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Chemical Properties of Red Rose (*Rosa Indica L.)* Herbal Tea with Variations of Temperature and Drying Time

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ABSTRACT

Red roses (Rosa Indica L.) are ornamental plants containing functional compounds that are good for health, such as antioxidants, vitamin C, and polyphenols. Due to the functional compounds in red roses, they can be processed into herbal teas. This study aims to determine the chemical nature of red rose herbal tea with variations in temperature and drying time. This study was designed using a Completely Randomized Design (CRD) consisting of two treatment factors: drying temperature T1= 50 ºC, T2= 60 ºC, T3= 70 ºC, and drying time S1=2 hours, and S2=3 hours. The parameters measured were the water content in dried flowers, while the antioxidant activity and total phenol were carried out in steeping dried flowers. The study results were processed using a two-way ANOVA (analysis of variance). The results showed that temperature and drying time significantly affected moisture content, antioxidant activity, and total phenol of red rose herbal tea. Red rose herbal tea produced the lowest water content of 4.55% in sample T3S2, and the highest antioxidant activity was 54.01% in sample T1S1. The highest total phenol was 11.45 mg GAE/g in sample T1S1.

1. Introduction

Tea is one of the most popular beverages because of its refreshing taste. Based on [1], people often consume tea because of its distinctive aroma and taste. Tea is a beneficial beverage providing a fresh taste that can restore body health [2]. The benefits of tea beverages come from the chemical compounds in tea leaves. Tea contains bioactive compounds such as polyphenols as antioxidants. Currently, tea products have undergone many developments. Initially, the term tea was only intended for tea made from Camelia Sinensis tea leaves. Along with the development of science and technology, tea products can be made from nutritious plants other than Camellia Sinensis tea leaves. This type of tea is known as herbal tea. Herbal tea is a type of tea that is not made from the basic ingredients of Camellia Sinensis tea leaves. The term herbal tea is also used for beverages made from brewed fruit, spices, bark, flowers, leaves, and roots of plants [1]. Treatment using herbal plants is popular because it is affordable, easy to get, and safer because it is made from natural ingredients. It has milder side effects than chemical drugs.

Red rose (*Rosa Indica L.*) is a type of ornamental flower that can be used as a raw material for making herbal teas. Thorny stems, red flower crowns, and a very fragrant aroma are the characteristics of red roses. Besides being used as an ornamental plant, red roses are extracted for their essential oil as raw materials for making cosmetics such as perfume, rose water, aromatherapy oil, and so on. This ornamental plant is widely cultivated and is usually used as an ornamental flower at formal or non-formal events [3].

The antioxidant content of red roses is 98.4–1635.6 mol TE/g [4]. Antioxidants from red roses are flavonoid group compounds that function to ward off free radicals. According to [3], red roses also contain anthocyanin dyes of the malvidin type and cyanidin glycosides. Anthocyanin dyes from red roses can be applied as natural dyes for several products such as fruit juice, yogurt, jelly, and carbonated drinks [3]. Besides antioxidants, based on [3], Red roses contain 0.8% essential oil, 1569 mg/100g vitamin C, and 83.32% water content. According to [5], Essential oil from roses serves to calm, and reduce depression and stress. With the content of nutritious compounds in red roses, they can be processed and used as raw materials in the manufacture of herbal teas.

The processing of red roses into herbal teas must go through the drying stages. Based on [6], drying is a technique used to remove most of the water from a product by applying heat energy. The moisture content of the material can decrease during the drying process to suppress the growth of fungi and bacteria and reduce the activity of enzymes that cause material damage so that the material's shelf life is longer. Temperature and drying time are factors that can affect the drying process. The use of high temperatures for a long time during the drying process can damage the chemical components contained in tea products. According to [7], the anthocyanin value, total phenol, and water content of the telang flower herbal tea will decrease with increasing temperature and drying time. The research written by [8] also mentioned that a too high drying temperature for a long time resulted in decreased antioxidant activity and total phenol of lotus flower tea. Meanwhile, a very low drying temperature with a very short drying time results in high moisture content of the material so that the dried material is easily damaged.

The making red rose herbal tea used a combination of temperature treatment and drying time to know the chemical properties of red rose herbal tea. So, it is necessary to know the right drying temperature and time so as not to damage the chemical components of the red rose herbal tea.

2. Research Methodology

2.1. Tools and Materials

The tools in this research are cabinet dryer, oven, Ohaus digital scale, stopwatch, and thermometer. It also uses a set of analysis tools for water content, antioxidants, and total phenol. The ingredients used for making herbal teas are red roses taken in the Ungaran area, Ambarawa, East Java. The chemicals used in this study were 0.2 mM DPPH solution, methanol PA, Folin Ciocalteu reagent, gallic acid solution with a concentration of 200 ppm with dilution series (0.2 mg/ml; 0.16 mg/ml; 0.12 mg/ml; 0.08 mg/ml; 0.04 mg/ml; 0 mg/ml) and 7.5% Na_2CO_3.

2.2. Procedure for Making Red Rose Flower Herbal Tea

It used the modified method developed by Martini et al. [7] in making red rose herbal tea. The red roses that had been sorted and washed using running water were withered for 8 hours and then dried using a cabinet dryer with a drying temperature of T1=50 ℃, T2=60 ℃, T3=70 ℃, and a drying time S1=2 hours and S2=3 hours. The dried herbal tea samples were then brewed using a modified method [9]. A total of 2.5 grams of dried herbal tea samples that had been given variations in temperature and drying time were brewed with 200 ml of hot water at 95 ℃ for 8 minutes.

2.3. Water Content Analysis of Red Rose Herbal Tea

Measurement of the water content of red rose herbal tea was based on the Thermogravimetric method [10]. A total of 1 gram of dry herbal tea samples given various treatments were put into a lead bottle with a known weight and in an oven at 150 ℃ for 24 hours. Samples in weighing bottles were heated in an oven with a temperature of 150 for 4 hours, then put in a desiccator for 30 minutes for cooling. Samples that have been cooled are weighed until their weight is constant.

2.4. Antioxidant Activity Analysis of red Rose Herbal Tea

Measurement of antioxidant activity of red rose herbal tea used the DPPH method [11-12] with several modifications. A total of 1 mL of dry herbal tea samples that have been brewed were mixed with 4 mL of 0.2 mM DPPH solution and then incubated for 30 minutes. The blank solution was made by mixing 0.2 mM DPPH solution and 1 mL distilled water, while the comparison solution was made by mixing 1 mL ascorbic acid solution with 4 mL 0.2 Mm DPPH solution. The

absorbance of the sample solution was measured with a maximum wavelength of 517 nm to detect how much antioxidant compound was contained in the sample solution after 30 minutes.

2.5. Total Pheno Analysis of red Rose Herbal Tea

The measurement of total phenol of red rose herbal tea was analyzed using the Folin-Ciocalteu method [13-14]. A total of 0.2 ml of the brewed herbal tea sample was added with 1 ml of Folin-Ciocalteu reagent and incubated for 3 minutes. After being incubated for 3 minutes, 0.8 mL of 7.5% Na_2Co_3 solution and 3 mL of distilled water were added and then incubated for 30 minutes. Then the absorbance was measured at a wavelength of 753 nm. Determination of the calibration curve using gallic acid as a standard solution.

2.6. Data Analysis

After collecting the research data using the IBM SPSS Statistics 21 application, data analysis was carried out. Data from the water content test, antioxidant activity, and total phenol samples will be processed using the two-way ANOVA statistical test.

3. Result and Discussion

Water Content

The data from the water content test of red rose herbal tea was processed using two-way ANOVA statistical analysis. Statistical test results obtained *sig* value. 0.000 for the drying temperature, which means it has a significant effect, and the *sig*. value is obtained. 0.001 for drying time which shows a significant effect on moisture content. While the value of *sig.* for temperature and drying time is 0.468, which means that the interaction between temperature and drying time does not affect the water content of red rose herbal tea. The results of testing the water content of herbal tea samples are in Table 1.

Table 1. Results of Moisture Content Analysis of Red Rose Herbal Tea.

Treatment		Water Content (%)
Time (Hour)	*Temperature (°C)*	
2	50	9.04 ± 0.52
	60	7.48 ± 0.72
	70	5.58 ± 0.42
3	50	7.97 ± 0.22
	60	6.99 ± 0.13
	70	4.55 ± 0.37

Notes: Figures are the mean ± standard deviation of 3 replications.

Based on Table 1, the highest water content of rose herbal tea was obtained from samples with a temperature of 50 °C for 2 hours at 9.04%, while the lowest value was obtained from the sample with a temperature of 70 °C for 3 hours, namely 4.55%. Based on the research data, the water content of the red rose herbal tea sample tends to decrease with the addition of temperature and drying time. The decrease in the moisture content of the dried material was thought to be caused by the evaporation of water from the material to the air during the drying process. It was supported by research from [7] which showed that the water content of Telang flower tea decreased due to the high temperature and long drying time. Variations in temperature and drying time caused different evaporation. According to [15], the amount of water that evaporates in food will increase if the drying time is longer because the heat received by the material will be longer, causing the water content to be low. According to [16], the high temperature during the drying process causes the heat energy under the air to be greater so that more water evaporates from the material's surface.

Antioxidant Activity

The statistical analysis results of two-way ANOVA on the red rose herbal tea sample obtained a *sig* value. ($P<0.05$) for the drying temperature factor, drying time, and the interaction between temperature and drying time. It means that it has a significant effect on the antioxidant activity of red rose herbal tea. Data on the results of testing the antioxidant activity of herbal tea samples are shown in Table 2.

Table 2. Results of Antioxidant Activity Analysis of Red Rose Herbal Tea.

Treatment		Antioxidant Activity (%)
Time (Hour)	***Temperature (°C)***	
2	50	54.01 ± 0.82
	60	40.94 ± 0.49
	70	23.76 ± 2.10
3	50	51.96 ± 1.11
	60	33.10 ± 0.72
	70	20.49 ± 0.93

Notes: Figures are the mean ± standard deviation of 3 replications.

Based on Table 2, the highest antioxidant activity was obtained from samples with a temperature of 50 °C for 2 hours at 54.01%, and the lowest antioxidant activity was obtained from a temperature of 70 °C for 3 hours, namely 20.49%. The results of this study indicate that the higher the temperature with an extended drying time, the antioxidant activity will decrease. It is supported by research from [8] that the higher temperature and drying time causes a decrease in the antioxidant activity of lotus flower tea. Antioxidant compounds will be damaged when exposed to high temperatures with long drying times. The antioxidant activity in this study decreased because the samples were given different heat treatments at different temperatures and drying times. It happens because antioxidants will be damaged by heat and cooking. According to [17], the higher the temperature and the longer the heating time, the compounds that act as antioxidants are damaged.

According to [18], heating treatment will increase the oxidation of antioxidants in the material, causing the antioxidant activity to decrease. The bioactive components that act as antioxidants in red rose herbal tea come from the flavonoid group, namely anthocyanins. Anthocyanins are bioactive compounds that can be damaged by heating so that when herbal tea samples are treated with different temperatures and drying times, different antioxidant activities will be obtained. Treatment of temperature and drying time causes anthocyanin compounds in rose herbal tea to be degraded. According to [7], the high temperature with a long drying time causes the aglycone ring to open on the anthocyanin compound to form a colorless carbinol and chalcone groups so that the anthocyanin compound is damaged and causes a decrease in the antioxidant activity of red rose herbal tea.

Total Phenol

The results of the statistical analysis of two-way ANOVA on samples of red rose herbal tea obtained *sig* values ($P<0.05$) for drying temperature, drying time, and the interaction between temperature and drying time, which means that it has a significant effect on total phenol. The data on the total phenol test results for herbal tea samples are in Table 3.

Table 3. Results of Total Phenol Analysis of Red Rose Herbal Tea.

Treatment		Total Phenol (mg GAE/g)
Time (Hour)	**Temperature (°C)**	
2	50	11.45 ± 0.12
	60	6.65 ± 0.25
	70	1.89 ± 0.06
3	50	8.72 ± 0.51
	60	6.47 ± 0.15
	70	1.74 ± 0.06

Notes: Figures are the mean ± standard deviation of 3 replications.

Based on the results of the study in Table 3, the highest total phenol was found in the sample with a temperature of 50 °C for 2 hours of 11.45 mg GAE/g and the lowest total phenol value was obtained from the sample with the temperature of 70 °C for 3 hours at 1.74 mg GAE/g. The research data shows that the high temperature and long drying time used to cause the total tea phenol produced to decrease. It is supported by research from [8] that the higher temperature and drying time decreased the total phenol of lotus flower tea. The decrease in total phenol is thought to be due to the high-temperature treatment with extended drying time to cause the damage to phenol compounds in the red rose herbal tea sample. According to [7], phenolic compounds are not resistant

to heat, so heating at high temperatures and for a long time causes the material to be exposed to heat for a longer time so that the chance of heat damaging phenolic compounds is higher. The nature of phenolic compounds that are not resistant to heating causes the decrease in total phenol levels in red rose herbal tea. The total phenol level is directly proportional to the antioxidant activity. It can be seen from the data from the antioxidant activity test results and the total phenol in the red rose herbal tea sample that whereas the total phenol decreases, the antioxidant activity also decreases. According to [17], decreased levels of phenols, flavonoids, and tannins can cause antioxidant activity also to decrease.

4. Conclusion

Variation of temperature and drying time significantly affected moisture content, antioxidant activity, and total phenol of red rose flower herbal tea. Red rose herbal tea produced the lowest water content of 4.55% in sample T3S2, the highest antioxidant activity was 54.01% in sample T1S1, and the highest total phenol was 11.45 mg GAE/g in sample T1S1.

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