

Comparison of Caffeine Compound Levels in Brewed and Boiled Oolong Tea Leaves (*Camellia sinensis* (L.) Kuntze) Based on Different Processing Methods

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ABSTRACT

Introduction: Tea contains many compounds that are beneficial for the body, namely caffeine. The process of brewing tea with a time and temperature that is not optimal can affect the caffeine content in it. And the brewing process by heating can widen the distance between the molecules in the tea. The higher the temperature and the longer the brewing time, the higher the caffeine content. **Aims:** This study aims to analyze the caffeine content of brewed and boiled oolong tea, then compare the caffeine content of oolong tea with brewing (without heating) and boiled (with heating) processes. **Methods:** The research method used is experimental. This study used dried samples of oolong tea leaves (*Camellia sinensis* (L.) Kuntze). Quantitative analysis using UV-Vis Spectrophotometry. **Result:** Quantitatively, the caffeine content in brewed oolong tea was 3.522% w/w and the caffeine content in boiled oolong tea was 4.001% w/w. The conclusion of this study is that there is no significant difference in caffeine levels in brewed and boiled oolong tea with a significant value of $P > 0.05$.

KEYWORDS: Caffeine, tea, brewed, boiled, UV-Vis spectrophotometry.

INTRODUCTION

A tea that undergoes partial oxidation in the production process is oolong tea. Oolong coffee is made by allowing the tea to dry in the sun and wind. Tea leaves are aerated and exposed to sunlight while being sifted to get the right level of oxidation. Oxidation to the desired level. Since oolong tea has been partially oxidized, its antioxidant concentration is lower compared to green tea, but higher than black tea (Artanti et al., 2016). The flavor

and aroma of oolong tea is superior to green tea, and has a tendency to taste bitter (Dewi et al., 2016). After water, tea is the most widely consumed beverage. In addition to various health benefits, tea contains a number of elements that can harm the body, especially caffeine (Danasrayaningsih, 2015). Excessive use of caffeine can have adverse effects on the body, such as headaches, insomnia, digestive problems, and psychomotor agitation (Yonata & Saragih, 2016). The type of tea also affects

how much caffeine it contains (Novita & Aritonang, 2017). Green tea (unfermented), black tea (fully fermented), and oolong tea (partially fermented) are three categories of tea types based on the processing process (Atmaja & Kurniawati, 2018).

Based on the habits of Indonesian people, people brew tea in less than five minutes using hot water at 70 degrees Celsius or boiling water at 100 degrees Celsius because it does not require a long time to make in everyday life (Putri & Ulfin, 2015). Temperature and extraction time are an impact on the amount of caffeine in black tea; the higher the temperature and the longer the extraction time, as caffeine is present in the tea (Wardani & Ferry Fernanda, 2016). UV-Vis Spectrophotometry method is the technique used. Because of its advantages which are easier to use, faster, more cost-effective, and very sensitive, UV-Vis Spectrophotometry was used in this study (Suryadi et al., 2010).

To try to determine which tea method has the best caffeine levels that are more reasonably priced for consumption by those who are not tolerant to it and those who experience side effects, the researcher would like to use UV-Vis Spectrophotometry to compare the caffeine levels of the dyed and drawn oolong with the dyed and pasted levels (Agustina Styawan et al., 2023.). It would allow them

to determine whether there is a significant difference in caffeine levels present in the oolong and the print and pay process (Styawan et al. 2024).

MATERIAL AND METHODS

This research was conducted using the experimental method. The population in this study was dry simplisia of tea plants (*Camellia sinensis* (L.) Kuntze) taken from “Kemuning Mbok Karti Tea”, which is located in Kemuning, Ngargoyoso District, Karanganyar Regency. The sample used was 500 grams for dry simplisia of oolong tea (*Camellia sinensis* (L.) Kuntze). While the materials used are anhydrous caffeine (PT Brataco) chloroform (PT Brataco), calcium carbonate (PT Chemix), aquadestilata (PT Chemix).

Quantitative Analysis of Caffeine Content

Preparation of 1000 ppm Caffeine Standart Solution

Weighed as much as 250 mg of caffeine, put into a glass cup, dissolved with enough hot distilled water, put into a 250 ml volumetric flask, diluted with distilled water to the mark line and homogenized (Maramis et al., 2013).

Preparation of 100 ppm Caffeine Standart Solution

Piped caffeine standard solution of 1000 ppm mother liquor as much as 2.5 mL was put into a 25 mL volumetric flask, then diluted with distilled water until the mark

line and homogenized (Maramis et al., 2013).

Wavelength Determination

Detection of absorbance of standard solution in the wavelength range of 250-300 nm using UV-Vis spectrophotometer instrument (Maramis et al., 2013).

Preparation of Standard Curve

The standard solution was taken 0.25; 0.3; 0.35; 0.4; 0.45; 0.5 mL of caffeine standard solution 2.5 mL/25 mL, then diluted into 5 mL of distilled water, the concentration of the standard solution obtained successively is 5; 6; 7; 8; 9; 10 mg/L (Maramis et al., 2013).

Determination of Sample Content

Read the absorbance with a spectrophotometer at a wavelength of 275 nm with a blank absorbance of distilled water, then calculate the amount of caffeine from the respective absorbance numbers (Maramis et al., 2013).

RESULTS AND DISCUSSION

Mbok Karti Kemuning Tea, situated in Kemuning, Ngargoyoso District, Karanganyar Regency, provided the oolong tea used in the present study. In a blender, simplisia is ground into a fine powder to make it into tea. The purpose of the extraction procedure is to extract the compounds—specifically, caffeine—from tea. Extraction is carried out using reflux. The principle of the reflux method is to draw chemical components carried out by

means of a sample inserted in a round bottom flask along with a distiller's solution and then heated (Susanti et al., 2020). The reflux extraction process is carried out by boiling the sample added with aquadestilata and CaCO_3 with the aim of helping the caffeine in tea so that the caffeine is free. Boiling the solution is intended to separate caffeine and other substances because CaCO_3 dissolves in heat (Romandhoni & Arrosyid, 2018).

Tea caffeine levels were obtained by filtering the tea solution using flannel. Then separated with a separating funnel by adding chloroform (Zarwinda & Sartika, 2019). Chloroform is an extractor that does not mix with the original solvent (Raharjo, 2010). Then shaking is carried out so that there is an equilibrium in the concentration of the extracted substance in the two layers formed. The bottom layer was taken and evaporated with a waterbath until the chloroform fraction disappeared (Fajriana & Fajriati, 2018).

Quantitative Test of Caffeine Content Using UV-Vis Spectrophotometric Method

Table 1. Standard Curve

Concentration (ppm)	Absorbance
5	0,328
6	0,332
7	0,426
8	0,431
9	0,458
10	0,496

Table 2. Determination Result of Brewed Caffeine Content

Replication	Vol (ml)	Concentrations (ppm)	Sample weight (mg)	Dilution factor	Abs	Levels (% b/b)
1	25	28,6876	50	2,5	1,151	3,585%
2	25	28,2005	50	2,5	1,134	3,525%
3	25	27,6561	50	2,5	1,115	3,457%
$\bar{X}$						3,522%

Table 3. Determination Result of Boiled Caffeine Content

Replication	Vol (ml)	Concentrations (ppm)	Sample weight (mg)	Dilution factor	Abs	Levels (% b/b)
1	25	29,9197	50	2,5	1,194	3,799%
2	25	35,7363	50	2,5	1,397	4,467%
3	25	30,3782	50	2,5	1,210	3,797%
$\bar{X}$						4,001%

Quantitative analysis of caffeine compounds using UV-Vis Spectrophotometry was carried out to determine how much caffeine is contained in oolong tea (*Camellia sinensis* (L.) Kuntze). In this study to determine the level of caffeine in the sample, anhydrous caffeine was used as a standard solution with a concentration series of 5, 6, 7, 8, 9, and 10 ppm. In quantitative testing of caffeine using the UV-Vis Spectrophotometry method, a curve was made. Standar curve result are presented in Table 1.

From these measurements, it can be concluded that the higher the concentration used, the higher the absorbance obtained. The standard results of caffeine obtained were plotted between the levels and absorbance, so that a linear regression equation was obtained, namely $y = 0.0349x + 0.1498$ with an R^2 value obtained of

0.9216. Caffeine calibration curve result are presented in Figure 1.

The results of quantitative analysis of caffeine levels in brewed and boiled oolong tea by UV-Vis spectrophotometric method read with a wavelength of 273 nm. The results of the determination can be seen in the Table 2 dan 3 below.

Formula for calculating content :

$$\frac{\text{Vol} \times \text{Concentrations} \times \text{Sample}}{100\%}$$

Based on the results of determining caffeine levels presented in Table 4 is brewed and boiled oolong tea, there is no significant difference ($P > 0.05$), because the highest caffeine levels are not due to the highest temperature when brewing tea for too long, causing caffeine to oxidize, besides carbon dioxide in free air can also affect caffeine levels in tea (Rahayuningsih, 2014).

From the data obtained, the caffeine content in brewed oolong tea was 35.22 mg

and the caffeine content in boiled oolong tea was 40.01 mg. According to the Head of POM, the limit of caffeine consumption is 150 mg/day or 50 mg/serving BPOM, 2004). The method of brewing this tea is based on the habits of the general public, namely brewed with hot water and also brewed in a teapot by heating over a fire without paying attention to the length of the

Table 4. Normality Data Analysis of Caffeine Content in Oolong Tea Which Brewed and Boiled Oolong Tea by Independent t-test

Sample	P Value
Brewed oolong tea	0,113
Boiled oolong tea	

tea brewing process (Putri & Ulfin, 2015). The longer the extraction and the higher the extraction temperature, the higher the caffeine content in black tea (Irawati et al., 2018.). Brewing is done at a temperature of 100 and a time of 5 minutes because with a temperature of 100 and with a time of 5 minutes is the optimum temperature in the tea brewing process (Annuryanti et al., 2018).

CONCLUSION

There was no significant difference in the caffeine content of brewed and boiled oolong tea with $p=0.113$. Brewed oolong tea had a caffeine content of 3.522% w/b and boiled had a caffeine content of 40.01% w/b. The longer and higher the tea brewing temperature, the higher the caffeine produced. The research can be continued

with different time variations from previous research.

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