Application of the Natural Antimicrobial *Kayu Purut* (*Dysoxylum parasiticum*) to Delay Arenga Sap (*Arenga pinnata* sap) Decay

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Abstract. Brown sugar is commonly made with palm sap (Arenga pinnata sap) as its primary raw source. The punic (first time the branch was tapped) of a palm tree was tapped in this study to test the effectiveness of *kayu purut* (*Dysoxylum parasiticum*) stems as a natural preservative (antimicrobial). The study involved pasteurizing palm sap for 10±2 minutes at 75±3°C, followed by storage in two conditions: room temperature (25±3°C) and cold temperature (10±3°C), both of which had antimicrobials added. The antimicrobials concentrations were 0.92% (w/V), 0.73% (w/V), and 0.65% (w/V). For each concentration of *kayu purut*, investigations on the control of unpasteurized arenga sap at each storage temperature were carried out as well. pH, sugar content (%Brix), and color (L Lightness) tests were performed after 15 minutes (for five measurements), 30 minutes (for five measurements), and 1 hour of storage. The results show that by utilizing 0.92% (w/V) *kayu purut* during the tapping process and storing it at low temperatures after pasteurization, the sap's quality is able to be preserved for a longer period of time.

Keywords: Arenga pinnata sap, Dysoxylum parasiticum, Palm Sap Decay

1 Introduction

Fermentation is the primary factor influencing the quality of palm sap to the point at which it can no longer be used as a raw material for sugar (liquid/molded/granulated sugar), and it is influenced by high sugar content (10-15%) [1][2][3][4][5] in order to be used as a growth substrate for the amylase enzyme and converted into alcohol, particularly the impact of the activity of Saccharomyces cereviceae and Acetobacter sp. [4][6]. During the harvesting time, the pH of arenga sap steadily decreases to approximately 4.5 and below. Yellow root (Arcangelisia flava Merr) extract [4,7], mango-

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steen wood (Garcinia mangostana) [8], guava leaves [9], and jackfruit tree bark (Artocarpus heterophyllus) with slaked lime (calcium hydroxide) [10] solution are some examples of natural substances that are frequently used to prevent this. In ad-dition to its ability to control pH with tannins and flavonoids derived from nira (arenga sap), kayu purut (Dysoxylum parasiticum) is another organic compound used. Unlike other natural materials, kayu purut has a distinct scent and no aftertaste.

The results of the study indicate that using the disc-diffusion method on anti-microbial activity with three different microorganisms, Saccharomyces, Pseudomonas, and E. coli, has a positive response with inhibition zones 1,51 mm (mild category) at a 10% concentration (w/V). Furthermore, without pasteurization and room storage, the concentration (0.65% w/V) of kayu purut was able to maintain pH levels of 6.15 for 15 minutes, or a total time of 11 hours from the tapping process, and pH levels of 6.62 for 2 hours for the concentration (0.93% w/V). In addition to increasing sugar content by around 20%, the combination of pasteurization (75 ± 3 °C) and cold storage (8 ± 2°C) results in pH 6.8 after 38 hours of expansion with no apparent sensory changes. The presence of active compounds such as alkaloid and saponin may contribute to kayu purut's ability to stabilize acid levels. In this study, the tannin content of kayu purut was found to be relatively moderate (0.0177 ppm) when compared to others, indicating the need for further investigation.

2 Materials And Methods

Both the arenga sap and the kayu purut were collected in Kekait, West Nusa Tenggara. The study was conducted in August and September 2022 at Mataram University's Food Science and Agroindustry Faculty. Arenga sap is gathered from tapped trees between the hours of 6 a.m. and 15 p.m. (local time, 10 ± 2 hours tapping); the palm trunk picked comes from a single tree with punic stems, or young stems that just put out nectar. To ensure a consistent calculation of the final volume, tapping is carried out using the same jerry can each time. Kayu purut, a natural preservative, is chopped to 3 cm x 1 cm, dried at 50 ± 2°C for 60 minutes to homogenize the moisture content, weighed, and packaged in an airtight packaging weighed 11 grams.

In one palm sap tapping process, the preservative concentrations are 0.92% (w/V) (P1), 0.73% (w/V) (P2), and 0.65% (w/V) (P3). Preservatives are placed in jerry cans and used in the tapping process for roughly 10 ± 2 hours. Samples are first filtered with a filter cloth before being pasteurized at 75 ± 3°C for 15 minutes (K1). Any foam that forms on the surface during the pasteurization process is removed by scraping away manually with a spoon. Arenga sap was subsequently preserved at room temperature (25 ± 2°C) (T1) and cold temperature (8 ± 2°C) (T2). For each concentration of *kayu purut*, investigations on the control of unpasteurized arenga sap (K2) at each storage temperature were carried out as well. pH, sugar content (%Brix), and color (L Lightness) tests were performed after 15 minutes (for five measurements), 30 minutes (for five measurements), and 1 hour of storage.

The pH of the arenga sap was determined at room temperature by a calibrated pH meter at pH 4.0 and 7.0. The total soluble solid (TSS) content of arenga sap was

determined in %Brix by a hand refractometer. Meanwhile, the color lightness was determined by a colorimeter. *Kayu purut* was tested for antimicrobial activity using the dics-diffusion method with *Saccharomyces*, *Pseudomonas* and *E. coli* as test microorganisms using NA (Nutrient Agar) media that had been prepared, sterilized, and spread on plates with wells formed by an 8 mm cork borer, then 50 µl of *kayu purut* extract (10% w/V) was injected and incubated at 37 ± 2°C for 24 hours. The diameter of the zone of inhibition surrounded the well was measured to obtain the results. For the tannin content test, the spectrophotometric approach was used three times.

Data analysis using a completely randomized design were analyzed by SPSS version 22 for windows. The data reported in all Tables are the average of triplicate observation subjected to one-way analysis of variance (ANOVA). Differences among the ranges of the properties were determined using the method of Least Significant Difference (LSD) tests at 95% confidence level ($P<0.01$). The best treatment test was then compared with the control treatment T-test.

3 Result and Discussion

3.1 Material Analysis (Raw Material (Nira Sap and *Kayu Purut)* Without Natural Preservatives Addition)

Table 1. Nira sap and *kayu purut* analysis without natural preservatives addition.

Parameter	Nira sap		*Kayu purut*
pH	6.8		-
Brix (%)	16.48		-
Lightness	60.45		-
Inhibition zone *kayu purut*	-		0.1507
Tannin (ppm)	-		0.0177
Reducing sugar (%)	Before pasteurization	After pasteurization	-
	0.61	0.70	

3.2 pH Value

The inclusion of *kayu purut* as natural preservatives, the pasteurization procedure, and the storage of arenga sap all had a substantial impact on the pH values reported during the observations (Tables 2, 3 and 4). The higher the concentration of *kayu purut* provided (0.92% w/V), the higher the pH of the nira sap after tapping and the ability to retain the pH of the nira sap for 150 minutes without pasteurization and storage conditions at room temperature (25 ± 2°C), in comparison to the concentrations of 0.73% (w/V) for 75 minutes and 0.65% (w/V) only for 30 minutes, even when compared with the control without kayu purut added. The addition of kayu purut to arenga sap, as well as the pasteurization and storage at cold temperatures, allowed the sap`s pH to be preserved for more than 35 hours without sensory changes (Fig. 1). The presence of heat during the pasteurization process reduces the solubility of CO2 in the nira sap, causing the pH value to rise. As a result, the higher the temperature, the higher the pH value, but the lower the nutrient content.

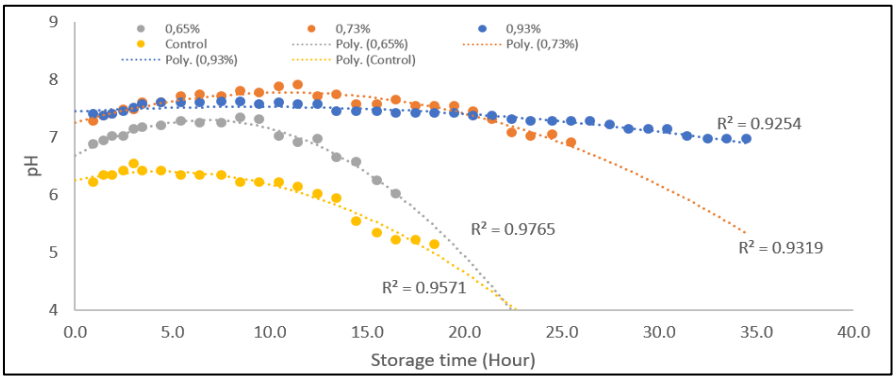

Fig. 1. The interaction of addition of *kayu purut* concentration and storage time with arenga sap pH value.

3.3 Lightness

The amount of kayu purut applied has a significant impact on the lightness of arenga sap; the more kayu purut used as natural preservatives, the brighter the sap, and vice versa (Fig.2). Sugar concentration, pH, and tannin significantly impact total dissolved solids, leading to turbidity and so affects the brightness of arenga sap. The improved brightness value appears to be related to tannin breakdown caused by pH [12]. The tannin's acidic character results in a dark brown color, but if kayu purut isn't added in large quantities, the pH of the arenga sap will be lower. The sugar concentration of the arenga sap, which undergoes a Maillard reaction after heating, additionally impacts the lightness the arenga sap is after pasteurization. Due to the fermentation process that occurs in arenga sap when held at cold temperatures, it tends to be more vivid than arenga sap preserved at room temperature.

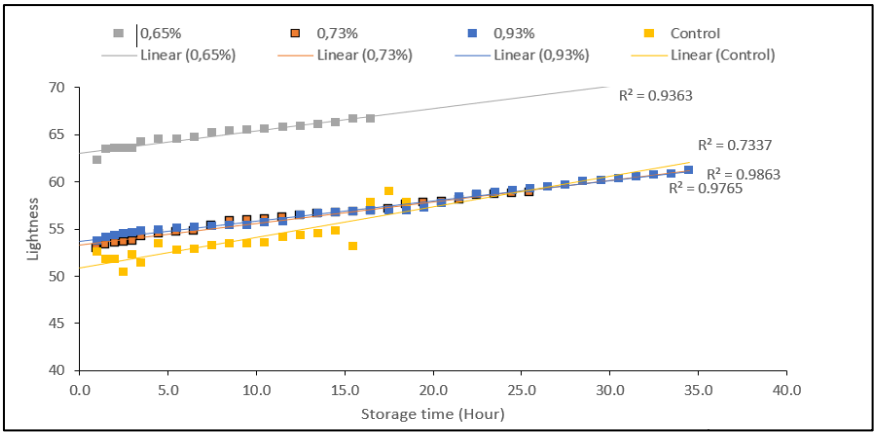

Fig. 2. The interaction of addition of *kayu purut* concentration and storage time with arenga sap lightness.

3.4 Sugar Content

During pasteurization, reducing sugar in arenga sap increased along with total sugar (%Brix), indicating an interaction between non-reducing sugar (sucrose), which has been broken down into reducing sugars like glucose and fructose, and binding levels (Fig.3). Furthermore, acids created by bacteria during storage have an effect on sugar. The storage process can be utilized to examine the sugar content rise inhibition. When stored at freezing temperatures, the acid-induced rise in sugar content can be significantly slowed down due to the crystallization process, which is also slowed down as the pH value shows. The inclusion of *kayu purut* increased the value of the reducing sugar in arenga sap, and the heating process was not excessively strong, implying that the reducing sugar generated had poor solubility and would solidify easily rather than dissolve quickly [13].

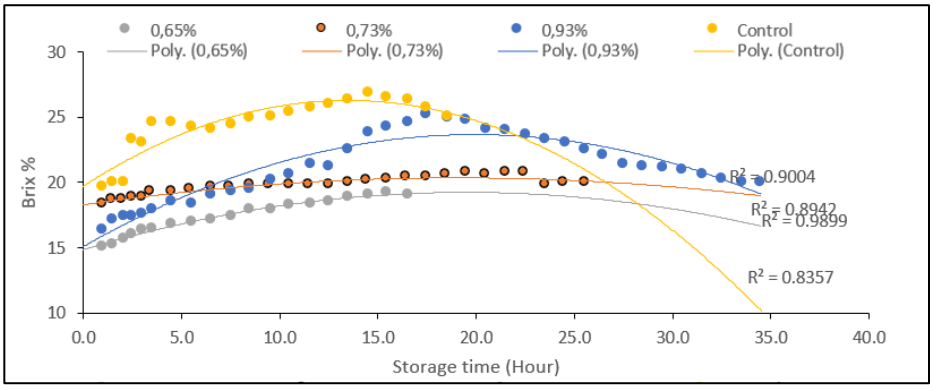

Fig. 3. The interaction of addition of kayu purut concentration and storage time with sugar content

Table 2. The addition of *kayu purut* concentration to arenga sap to the observed parameters

Parameter	P1	P2	P3
pH	7.09 ± 0.03[a]	6.81 ± 0.05[b]	6.43 ± 0.03[c]
Brix	16.83 ± 0.06[b]	17.31 ± 0.02[a]	14.79 ± 0.07[c]
Lightness	57.81 ± 0.03[c]	60.55 ± 0.12[b]	63.34 ± 0.11[a]

Table 3. Pasteurization of arenga sap against the observed parameters

Parameter	K1	K2
pH	7.01 ± 0.09 [a]	6.39 ± 0.13 [b]
Brix	16.75 ± 0.1 [a]	15.82 ± 0.07 [b]
lightness	58.79 ± 0.04 [b]	62.19 ± 0.2 [a]

Table 4. Storage time of arenga sap against the observed parameters

Paramater	T1	T2
pH	6.87 ± 0.034 [a]	6.63 ± 0.05 [b]
Brix	16. 51 ± 0.03 [a]	16.20 ± 0.04 [b]
lightness	60.48 ± 0.09 [a]	60.52 ± 0.04 [b]

3.5 Conclusion

The addition of kayu purut to arenga sap during the tapping process, along with pasteurization and cold storage, results in significant differences (p 0.01) in pH, %Brix, and lightness pH of arenga sap as an indicator of inhibition fermentation, which affects its characterictis. According to the findings of this investigation, the P1K1T1 treatment, which included 0.93% (w/V) *kayu purut* addition, pasteurization (75±3°C), and cold storage (8±2°C), produced the best arenga sap.

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