

Effect of Preservatives and Storage Temperature on the Quality and Antioxidant Stability of Snake Fruit Peel Tea Drink

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Abstract. Salak is a tropical fruit that is widely found in Indonesia, the skin of the snake fruit which has been considered waste turns out to have health benefits. The skin of the snake fruit contains flavonoids, tannins, alkaloids, and other compounds that contribute to these benefits. Snake fruit peel tea contains phenolic compounds with strong antioxidant and but its stability during storage has not been comprehensively evaluated. Previous research focused on extraction optimization, so there is still a gap regarding how preservatives and storage conditions affect product stability. This study utilized snake fruit peel to produce a functional tea, with optimal brewing conditions determined at 100°C for 5 minutes, and to evaluate the effect of different preservatives (sodium benzoate (100mg/L), calcium propionate (100mg/L), and their balanced combination (50 + 50 mg/L) and two storage temperatures (27°C and 4°C). The parameters observed included antioxidant activity (DPPH radical scavenging), pH, total sugar (°Brix). Observations were conducted, analyzing antioxidant content, total soluble solids (°Brix), pH, over a 10-day storage period. All preservative concentrations complied with BPOM and Codex Alimentarius standards. The results showed that refrigerated storage was more effective in preserving antioxidant activity and maintaining physicochemical stability compared to room temperature storage. Antioxidant retention after 10 days was significantly higher under refrigerated storage than room temperature storage. Treatments with sodium benzoate and calcium propionate exhibited better stability than the control, particularly under cold storage conditions. Sodium benzoate and calcium propionate individually maintained antioxidant stability better than the control, while the combination treatment showed no synergistic improvement.

1 Introduction

Snake fruit (Salak) is a tropical fruit found widely in Southeast Asia and widely cultivated in Indonesia, including East Kalimantan. Snake fruit is generally consumed only as the

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flesh, resulting in waste in the form of the skin. Research has shown that snake fruit skin contains natural antioxidants and other phenolic compounds, such as flavonoids, tannins, and other bioactive components [1]. Snake fruit skin can be consumed as a tea-like extract by brewing it with hot water. However, such studies do not address how these phenolic compounds behave during storage—a critical factor in beverage stability and commercial viability.

Salak skin tea has numerous health benefits, but the stability of its antioxidant activity and physicochemical properties during storage remains a major challenge. This snake fruit peel tea drink is susceptible to spoilage due to several factors, including oxidation, microbial activity, and storage conditions, which can affect its shelf life [2].

A systematic review of the literature indicates that in other fruit-based beverages, including kombucha [2], watermelon juice [3], and beetroot extract [4], storage temperature strongly influences the degradation of phenolics through pathways such as polyphenol oxidation, anthocyanin degradation, and flavonoid structural breakdown. Elevated temperatures accelerate oxygen diffusion, free-radical formation, and hydrolysis reactions, resulting in rapid antioxidant loss. Cold storage, by contrast, slows reaction kinetics and stabilizes phenolic structures

Storage conditions can be influenced by temperature. Temperature is believed to accelerate or even inhibit product spoilage [3]. In addition to temperature, the addition of preservatives can also significantly extend a product's shelf life [5]. Sodium benzoate and calcium propionate are preservatives frequently used in beverage products and have been shown to inhibit microbial spoilage and extend shelf life [6]. Previous research has shown that cold storage preserves antioxidant compounds and sensory assessments compared to storage at room temperature [7].

No previous research has examined snake fruit peel tea drink using different storage temperatures and preservative additions. Thus, the research gap lies in the absence of studies evaluating the combined effects of preservatives and temperature on the antioxidant stability and physicochemical quality of snake fruit peel tea drink. This study aims to evaluate the effect of the addition of preservatives (sodium benzoate and calcium propionate) and different storage temperatures (room temperature and refrigerated temperature) on antioxidant stability and the quality attributes of snake fruit peel tea drink, namely pH and Total Sugar (°Brix).

2 Material and Method

This study aimed to evaluate the effects of sodium benzoate, calcium propionate, and their combination on antioxidant and physicochemical stability of snake fruit peel tea drink and Compare the influence of room temperature and refrigerated storage on beverage stability over 10 days. Sample preparation using snake fruit peels were washed, dried, and ground. Tea was prepared by boiling at 100°C for 5 minutes. This study using four treatments was prepared preservative type (K = control without preservative, S = sodium benzoate 100 mg/L, P = calcium propionate 100 mg/L, and S+P = balanced combination of sodium benzoate 50 mg/L and calcium propionate 50 mg/L) and storage temperature (room temperature 27°C and refrigerated temperature 4°C). Samples were filled into sterile amber glass bottles (125 mL) with 100 mL fill volume, producing ~20%

headspace. Bottles were sealed with PTFE-lined caps. All bottles were autoclaved at 121°C for 15 minutes prior to filling.

Antioxidant activity (% DPPH inhibition): using a 0.1 mM DPPH solution in ethanol, absorbance was measured at a wavelength of 517 nm using a UV-Vis spectrophotometer. The % inhibition value was calculated using the formula: $((A_0 - A_s) / A_0) \times 100$. [8]

pH: measured using a calibrated pH meter at room temperature.

Total sugar (°Brix): measured using a calibrated hand refractometer.

All tests were conducted in duplicate to validate the results. Four treatments were used: K (control), S (sodium benzoate), P (calcium propionate), and S+P (balanced combination). Storage was carried out at room temperature and refrigerated temperature until day 10. Observed parameters included % inhibition of the antioxidant DPPH, pH, and Total Sugar (°Brix). Data were analyzed descriptively. Two-way ANOVA was conducted to test the effects of preservative type, temperature, and their interaction at each time point. Tukey HSD was used for post-hoc comparison ($\alpha = 0.05$). When needed, antioxidant data were transformed to meet ANOVA assumptions.

3 Results and Discussion

This study used different storage temperatures, namely room temperature and refrigerated temperature with 4 types of treatments: control treatment without the addition of preservatives (K1), the addition of sodium benzoate (S1), calcium propionate (P1), and a combination treatment of sodium benzoate and calcium propionate (S1P1). Samples were subjected to antioxidant, pH, and total sugar (°Brix). analysis tests.



Fig. 1. Sample Snack Fruit Peel Tea Drink

3.1 Antioxidant activity

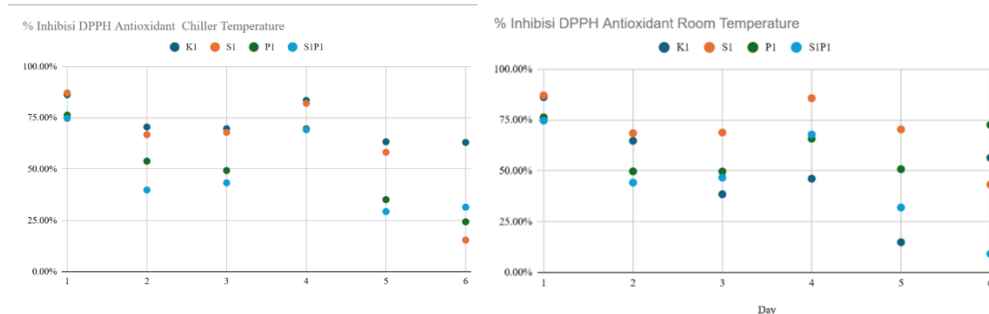


Fig. 2. Graphic Antioxidant Room Temperature and Refrigerated Temperature

The result showed that a decreasing trend over storage time, with samples stored at room temperature exhibiting a more rapid decline compared to those stored under refrigeration. This finding is consistent with previous research reporting that higher storage temperatures accelerate oxidative degradation of phenolic compounds [6]. Sample treatment using Sodium benzoate (S) and calcium propionate (P) were more effective in maintaining antioxidant stability compared to the control, especially under cold storage conditions. The combination treatment (S+P) did not consistently outperform single preservatives, suggesting a possible interaction effect that may influence antioxidant retention [4].

3.2 pH value

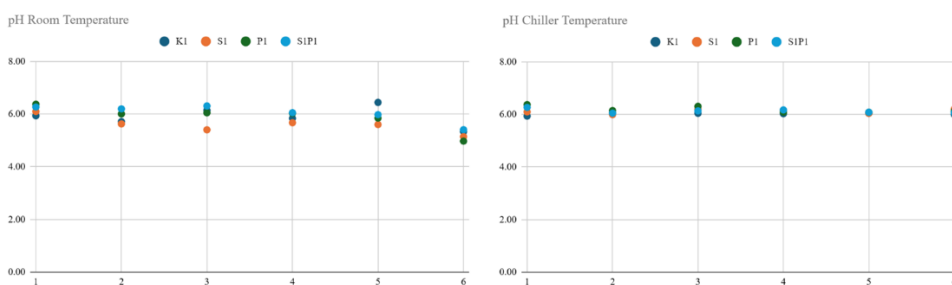


Fig. 3. Graphic pH value Room Temperature and Refrigerated Temperature

The result of pH values exhibited minor fluctuations during storage, with room temperature samples showing a more noticeable decrease, particularly in the control and preservative-free samples. This trend may be attributed to microbial activity leading to organic acid formation [2]. Refrigerated storage maintained pH stability more effectively, aligning with literature indicating that low-temperature storage suppresses microbial activity and fermentation processes [4].

3.3 Total Sugar (°Brix)

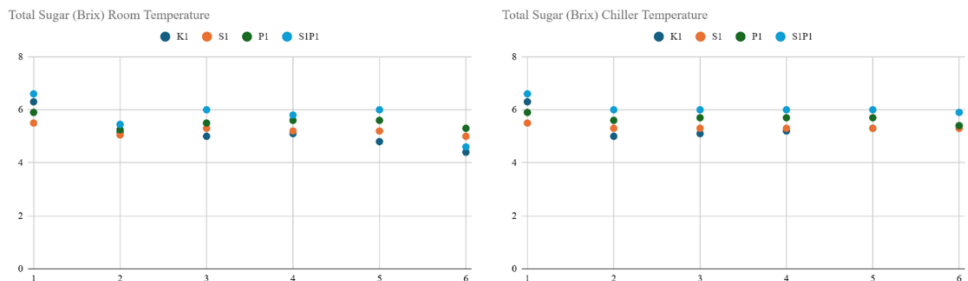


Fig. 4. Graphic Total Sugar °Brix (Room Temperature and Refrigerated Temperature

The result showed that a gradual decrease in °Brix values was observed in samples stored at room temperature, indicating potential sugar metabolism by microorganisms or ongoing fermentation. In contrast, °Brix values were more stable under refrigerated storage, suggesting reduced metabolic activity [9]. Samples treated with preservatives showed better retention of soluble solids compared to the control [10].

4 Conclusion

Refrigerated temperature significantly improved the functional and sensory qualities of snake fruit drinks. Sodium benzoate and calcium propionate preservatives provided a protective effect, particularly during chilled storage. The natrium benzoate and Calcium propionate combination was not always superior at room temperature.

Acknowledgements

Thanks to funder and this research was funded Lembaga Penelitian dan Pengabdian Masyarakat (LPPM) of Institute Technology Kalimantan.

Fundings

Thanks to funder and this research was funded Lembaga Penelitian dan Pengabdian Masyarakat (LPPM) of Institute Technology Kalimantan.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author contribution statement

Ni'matus Sholihah: Conceptualization, Methodology, Writing- Original draft preparation. Jefri Pandu Hidayat: Data curation, Validation, Writing- Reviewing and Editing. Amalia Nur Kumalaningrum: Visualization, Validation, Writing- Reviewing and Editing. Farrah Widy Herlina: Investigation, Visualization. Raudhatul Jannah: Investigation, Visualization. Alya Nofianti: Investigation, Visualization.

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