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Antioxidant and Vitamin C Content of a Combination Tea Made from Rose Flowers and Katuk Leaves Under Varying Drying Temperatures

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Abstract

Rose flowers and katuk leaves have not been fully utilized; rose flowers are typically used as ornamental plants, while katuk leaves are commonly consumed as vegetables. However, both contain numerous bioactive compounds, including antioxidants and vitamin C. The present study examined the effect of drying temperature on the physical and chemical properties of tea made from a combination of rose flowers and katuk leaves. The research employed a factorial completely randomized design (CRD), using drying temperatures of 50°C, 60°C, and 70°C for 5 hours, each treatment was replicated three times. The parameters analyzed included chemical properties, including antioxidant content (using the DPPH method) and vitamin C content (via iodometric titration), and physical properties, such as pH value (measured with a pH meter), as well as sensory evaluation of color, taste, and aroma. The results showed that drying temperature had a significant effect on antioxidant content, vitamin C levels, pH value, color, and taste, but had no significant effect on aroma. The tea dried at 50°C exhibited the best overall quality, with an antioxidant content of 49.60%, a vitamin C content of 85.05 mg/100 g, a pH value of 6.56, a light brown color, a slightly bitter taste, and a distinctive katuk leaf aroma. In conclusion, a drying temperature of 50°C is recommended for producing the highest quality combination tea made from rose flowers and katuk leaves in terms of physical and chemical characteristics.

Keywords: antioxidants; drying temperature; katuk leaves; rose flowers; vitamin C

Introduction

Roses (*Rosa damascena* Mill.) are higher plants in the *Rosaceae* family, commonly found in temperate regions. They typically grow as small trees or shrubs with thorny stems (Tjitrosoepomo, 2013). Katuk leaves (*Sauropus androgynus* L.) are tropical plants widely used as vegetables and in traditional medicine (Rahma et al., 2022). These plants have elliptical leaves, dark green on the upper surface and light green underneath, arranged alternately on slender twigs (Nurliani & Rachmawati, 2023). The potential of rose flowers and katuk leaves remains underutilized. Roses are generally cultivated for ornamental purposes, while katuk leaves are primarily consumed as vegetables. However, both plants contain numerous bioactive compounds, including antioxidants and vitamin C. Additionally, katuk leaves are known for their galactagogue properties, aiding in breast

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milk production. To enhance the economic value and broader utilization of these plants, value-added processing is needed. One such approach is to process them into tea, making them more accessible and beneficial to a broader audience. Tea is a beverage made by steeping processed plant leaves in hot water (Nugraheni et al., 2022).

Roses contain various beneficial compounds, depending on the plant part. For instance, Mawarni et al. (2020) found that rose petals possess antioxidant properties with an IC_{50} value of 4.46 ± 0.34 µg/mL. They are also rich in vitamin C, which supports immune function, combats infections, and promotes wound healing (Sinambela et al., 2024). Similarly, katuk leaves exhibit strong antioxidant activity, as demonstrated through the DPPH assay, with an IC_{50} value of 80.81 ppm (Chopipah et al., 2021).

Tea production begins with drying fresh rose flowers and katuk leaves, which have high moisture content. Various drying methods can be employed; the oven-drying method was used in this study. According to Huriawati et al. (2016), oven drying offers the advantage of adjustable temperatures and reduced contamination risk, which can affect the quality of the dried material. The drying temperature is a critical factor affecting phytochemical content, nutraceutical properties, and the organoleptic quality of plant-based products (Garcìa et al., 2021). Inadequate drying temperatures can lead to a loss of beneficial compounds. Research by Yap et al. (2020) suggests that the optimal temperature range for drying *simplisia* is between 40°C and 60°C, with a maximum drying time of eight hours. Furthermore, Fahmi et al. (2019) found that oven drying at 45–50°C yields the best chemical analysis results. Samosir et al. (2018) also reported that the highest antioxidant activity in *pedada* leaf functional drinks (76.94%) was achieved using oven drying at 50°C.

The present study aimed to evaluate the effect of drying temperature on the antioxidant content, vitamin C levels, pH, and physical properties of rose flower and katuk leaf tea. Additionally, this study strived to identify the optimal drying temperature that preserves the bioactive compounds in both ingredients. The combination of rose flowers and katuk leaves as an herbal tea has not been widely explored. Hence, the findings are expected to contribute to the development of functional beverage products.

Research Methods

This study employed a factorial completely randomized design (CRD) with one factor, namely the drying temperature, consisting of three levels: 50°C (P1), 60°C (P2), and 70°C (P3), applied for 5 hours. Each treatment was replicated three times. Data were analyzed using a one-way ANOVA test at a significance level of 0.05. If significant differences were found, the Tukey HSD test was conducted to determine the differences between treatments at the 5% significance level.

Tools and Materials

The tools used in this study included a Binder oven, baking sheet, blender, digital scales, tray, measuring cup, tea bags, spoon, teacup, and equipment for chemical analysis, including a magnetic stirrer, Erlenmeyer flasks, vortex mixer, stopwatch, Genesys 10S UV-Vis spectrophotometer, test tubes, test tube rack, pipettes, labels, plastic containers, pH meter, and analytical balance.

The materials used in this study were fresh rose flowers and fresh katuk leaves. The chemicals used for analysis included DPPH solution, methanol,

distilled water, citric acid, 90% ethanol, iodine (I_2) standard solution, and 1% starch indicator solution.

Procedure

Rose and Katuk Combination Tea Preparation

Rose flowers and katuk leaves were thoroughly washed and then air-dried for 24 hours. Further drying was carried out using a Binder oven at temperatures of 50°C, 60°C, and 70°C for 5 hours. The dried materials were then ground into tea powder using a blender. The powder was weighed in a 1:1 ratio and packed into tea bags. Brewing was performed using boiling water at 100°C for 5 minutes.

Data Collection

This study involved both physical and chemical analyses. Physical analysis was conducted using sensory evaluation (Andriani & Buamona, 2024), focusing on attributes such as color, taste, and aroma. Chemical analysis included the measurement of antioxidant activity using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method (Leslie & Gunawan, 2019) and vitamin C content using the iodometric titration method (Aryani & Mu'awanah, 2019). Acidity (pH) was measured using a pH meter and expressed on a pH scale ranging from 0 to 14 (Rahimi et al., 2016).

Research Results and Discussion

Antioxidant Levels

Antioxidants are compounds that can minimize the oxidation process. Based on the ANOVA test results on antioxidant levels in a combination tea made from rose flowers and katuk leaves, it was found that different drying temperatures had a significant effect on the tea's antioxidant content. The highest antioxidant content was observed in the tea dried at 50°C (P1), with a value of 49.60%, while the lowest was found in the sample dried at 70°C (P3), with 48.12%. These findings indicate that higher drying temperatures lead to a reduction in antioxidant content. This result is consistent with the study by Rohkyani and Suryani (2015), which reported the highest antioxidant activity in the T1W2 treatment (flower tea material dried at 65°C), at 66.43%, and the lowest in the T3W1 treatment (stem tea material dried at 85°C), at 56.76%. Furthermore, the antioxidant activity in this study was higher than that found in kombucha tea research by Rindiani and Suryani (2023), which reported an antioxidant level of 47.4%.

Antioxidant levels are presented in **Table 1** and **Figure 1**. **Table 1** shows that the antioxidant content of the combination tea was highest at a drying temperature of 50°C (49.60%), followed by 60°C (48.79%) and 70°C (48.12%). Therefore, the tea dried at 50°C retained more antioxidants than those dried at higher temperatures. This trend is also depicted in **Figure 1**. The findings are supported by the research of Samosir et al. (2018), which demonstrated that the highest antioxidant activity in pedada leaf functional drinks occurred with oven drying at 50°C, yielding a value of 76.94%.

The results of the Tukey HSD test revealed significant differences in antioxidant levels based on temperature treatment. The analysis demonstrated that drying temperature had a significant effect on the stability of antioxidant levels, with varying patterns at each temperature. Specifically, significant differences in antioxidant content were found between 50°C and 70°C ($p = 0.002$), and between 60°C and 70°C ($p = 0.033$). These results suggest that antioxidant levels decreased significantly at 70°C compared to 50°C and 60°C. This finding aligns with the study by Yap et al. (2020), which concluded that the optimal drying

temperature for simplisia was around 40°C–60°C.

Table 1. Chemical analysis results based on temperature variation

Drying Temperature	Antioxidant Levels DPPH (%)	Titrimetric Vitamin C Level (mg/100g)	pH Value
50°C (P1)	49.60	85.05	6.72
60°C (P2)	48.79	84.18	6.53
70°C (P3)	48.12	83.14	6.39

Note:
*Data are presented as mean values from three replicates.

Figure 1. Antioxidant measurement results based on temperature variation

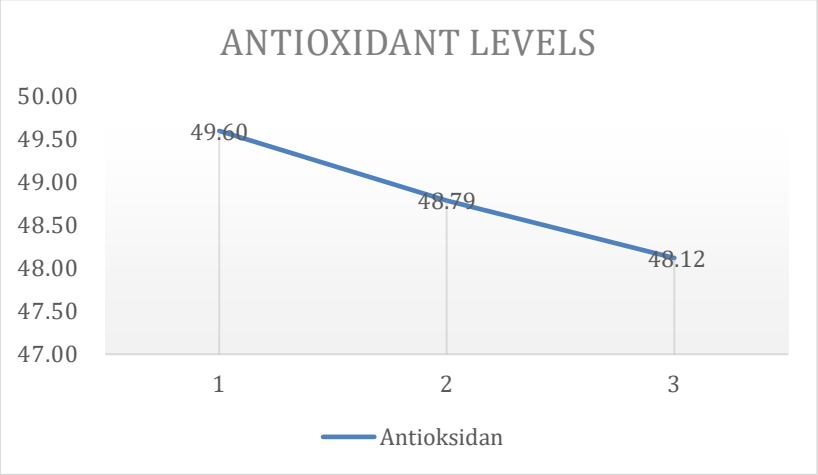
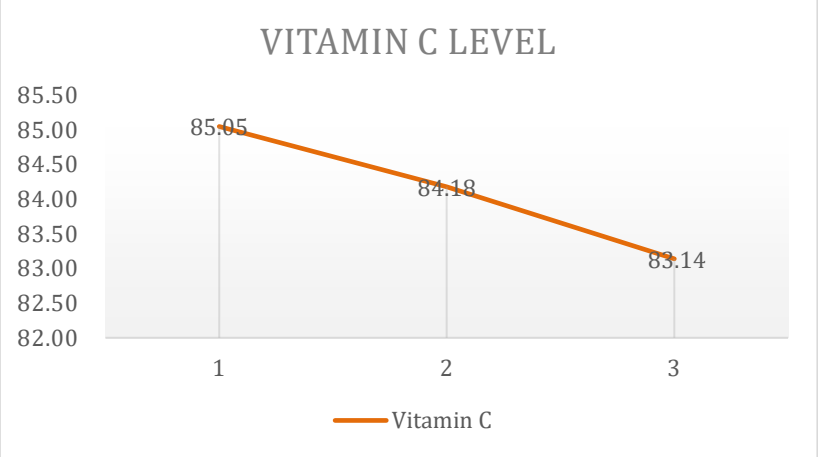


Figure 2. Vitamin C measurement results based on temperature variation



Vitamin C

Vitamin C levels are presented in **Table 1** and **Figure 2**. Based on the ANOVA test results, different drying temperatures had a significant effect on the vitamin C content of the rose flowers and katuk leaves combination tea. **Table 1** shows that the highest vitamin C content was found in the P1 treatment (dried at 50°C), with 85.05 mg/100g, followed by the P2 treatment at 60°C with 84.18 mg/100g, and the lowest in the P3 treatment at 70°C, with 83.14 mg/100g. The decreasing trend in vitamin C content as drying temperature increased is also illustrated in **Figure 2**.

The present study results support the findings of Murti (2017), who concluded that the highest vitamin C content was found at a drying temperature of 50°C (550.69 mg/100g), and the lowest at 70°C (131.64 mg/100g), indicating that vitamin C degrades with increasing temperature. Similarly, Wulandari and Sutardi (2021) stated that heat treatment during the processing of red rose petals significantly reduces vitamin C content. This is because vitamin C is sensitive to high temperatures, leading to thermal degradation (Amanto et al., 2016).

Based on the Tukey HSD test analysis, drying temperature had a significant effect on the stability of vitamin C content, with distinct patterns at each temperature level. A significant decrease in vitamin C was observed at higher temperatures. Specifically, there was a significant difference between 50°C and 70°C ($p = 0.004$, mean difference = 6.96), and between 60°C and 70°C ($p = 0.009$, mean difference = 5.91), both indicating significantly lower vitamin C levels at 70°C.

pH Measurement

The pH value is an important parameter in assessing the quality of rose flowers and katuk leaves combination tea produced during processing. Measuring the pH helps determine the level of acidity in the final product. The analysis results showed that drying temperature had a significant effect on the pH value. As shown in **Table 1**, the highest pH was observed in the P1 treatment (50°C) at 6.72, followed by P2 (60°C) at 6.53, and the lowest in P3 (70°C) at 6.39. These findings align with the research of Lagawa et al. (2019), which reported the highest pH value in tabah bamboo leaf tea dried at 50°C (6.56), and the lowest at 70°C (6.29). The decreasing pH with increasing drying temperature can be attributed to the degradation of compounds such as amino acids, sugars, and phenolic substances. These compounds can break down into acidic derivatives, leading to a reduction in pH value.

Physical Characteristics

Color

Tea color is affected by pigments in the leaves, such as chlorophyll and carotenoids, as well as tannin content. Drying temperature affects the visual appearance of the tea brew, particularly in the production of rose flowers and katuk leaves combination tea. As drying temperature increased, the tea brew color tended to darken. Observations from **Table 2** and **Figure 3** show that in the P1 treatment (50°C), the color of the brewed tea was light brown. When the drying temperature was increased to 60°C (P2), the steeped tea became reddish brown, and at 70°C (P3), it turned dark brown. These findings are consistent with the study by Ariva et al. (2020), which found that tea dried at 35°C produced a very light tea color; drying at 40°C, 45°C, and 50°C produced a typical golden yellow tea color; and drying at 60°C resulted in a reddish-brown hue.

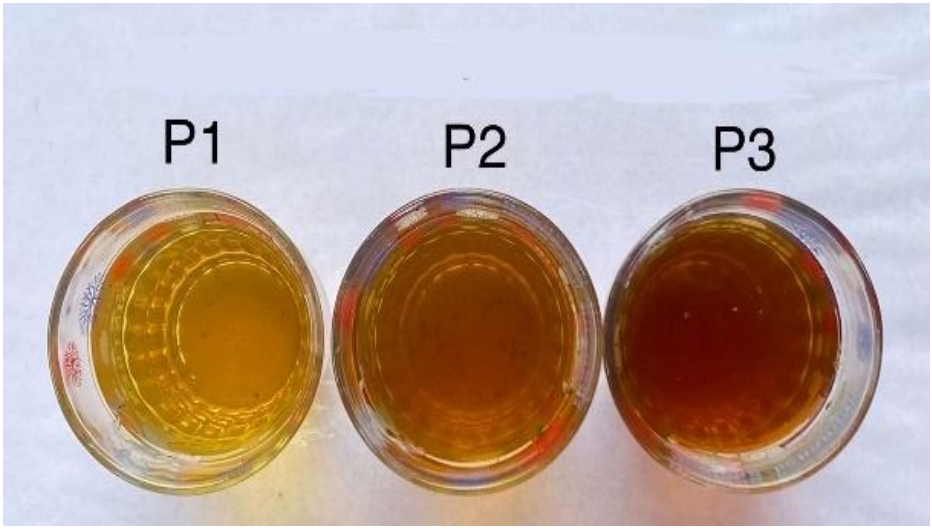
Drying temperature affects the chemical composition of tea, which contributes to its final color (Nafisah &

Widyaningsih, 2018). The light brown color observed in tea brewed from leaves dried at 50°C indicates that polyphenols and flavonoids have not been fully oxidized. As temperature increased to 70°C, a higher level of oxidation occurred, forming compounds such as theaflavins and thearubigins, which are responsible for reddish hues and darker pigmentation (Irbah et al., 2023).

Table 2. Physical characteristics analysis results based on temperature variation

Drying Temperature	Color	Taste	Aroma
50°C (P1)	Light brown	Bitter-astringent	Typical katuk leaf
60°C (P2)	Reddish brown	Bitter-astringent	Typical katuk leaf
70°C (P3)	Dark brown	Slightly bitter-astringent	Typical katuk leaf

Figure 3. Color of rose flowers and katuk leaves combination tea based on drying temperature variation: (P1) 50°C, (P2) 60°C, (P3) 70°C



Taste

The results of this study indicate that the rose flowers and katuk leaves combination tea across all drying temperature treatments consistently produced a bitter and astringent flavor. As shown in **Table 2**, the intensity of bitterness decreased with increasing drying temperature. This trend is attributed to the tannin compounds present in rose petals (Purwanto et al., 2024). According to Sari et al. (2020), tannins contribute to the bitter taste of tea and tend to degrade at high temperatures. Thus, higher drying temperatures reduce tannin content in the tea, which in turn lowers bitterness in the brew.

Aroma

Based on observations in **Table 2**, the aroma of the rose flowers and katuk leaves combination tea remained consistent across temperature variations, characterized by the distinctive scent of katuk leaves, which was more pronounced than the rose aroma. Katuk leaves possess a stronger and sharper natural fragrance. Although different drying temperatures may alter the composition of volatile aromatic compounds, the dominant compounds in katuk leaves, such as terpenoids and phenolics, are relatively stable and remain detectable during infusion (Simbolon et al., 2023).

Conclusion

The results demonstrated that drying temperature had a significant effect on antioxidant content, vitamin C levels, pH, and the physical properties of color and taste, but no effect on the aroma of the combination tea made from rose flowers and katuk leaves. Based on the physical and chemical analyses, the optimal treatment was found to be a combination dried at 50°C. This treatment yielded tea with an antioxidant content of 49.60%, a vitamin C content of 85.05 mg/100 g, a pH of 6.56, a light brown color, a slightly bitter taste, and the distinctive aroma of katuk leaves.

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