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Test of Antioxidant and Vitamin C Levels in the Combination of Rose Tea (*Rosa damascena Mill*) and Lemon (*Citrus limon* L.) with Variations of Clay and Aluminum Frying Pans

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Abstract: *Tea is a drink made from the shoots of the Camellia sinensis plant that has undergone certain processing processes such as wilting, grinding, enzymatic oxidation, and drying. The activity of drinking tea is a habit that has long been known to the Indonesian people. A study has been conducted on the antioxidant and vitamin C content test in a combination of rose tea and lemon with variations of clay and aluminum frying tools. The purpose of this study was to determine the* antioxidant *levels and vitamin C content in rose tea and lemon. This study used an experimental research type with a Completely Randomized Design (CRD) with one factor, namely frying variations with three replications. Antioxidant activity was measured by the free radical capture method with DPPH, while the vitamin C test used the Iodometric titration. The results of 2 samples showed that the highest antioxidant levels were found in the clay pot frying treatment. The data were analyzed using SPSS 28 software with the results of the prerequisite test with the normality test and the homogeneity of variances test, then an independent sample T-test was carried out showing a significant value of antioxidant and vitamin C levels with <0.005 so that it can be concluded that the difference in treatment has an effect or is significant on the antioxidant and vitamin C levels of rose and lemon tea.*

Keywords: *Herbal tea, rose flower, lemon, antioxidant level test, vitamin C, frying*

1. INTRODUCTION

Tea is a drink in the form of brewed water from plant leaves that is usually consumed, because tea is often a drink that is widely consumed after water. Tea is a drink that comes from the leaf tips of the *Camellia sinensis* plant that has undergone certain processing processes such as wilting, grinding, enzymatic oxidation, and drying (Wirda Hayati *et al*., 2022). The activity of drinking tea is a habit that has long been known to the Indonesian people (Khamidah *et al*., 2020).

Roses have the weakness of easily wilting and being damaged if not immediately handled further. Tea is known to contain antioxidant compounds such as polyphenol compounds, flavonols, catechins, catechin gallate, adenine, caffeine, theobromine, theophylline, gallic acid, tannins, and gallotannins (Aboulwafa *et al*., 2019). Rose flowers (*Rosa damascena*) contain high levels of antioxidants, antiseptics, antibacterials and vitamin C. (Imran, 2023) so that roses can be made into tea (Sartika *et al*., 2023). Tea has health benefits, including improving heart health, aiding weight loss, and improving concentration. Although tea is a beverage that is generally considered healthy and has various health benefits, tea consumption can also have some potential risks or dangers, because there are substances that have bad effects on the body in tea, namely caffeine. Caffeine in tea can cause the process of food absorption to be inhibited (Wahyuni *et al*., 2019). The tannin content in tea can also inhibit iron absorption if consumed at the

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wrong time, such as during meals or within an hour after eating. This habit is one of the causes of iron deficiency anemia.(Sariyanto *et al*., 2019).

Lemon (*Citrus limon*) is a plant of the citrus genus. The main characteristics of the lemon plant are thorny branches and white flowers with purple edges, sour, juicy fruit, oval (egg- shaped), has a yellow aromatic skin when ripe. Empirically, lemons are believed to be rich in vitamin C which is important for body health. Lemons are widely used as food or drink ingredients, medicines, cosmetics, detergents and aromatherapy (Waris *et al*., 2024). Lemon fruit is a plant that has benefits as a natural antioxidant because it contains vitamin C, citric acid, polyphenols, flavonoids, bioflavonoids, coumarins, essential oils and volatile oils in its skin such as limonene (±70%), polyphenols, coumarins, α-terpenin, α-pinene and β-pinene.

Antioxidant compounds have characteristics that are able to capture free radicals. Natural antioxidant components such as tocopherol, ascorbic acid and flavonoids have been widely studied because their activities have properties as antitumor, antimutagenic, anticancer and other diseases. The DPPH method is always used as a method in testing antioxidant activity because it only requires a comparison compound, stable compound properties and does not require a substrate (Julizan *et al*., 2019).

Vitamin C is a natural antioxidant compound that is often used as a comparative compound in testing antioxidant activity, because natural antioxidant compounds are relatively safe and do not cause toxicity (Lung *et al*., 2017). Vitamin C also acts as an antioxidant, accelerates wound healing, the process of hydroxylation of adrenal cortex hormones, collagen formation and lowers cholesterol levels in the blood (Hasanah, 2018).

Physical properties include color, taste, and aroma. Physical property testing is also known as sensory testing or sensory testing is a testing method that uses human senses as the main tool to measure the acceptance of a product. The senses used in sensory testing are sight/eyes, smell/nose, taste/tongue and touch/hands (Gusnadi, 2021).

Drying is the process of using heat to remove most of the water from a material. Drying can reduce the water content of the material, thus inhibiting the growth of bacteria and fungi. It can also reduce the activity of enzymes that can damage the material, meaning that the material can be stored and kept for longer. Water can affect the physical properties of the material and change the color, texture, and aroma of food. The main purpose of drying is to reduce the amount of water in food so that it can prevent the spread of unwanted microbes (Lagawa *et al*., 2019).

Roasting is a very important processing activity to develop specific organoleptic properties (aroma, taste and color) that underlie tea roasting. However, this process is very complex, because the amount of heat transferred is very important. The use of a frying pan made of clay (earthenware) with a wood-burning stove provides more even roasting results and a more fragrant tea aroma. The results showed that the parameters of changes in the physical properties of tea leaves occurred faster in a metal pan. From the results of the preference test for the aroma and taste of tea, all panelists preferred tea roasted using an earthenware pan compared to a metal pan (Marpaung *et al*., 2021).

2. RESEARCH METHOD

This study uses an experimental research type. The design of this study used a Completely Randomized Design (CRD) with 1 factor, namely frying variations with 3 replications. The variables studied were a combination of lemon rose tea with drying variations using clay and aluminum frying pans, antioxidant and vitamin C tests. The entire experiment was carried out using 2 treatments and produced a combination of overall factors, namely 2 x 3 with 3 repetitions. So the total sample repetition is 6 repetitions.

Place and time of research:

The making of rose tea with a combination of lemon was carried out in the Food Science Laboratory of the Nutrition Study Program, FIK, Muhammadiyah University of Surakarta, while the antioxidant content and vitamin C content test of rose tea with a combination of lemon were carried out in the Food Quality Analysis Laboratory of the Nutrition Study Program, FIK, Muhammadiyah University of Surakarta. This research was conducted from September to December 2024. The stages of this research began with preparing tools and materials, making samples of rose tea combined with lemon, antioxidant tests, vitamins C and physical properties testing.

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Tools and materials:

The tools used in this study consist of tools used for making lemon rose tea, testing vitamin C content, testing antioxidant levels, testing pH acidity, roasting rose tea and organoleptic testing (color, taste, aroma). The tools used in making rose tea are stove, pan, strainer, basin, digital scale, measuring cup, beaker, glass jar, tray, knife, clay frying pan, aluminum frying pan and spatula. The tools used in the vitamin C test are test tubes, test tube racks, pipettes, Erlenmeyers, labels, plastic. The tools used in the antioxidant test are*magnetic stirrer*, Erlenmeyer Flask, vortex mixer DLAB Mx-S, stopwatch. The tools used to measure pH are glass jars, pH indicators and pH sticks. The tools used for the test physique namely plastic cups.

The materials used in this study consisted of materials used to make lemon rose tea, vitamin C content test, antioxidant level test, acidity test (pH), and organoleptic test (color, taste, aroma). The materials used in making lemon rose tea were rose flowers, lemon, boiling water. The materials used in the vitamin C test were standard I2 solution. The materials used in the antioxidant test were DPPH solution, methanol, distilled water, citric acid. The materials used to measure pH and organoleptic test were lemon rose tea samples.

Making Lemon Rose Tea:

Preparation stage

Prepare the tools and ingredients that will be used to make a combination of rose tea with lemon. Wash the rose and lemon until clean, wash repeatedly so that the frying of the ingredients is maintained, then drain.

Withering stage

Roses and lemons that have been washed clean are spread out in a shady place so that the remaining washing water disappears and they wilt. The withering process is carried out for 24 hours or 1 day so that when drying you get good tea frying results.

Drying stage

After wilting for 1 night, the roses are dried in the sun until dry (1 day) with a black cloth cover on top so that they are not exposed to dust etc. Lemons that have been wilted for 1 night are cut thinly and then dried in the sun for 1 day using a black cloth cover on top so that they are not exposed to dust etc.

Roasting stage

The dried rose flower weighing 160 g will be divided into 2 parts, in each roasting treatment with 2 different frying pans, the first frying using a clay frying pan while the second using an aluminum frying pan. The dried lemon weighs 120 g, divided into 2 parts and roasted using a clay frying pan and an aluminum frying pan.

Refining stage

Puree the roses and lemons using a blender until smooth (to blend the roses and lemons, you need to do it differently according to the treatment of each), for the roses 10 seconds and for the lemons 2 minutes.

Weighing stage

The powdered rose and lemon flowers are then weighed using a digital scale. The ratio is 1:1 (1g rose flower : 1g lemon).

Packaging stage

Put 1g of rose flower powder and 1g of lemon into a tea bag based on 2 treatments, then label it.

Brewing Stage

Prepare 2 cups of tea, then brew 2 tea bags containing lemon rose tea powder with boiled water at 100°C for 5 minutes.

Antioxidant Level Testing:

This method uses IC50 as a parameter to determine the concentration of antioxidant compounds that can inhibit 50% of DPPH free radical activity. The smaller the IC50 value, the higher the antioxidant activity. Then to determine the IC50 value, a relationship curve is made between the extract concentration and the percentage of inhibition which will produce a linear regression equation. The antioxidant content test in this study was measured using the DPPH method (Kang Sing Lung *et al*., nd)

$$\text{DPPH antiradical activity (\%)} = \frac{A\ blanko - A\ sample}{A\ blanko} x100\%$$

Description: A = Absorbance Value

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Vitamin C Content Testing:

Iodometric and iodimetric titration is one of the titration methods based on redox reactions. This method is more widely applied in analysis when compared to other methods because the stoichiometric comparison is simple to use, practical and not many problems and easy. Iodimetry is a titration or volumetric method whose determination is based on the amount of I2 (Iodine) that reacts with the sample (ascorbic acid) or is formed from the reaction between the sample and iodide ions. The indicator used in iodimetry is a 5% starch solution. The equivalent point is marked by a color change from blue to clear (Iskandar, 2017).

$$\text{Vitamin C content (mg/100 g)} = \frac{ml\ iod\ x\ 0{,}88\ x\ FP}{berat\ bahan} x100$$

Information :
0.88 : 0.88 mg of ascorbic acid is equivalent to 1 mL of 0.01 N 12 solution
Fp : Dilution Factor

Physical Properties Testing:

Physical properties test or sensory test is a testing method using human senses as the main tool for measuring product acceptance. Organoleptic frying test in this study is in the form of color, taste and aroma which are determined by acceptance test. In principle there are 3 types of physical properties test, one of which is the preference test (hedonic) (Permadi *et al*., 2019).

Data analysis:

This study uses data analysis conducted after the data is collected. Antioxidant levels, vitamin C content were analyzed using quantitative descriptive methods using independent sample T-tests and physical properties of tea were analyzed using quantitative descriptive methods.

3. RESULTS AND DISCUSSION

After 24 hours/1 day of drying, 1 kg of roses and 290 g lemons were harvested. dried for 1 day under the sun using a black cloth cover on top to prevent dust, etc. During the drying stage, the roses and lemons shrink to 160grose flowers and 120 g of lemon, the drying results will be divided into 2 parts and roasted using two treatments, namely P1 = Clay frying and P2 = Frying aluminum. Roasting is done with low heat for 5 minutes for clay frying pans while aluminum requires 10 minutes for roasting.

Drying by roasting method can affect physical frying through color changes and decreased water content. According to Joko *et al*., (2009) stated that during the roasting process there is heat transfer from the roasting media to the food material and also water mass transfer. The heat that causes changes in the water mass of the material is due to the latent heat of evaporation. Changes in water mass occur when the water content in the material has reached a saturated condition, causing the water content in the material to change from the liquid phase to vapor.

Results roasted rose and lemon flowers will be ground using a blender with different times between rose and lemon flowers. rose flowers need 10 seconds in grinding while lemons need 2 minutes. Rose and lemon powder are put into tea bags with a ratio of 1: 1 according to the treatment.

Antioxidant Level Test Results

The results of the antioxidant content test are shown in Table 1 below:

Table 1. Antioxidant Level Test Results

Treatment	% rate
P1.UI	42.68
P1.U2	43.03
P1.U3	42.76
Average	**42.82**
P2.U1	37.61
P2.U2	38.34
P2.U3	38.05
Average	**37.98**

Information:
P1: Roses and lemons are dried under sun light then roasted using a clay pan.
P2: Roses and lemons are dried under the sun and then roasted using an aluminum frying pan.

Based on **Table 1** shows that the antioxidant content of each treatment is different. The highest antioxidant content of rose tea combined with lemon in the roasting treatment using a clay frying pan with an average of 42.82%.

While the lowest antioxidant content in the roasting treatment using an aluminum frying pan with an average of 37.98%.

Vitamin C Content Test Results

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The results of the vitamin C content test are shown in Table 2 below:

Table 2. Vitamin C Content Test Results

Treatment	% rate
P1.UI	36.71
P1.U2	36.13
P1.U3	35.99
Average	36.28
P2.U1	33.17
P2.U2	33.86
P2.U3	32.67
Average	33.23

Information:
P1: Roses and lemons are dried under the sun and then roasted using a clay pan.
P2: Roses and lemons are dried under the sun and then roasted using an aluminum frying pan.

Based on **Table 2**, it shows that the vitamin C content of each treatment is different. The highest vitamin C content of rose tea combined with lemon is in the roasting treatment using a clay frying pan with an average of 36.28%. While the lowest vitamin C content is in the roasting treatment using an aluminum frying pan with an average of 33.23%.

The results of the highest antioxidant levels can be seen in the Percent statistics and continued with one way ANOVA analysis with the non-parametric assumption test method or commonly called the homogeneity test, the antioxidant results obtained were <0.005.

The DPPH free radical scavenging activity of rose tea combined with lemon increased along with the decreasing composition of lemon peel in treatments P1 and P2. The highest DPPH free radical scavenging activity was found in the roasting treatment using a clay frying pan (P1) with a statistical percentage reaching 0.302%. The lowest DPPH free radical scavenging activity was found in the roasting treatment using an aluminum frying pan (P2) with a statistical percentage of 0.221%. This is likely due to the roasting time affecting the phenol content and the value obtained will be smaller (Setiawan *et al*., 2015)

Vitamin C testing on 2 treatments of rose tea combined with lemon using the iodometric and iodimetric titration methods, which are titration methods based on redox reactions (Iskandar, 2017). The highest vitamin C content test results fell on the clay frying treatment (P1) with a statistical percentage reaching 0.316% while the lowest vitamin C activity levels fell on the aluminum frying treatment (P2) with a statistical percentage reaching 0.209% so that it can be concluded that roasting variations do not affect the vitamin C content of rose tea combined with lemon. Vitamin C can be formed from L-ascorbic acid and L-dehydrocorbic acid, both of which have activity as vitamin C. Ascorbic acid is very easily reversibly oxidized to L-dehydrocorbic acid. L-dehydrocorbic acid is chemically very labile and can undergo further changes to L- diketogulonic acid which does not have vitamin C activity. of all vitamins. Vitamin C is the most easily damaged vitamin, easily oxidized, very soluble in water, easily lost due to heat. (Winarno, 2004)

Based on the results of statistical testing using SPSS 28 software with the results of prerequisite tests with normality tests and homogeneity of variance tests with clay frying pan roasting and aluminum frying pan roasting methods on antioxidant and vitamin C levels showed normal data, then an independent sample T-test was carried out showing a significant value of antioxidant and vitamin C levels with <0.005 so that it can be concluded that the difference in treatment has an effect or is significant on the antioxidant and vitamin C levels of rose and lemon tea.

Formulas that have antioxidant activity will be continued to physical properties testing. Physical properties testing in this study used the affective method. The affective method is a method used to measure the subjective attitude of consumers towards products based on organoleptic properties (Sudarsi *et al*., 2018). The test chosen in the affective method is the preference test.

The preference test is the most widely used test to measure the level of preference of a product. This test was conducted on a rose tea formula combined with lemon which has high antioxidant activity which was given a roasting treatment using a clay frying pan. The use of a frying pan made of clay (earthenware) with a wood-burning stove provides more even roasting results and a more fragrant tea aroma (Marpaung *et al*., 2021).

This preference test used 10 panelists with an age range of 20-23 years. The results of the preference test of the 10 panelists for rose tea combined with lemon with the selected treatment, namely roasting using a clay frying pan with a red

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color that has a lemon aroma with a fitting taste, while the aluminum frying pan roasting treatment has a darker red color to black with a normal aroma and the taste is more inclined to citrus acid.

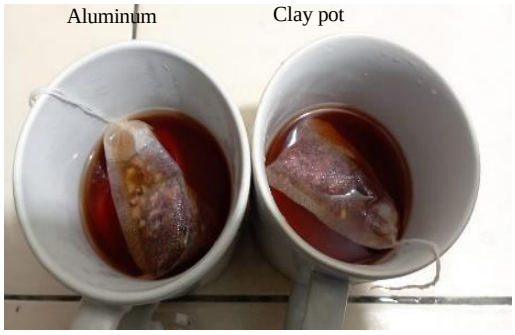

Figure 1. Sample image of rose flower tea combined with lemon

4. CONCLUSION

The highest antioxidant levels are found in rose tea combined with lemon when roasted using frying clay compared to roasting treatment using aluminum frying pan. The highest vitamin C content fell on rose tea combined with lemon in the roasting treatment using clay frying pan compared to aluminum frying pan. For the hedonic characteristic test of color, taste and aroma, the highest was the roasting treatment using clay frying pan with the category of liking.

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