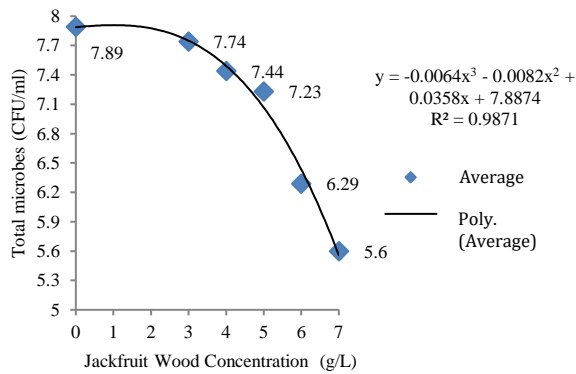


Figure 2. Effect of jackfruit wood concentration on total palm sap microbes

Research shows that flavonoids (luteolin, morin, naringin, quercetin, rutin, apigenin, and catechins) are very effective anti-bacterial [14]. The activity test of flavonoid compounds from mango leaf extract as anti-bacterial showed that mango leaf flavonoid isolates produced a larger diameter of inhibition zone than mango leaf ethanol extract against *Escherichia coli* and *Staphylococcus aureus* bacteria [15], so it was concluded that flavonoid compounds play an active role in inhibiting bacterial growth. In another study, the anti-bacterial activity of *Syzygium polyanthum* fruit which contains flavonoids, alkaloids, terpenoids, tannins, and saponins, can inhibit the growth of *Escherichia coli* bacteria [16].

### Yield

The effect of the concentration of kurut wood and jackfruit wood on the yield value of palm sugar can be seen in Figure 3 and Figure 4.

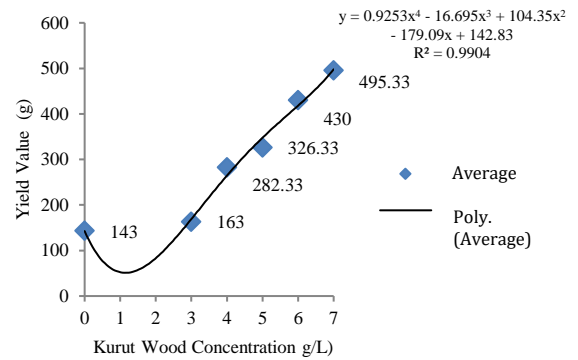


Figure 3. The effect of the concentration of kurut wood on the yield value of palm sugar

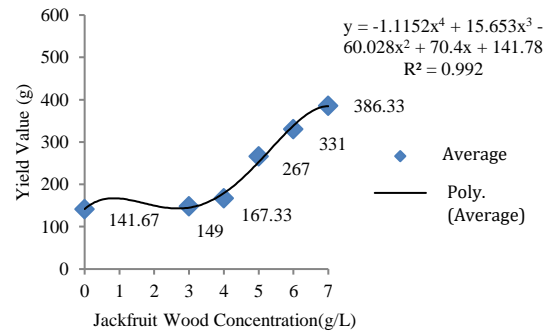


Figure 4. The effect of jackfruit wood concentration on the yield value of palm sugar

Many factors influence the value of sugar yield, one of which is microbial activity. Microbes take advantage of the content contained in sugars, such as sucrose, which is used as a food source. The more total microbes, the greater the amount of sugar used. Research conducted by [17] on coconut sap with the administration of antimicrobials showed that the higher the concentration of antimicrobials (sodium metabisulfite) given, the amount of yield of sugar produced increased. From an economic point of view, increasing the amount of yield is certainly very profitable for farmers because it can increase the income of sugar farmers.

Inhibition of the inversion reaction from microbial activity is necessary to reduce the rate of hydrolysis of sucrose by enzymes. Another study showed that the addition of anti-inversion affected sugar-sucrose levels. Sucrose is a determining factor for the final yield in the sugar processing process [18].

### pH

The effect of the concentration of kurut wood and jackfruit wood on the pH of palm sap can be seen in Figure 5 and Figure 6.

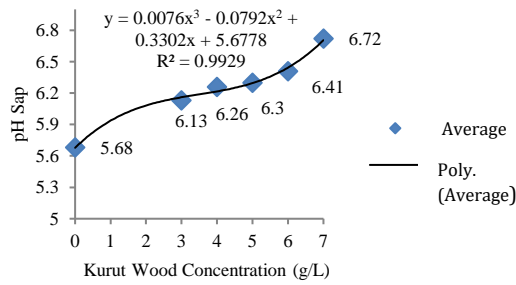


Figure 5. The effect of the concentration of kurut wood on the pH of palm sap.

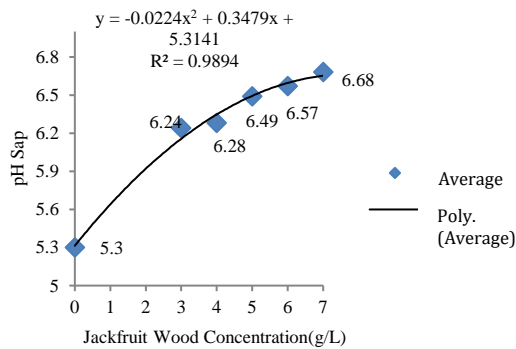


Figure 6. The effect of the concentration of jackfruit wood on the pH of palm sap

The pH value can be affected by the microbes present in the sap. The higher number of microbes, pH sap, is lower. In addition, pH can affect the growth and development of microbes, which can cause a decrease in the quality of sugar by affecting the activity of enzymes in the fermentation process. When the environmental pH is not optimal for a particular enzyme, the reaction rate it catalyzes will slow down. According to [19], the invertase enzyme that works on the sucrose inversion reaction takes place optimally at low pH, namely pH 4.00 - 5.50, so the inversion rate is faster in sap with low pH. It accelerates the increase in the percentage of reducing sugars, which decreases the quality of sugar.

### Reduction Sugar

The effect of the concentration of kurut wood and jackfruit wood on the percentage of reduction sugar in palm sugar can be seen in Figure 7 and Figure 8.

The percentage of reducing sugars is related to inverting sucrose into inverted sugars (glucose and fructose). The inversion reaction is an irreversible hydrolysis reaction in which one molecule of sucrose and one molecule of water produces one molecule of glucose and one of fructose. This hydrolysis reaction can occur in a solution with an acidic pH or with the inverses enzyme. [20] explained that the formation of reducing sugars apart from heating can also be caused by the presence of acid.

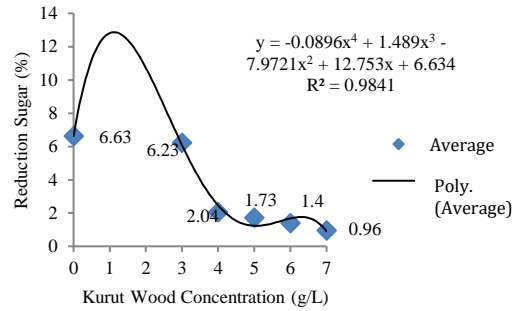


Figure 7. The effect of the concentration of kurut wood on the percentage of reducing sugar in palm sugar

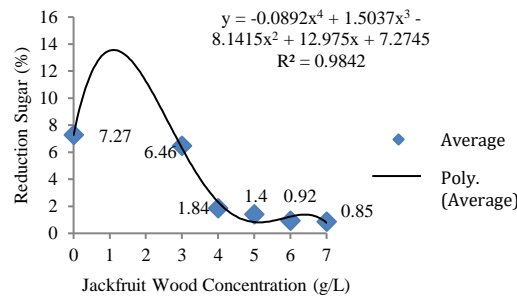


Figure 8. The effect of jackfruit wood concentration on reducing sugar in palm sugar.

The invertase enzyme is produced by microbes, for example, *Saccharomyces cerevisiae*. Research conducted by [17] by adding anti-invertase and sodium metabisulfite when soaking the roof used for tapping the sap. The higher the concentration of anti-inversion and sodium metabisulfite used, the lower the percentage of reducing sugar. By reducing the activity of the invertase enzyme, the breakdown of sucrose into reducing sugars will decrease. It is supported by research conducted by [21], which explains that adding sodium metabisulfite can maintain sucrose levels in coconut sugar.

### CONCLUSION

Based on the results of the research that has been done and referring to the research objectives, it can be concluded that increasing the concentration of kurut wood and jackfruit wood (0 g/L - 7 g/L) has a significant effect on decreasing total microbes and the percentage of reducing sugars and has a significant effect on increasing the value of yield and pH. The 7 g/L treatment was the best, with different analysis results for kurut wood and jackfruit wood. In kurut wood, the total microbial count was 5.46 CFU/ml; yield 495.33g; pH 6.72; and reducing sugar 0.96. In jackfruit wood, total microbes counted 5.6 CFU/ml; yield 386.33g; pH 6.68; and reducing sugar 0.85.

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