



Preservative of Coconut Sap Shelf Life derived from Mangosteen Yellow Latex

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Article info	Abstract
<p>Keywords: coconut sap, nira, preservative, mangosteen, yellow latex</p>	<p>The quality of coconut sap (nira) is a significant aspect in the manufacturing of palm sugar. Coconut nira deteriorates quickly, and handling nira in the field is challenging due to the long duration of the tapping process, and coconut trees are high, making it tough to reach. The use of natural preservatives to nira help in the preservation of its quality prior to processing. The objectives of this study were to 1) develop a natural coconut nira preservatives formula from mangosteen yellow latex and 2) evaluate the dose of preservatives necessary to maximize nira's shelf life. The study employed a randomized complete analysis with four preservative concentrations of 0%, 1%, 1.5% and 2%. and four different storage durations: 0, 6, 12, and 12h. Chemical analysis of pH, total acid, total sugar, and reduced sugar was performed, as well as sensory evaluation. The study concluded that yellow mangosteen latex can help in the preservation of coconut nira. Preservative concentrations of 1.5% and 2% are still acceptable in 12h of storage. While a concentration of 1% is allowed for storage of up to 6h. If no preservatives are applied, nira should be processed shortly after harvesting. Nira's quality is deplorable after 24h of storage.</p>

1. Introduction

Coconut sap (nira) is a clear liquid derived from coconut flowers. Coconut sap, also known as “legen”, “sajeng”, or “badeg” in Javanese, is a raw material used in the production of palm sugar. Coconut sap has a sweet taste, a distinct aroma, and is colorless when it is fresh. The sweetness of coconut sap is due to the presence of sugars such as sucrose, fructose, and glucose. Coconut nira contains 10.27% sugar, 0.41% protein, 0.71 % fat, and 0.38 % ash, and 88.40% water and organic acids (Haryanti et. al.2012). The coconut sap nutritional content makes it an ideal medium for microbial growth.

Coconut sap is fermented primarily by khamir of the genus *Saccharomyces cereviceae* that convert glucose to ethanol and *Acetobacter sp.* bacteria that oxidize ethanol to acetic acid during the tapping and storage processes (Setyawan &Ninsix, 2016). The coconut sap quality is influenced by harvesting time (morning or evening), environmental conditions, and harvesting methods (Mustaufik et al., 2021).

Coconut sap was collected in the morning and/or evening by farmers. It takes anywhere from 6 to 24 hours to collect. Although it is preferable to process coconut sap once collection is completed, farmers frequently keep it before processing. When coconut nira is kept for more than 6 hours after collection in the morning and 8 hours after collection in the afternoon, the quality degrades (Mustaufik et al., 2021). As a result, the addition of nira preservative is required to maintain nira quality during collection and storage.

Among the preservatives (*laru*) frequently used by coconut sugar farmers was sodium metabisulphite ($\text{Na}_2\text{SO}_2\text{O}_5$), more commonly referred to as sulphites. Sulphites are permitted in foodstuffs as long

as they do not exceed the specified limit. Na-metabisulphites have an acceptable daily intake limit of 0–0.7 mg/kg of body weight (Regulation of the Food and Drug Regulatory Agency number 11 of 2019 on food additives). Certain individual exceed the maximum permissible level of the preservative, posing a risk to health (Setyawan & Ninsix, 2016).

Some research has been conducted on the addition of natural preservatives to coconut nira (Haryanti & Setyawati, 2012; Naufalin & Yanto, 2012; Setyawan & Ninsix, 2016; Suganda, 2018). Haryanti & Setyawati (2012) demonstrated that the combination of *laru* from green betel leaves (*Piper betle* L) and lime results in the best physical and chemical properties of coconut sugar when the ratio was 0.75:9.25 and the amount of natural addition was 1 g / litre coconut sap. Several additional natural preservatives include rough extracts of cempedak wood (*artocarpus champeden* (lour), mangosteen and jackfruit wood (Sukandi, 2018), red galangal (Saleh, 2015), propolis trigona (Ramadhani (2015), guava wood (Sukandi, 2018), bee propolis (Liaстика, 2018), powdered mangosteen pericarp (Karseno, 2021). Naufalin and Yanto (2012) revealed the research result that 2% of calcium hydroxide can prolong the shelf life of coconut sap by up to 4 hours and mangosteen pericarp was the most effective at preserving the quality of coconut sap during storage. Clove leaves and guava leaves are also fairly effective at preserving the quality of coconut sap. The best treatment for preserving the quality of sap was a combination of $\text{Ca}(\text{OH})_2$ 2% and mangosteen pericarp.

Yellow latex mangosteen is an undesirable substance found in mangosteen fruit. Mangosteen yellow latex is produced when mangosteen fruits are injured by

physical forces such as impact, friction, or puncture. The physical treatment causes the vessels to discharge yellow latex. Yellow latex is also produced as a result of physiological factors. Mangosteen will produce yellow latex in the absence of calcium nutrients (Tanari & Tinggogoy, 2014). Calcium is responsible for the cell wall's rigidity, as the Ca^{2+} ion acts as a link between the pectin chains on the cell wall (Taiz and Zeiger, 1991). Calcium deficiency can result in brittle and easily damaged fruit cell walls. (Tanari & Tinggogoy, 2014)

The yellow latex of mangosteen is rich in terpenoids, flavonoids, and tannins (Dorly, 2008). Xanthones are a type of flavonoid that has antimicrobial properties, anti-inflammatory, antibacterial, and anti-cancer properties (Gutierrez-Orozco & Failla, 2013). These properties may be beneficial in the case of mangosteen yellow latex used as a preservative. Additionally, this research will aid in the conversion of discarded and unwanted goods into useful and valuable products.

Despite many research on coconut sap preservatives has been conducted, however chemical and non food preservative are still widely used, i.e. soap. (Asmoro, 2015). This study aims to determine the effect of adding natural preservatives derived from mangosteen yellow latex on the shelf life of coconut sap. The study's findings will help farmers improve the quality of their coconut sap by applying natural preservatives.

RESEARCH METHODS

The study employed a complete Random Design (CRD) factorial 4x4 design. Each factor has four levels: the first was the preservative concentration, and the second was the storage time. The preservative concentrations were 0%, 1%, 1.5%, and 2%, and the storage times were 0h, 6h, 12h, and

24h. The pH, total acidity, total sugar content, reduced sugar content, and organoleptic parameters, which include appearance and aroma, are all measured. Each treatment was repeated three times to obtain a total of 48 units of experimental treatment. ANOVA was used to analyze the test results, and significant results are further analyzed using Duncan's Multiple Range Test at a 5% level of significance. The organoleptic test employed 15 panelists to evaluate the appearance and aroma of coconut sap. Fig. 1 illustrated the research flow.

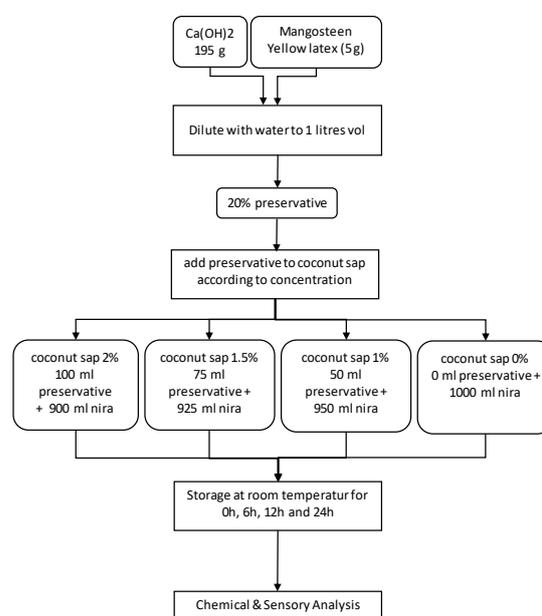


Fig 1. Research Flow diagram

Equipment

The main equipment for this research were UV-Vis Spectrophotometer (Shimadzu UVmini 1240) for sugar analysis. A distillation set for fat analysis, and analytical weigher.

Material

Coconut sap was collected from Widoro village, Donorejo Subdistrict, Pacitan Regency, East Java Province, Indonesia, a major producer of coconut sap for palm sugar. Mangosteen yellow latex was obtained from Somongsari Village, Kaligesing Subdistrict, Purworejo Regency, Central Java province. Indonesia. Ca(OH)_2 was obtained from Kolombo traditional Market, Yogyakarta, Indonesia.

RESULT AND DISCUSSION

The analysis revealed that preservative concentrations had a significant effect on pH, reduced sugar, and sensory evaluation, but had no significant effect on total acid and total sugar. The duration of storage has a significant effect on the pH, appearance, aroma, total sugar, and reduced sugar, but has no discernible effect on the total acid. There was no correlation between preservative concentration and duration of storage.

According to statistical analysis, both the preservative concentration and the storage duration have an effect on pH, and there was no interaction between the preservative concentration and the storage duration in pH. The longer the sap were stored, the lower the pH sap will be due to fermentation (Fig. 2). Fresh coconut sap should have a pH of around 7, however the average pH of fresh coconut sap (0-hour storage) in this study was 6.1. This difference was due to the fact that the coconut sap was harvested for approximately 12 hours, during which time the sap was most likely partially fermented. Coconut sap was fermented into acid as a result of the activity of lactic acid and acetic acid bacteria (Litana et. al., 2018). The addition of preservatives to the coconut sap will inhibit the decrease in pH during storage. The coconut sap sample with the addition of 2% preservative had lesser pH reduction 6.3 to 4.8, compared samples without preservatives 6,3 to 4.2 in 24-hour storage.

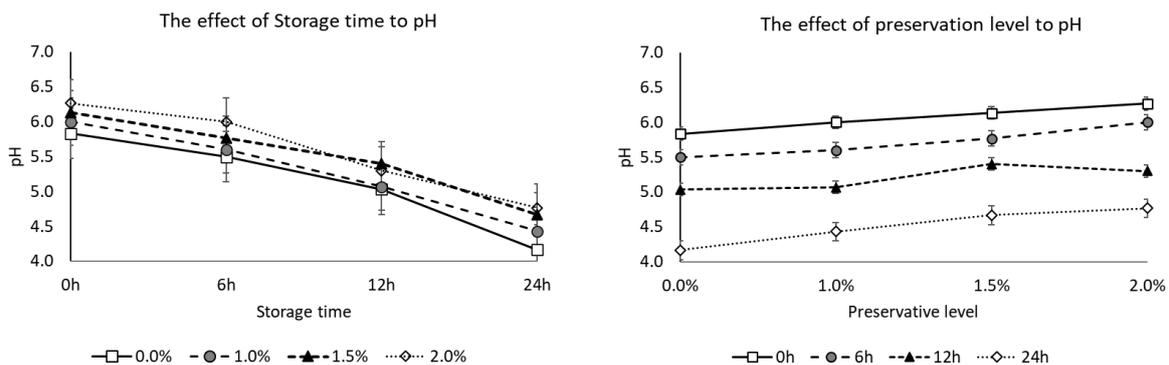


Fig. 2. Effect of preservative storage time and preservative level to pH

The analysis revealed that 24-hour storage had no effect on the total acid (Fig.3) The finding of this study was most likely attributable to the fact that acid was created at the time the coconut sap sample was

collected. The impact of analysis demonstrating that the addition of preservatives can keep total acid levels stable. Preservatives at a concentration of 2% was effective at preserving the acidity of

coconut sap. Without preservatives, total acid was increasing higher from 0.85% to 1.32% compare addition of 2% preservative

which only increase from 1.33% to 1.44% in 24 hours storage.

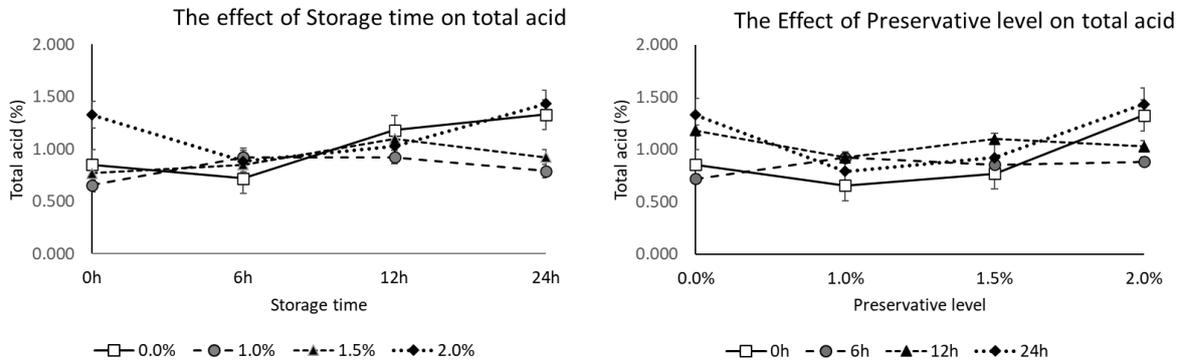


Fig. 3. Effect of preservative storage time and preservative level to pH

Preservative concentrations and storage duration affect total sugar levels (Fig. 4). The statistical analysis results showed that there was no interaction between preservative level and storage length. During storage, there was a tend for total sugar levels to rise. This effect was consistent with Harahap research (2019), which found that total sugar levels increased during palm oil storage. This increase in total sugar levels was due to a relationship with the polysaccharide hydrolysis process (Helmiyesi, 2008). Additionally, the increase in total sugar content was likely due to evaporation during storage (Zhang et. al,

2019). The most significant increase in total sugar was a 1% increase in 24-hour storage.

The total sugar content was increased in proportion to the amount of preservative utilized. A higher preservative content signifies a higher calcium concentration Ca(OH)_2 . This conclusion was most likely attributable to the fact that total sugar was primarily composed of sucrose. According to Naufalin (2018), who tested coconut sap at various Ca(OH)_2 concentrations and obtained similar results. According to this study, Ca(OH)_2 tends to increase sucrose levels and achieves a maximum value at Ca(OH)_2 2.3%.

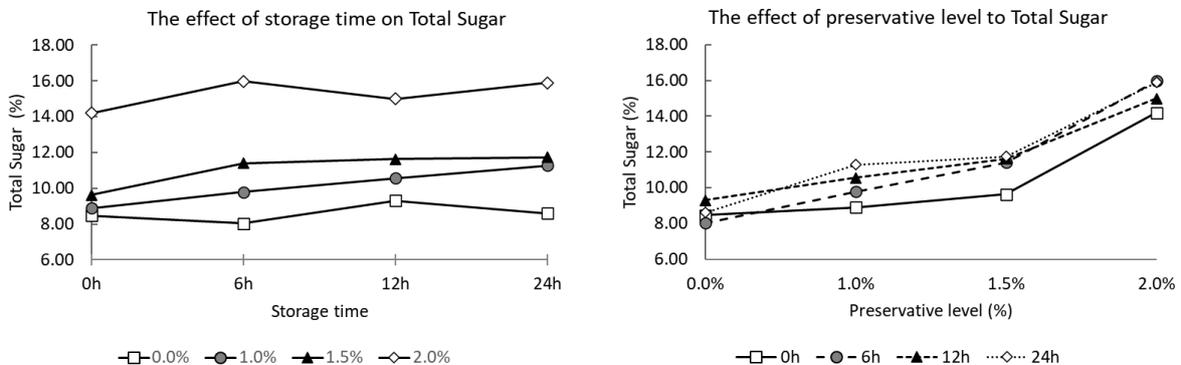


Fig. 4. Effect of storage time and preservative level to Total Sugar

The level of reducing sugar was also affected by the level of preservatives and the length of storage. There was evidence of a relationship between the concentration of preservatives and the length of time the reducing sugar levels are stored. At higher preservative concentrations (2%), sugar reduction levels tend to be lower (Fig. 5). According to Suntoro (2016), adding

preservatives containing lime ($\text{Ca}(\text{OH})_2$) reduces reduced sugar levels by inhibiting the growth of *saccharomyces* bacteria that are involved in the breakdown of sucrose into reduced sugars. Hence, preservative used was effective in lowering the metabolic rate of coconut sap. The higher the concentration of preservative results in lower reduction of sugar level.

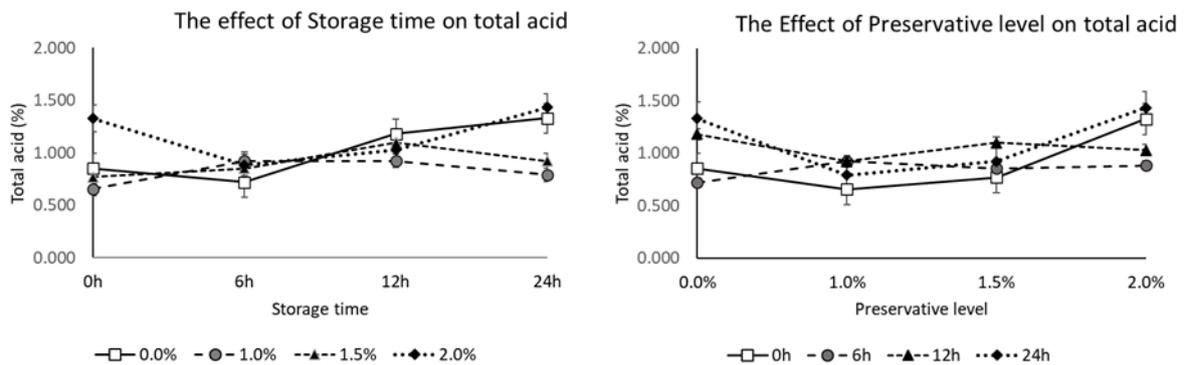


Fig. 5. Effect of storage time and preservative level to reducing Sugar

The longer the coconut sap was stored, the lower the sugar levels become. This was in line with Amema's (2017) findings, which revealed that during coconut sap storage, sucrose was broken down into reduced sugar, especially in the first 10 hours. The addition of coconut sap with a 2% preservative resulted in the smallest sugar reduction. This means that adding Coconut sap 2% to the mix will help to slow down the conversion of sucrose to reduced sugar.

The appearance sensory test was carried out with 15 participants. The analysis revealed that the preservative concentration and storage duration have an effect on the appearance of coconut sap. The following grading system was used to determine the appearance: (1) Clear; (2) Clear but slightly murky; (3) Murky; (4) Brownish cloud (5) Brown. Sensory evaluation of fresh coconut sap (0 hours storage) results in a score of 2.41 (clear –

clear but slightly cloudy). Coconut sap is transparent in fresh condition. However, due to physiological process, storage will cause the coconut sap to become cloudy. The length of time required to tap coconut sap from trees indicated that physiological processes had begun, therefore the appearance of fresh coconut sap samples was typically cloudy.

Table 1. Sensory evaluation of appearance

Preservative level	Sensory evaluation of appearance			
	0h	6h	12h	24h
0.0%	2.6	2.5	3.0	3.0
1.0%	2.5	2.5	3.0	2.8
1.5%	2.4	2.6	2.5	2.8
2.0%	2.3	2.3	2.4	2.7

(1) Clear; (2) Clear but slightly murky; (3) Murky; and (4) Brownish cloud (5) Brown

The higher the coconut sap preservative concentration, the better the sensory test results at the same storage time. With a maximum appearance grade tolerance of 3 (murky), coconut sap with a

1% preservative addition should be stored for no more than 12 hours. While coconut sap with a preservative level of 1.5 to 2% can be kept for up to 24 hours.

The panelists' assessment of the aroma of coconut sap during storage revealed that both the preservative concentration and the duration of storage had an effect on the aroma of coconut sap, with no interaction between the concentration and the duration of storage. Sensory evaluation of aroma was graded as follows: (1) fresh coconut sap aroma; (2) fresh flavorful but slightly sour aroma; (3) acid aroma; and (4) sour and rotten aroma (Table 2)

Table 2. Sensory evaluation of appearance

Preservative level	Sensory evaluation of aroma			
	0h	6h	12h	24h
0.0%	1.27	2.93	3.40	4.00
1.0%	1.20	2.53	3.13	3.73
1.5%	1.27	2.47	2.87	3.67
2.0%	1.20	2.27	2.73	3.47

(1) fresh nira aroma; (2) fresh flavorful but slightly sour aroma; (3) acid aroma; and (4) sour and rotten aroma

The average sensory assessment of a fresh sample was 1.2, indicating that the aroma of the sample has changed slightly. The sensory acceptance level was 3, indicating that the aroma was predominantly acidic and rotten. Sensory tests on coconut coconut sap (table 3) indicated that coconut sap with preservative concentrations of 0% and 1% can be stored for up to 6 hours, while coconut sap with preservative concentrations of 1.5% and 2% can be stored for up to 12 hours.

CONCLUSION

Yellow latex mangosteen's natural preservative can significantly extend the shelf life of coconut sap. This research will help coconut sugar farmers in preserving the

quality of the coconut sap during the tapping and processing.

Preservative concentrations had a significant effect on pH, reduced sugar, and sensory evaluation, but had no significant effect on total acid or sugar. The storage duration has a noticeable effect on the pH, appearance, aroma, total sugar, and reduced sugar, but has no discernible effect on the total acid. There was no correlation between the concentration of a preservative and the duration of storage. A 1% solution of yellow latex mangosteen preservative can be used to store coconut sap for up to 6 hours, while a 2% solution can be used to store coconut sap for up to 12 hours.

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