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Cardamom (*Elettaria cardamomum*) and Sappan Wood (*Caesalpinia sappan* L.) Proportion Effect on the Antioxidant Activity of "Wedang Kapusecang"

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Abstract

This research explores the impact of varying proportions of cardamom and sappan wood on the antioxidant activity of Wedang Kapusecang, a heated beverage inspired by the traditional Imogiri drink "Wedang Uwuh." Using a factorial Randomized Block Design (RBD) with two factors, the study examines two levels of cardamom (0.5g and 1g) as the first factor and three levels of sappan wood (2g, 5g, and 8g) as the second factor, resulting in six treatment combinations, each duplicated twice. Data analysis employs ANOVA with 1% and 5% confidence intervals, followed by the BNT test (5%) if significant effects are detected. The study includes evaluations of antioxidant activity using the DPPH test and organoleptic aspects such as taste, aroma, and color. The research findings indicate that the most potent antioxidant activity is observed in treatment K2S3 (1g cardamom and 3g sappan wood), with an IC50 parameter of 55,604 ppm, signifying robust antioxidant properties. Organoleptic results identify treatment K2S2 (1g cardamom and 2g sappan wood) as the optimal choice, with moderately liked taste (2.76), moderately liked aroma (2.88), and liked color (3.68). Considering the effectiveness index, treatment K2S2 remains superior, exhibiting an average IC50 antioxidant activity value of 55,604 ppm (strong), with moderately liked taste and aroma ratings, along with a liked color rating.

Keywords: *Antioxidant activity, Cardamom, Sappan wood*

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1. Introduction

One of Allah's creations is plants, which provide various benefits to living creatures, including humans and animals. Allah has given a variety of plants to His creatures (Mahbub & Swasono, 2017), including Indian cardamom (*E. cardamomum*) and sappan wood (*Caesalpinia sappan* L.), which hold value as medicinal plants and rich sources of antioxidants.

Cardamom belongs to the *Zingiberaceae* family and is used in traditional medicine. There are two types of cardamom known in Indonesia, namely local/Javanese cardamom (*A. compactum*) and Indian cardamom (*E. cardamomum*). Cardamom has culinary value and health benefits, containing antioxidant compounds, phenolics, and flavonoids. Several studies have shown that

cardamom possesses strong antioxidant activity and can protect red blood cells from oxidative stress (Nurzaman, Pridani, & Setiawati, 2020). Cardamom (*Elettaria cardamomum*) is an Asian spice widely distributed across the continent, often referred to as the "queen of spices" due to its delightful taste, mild aroma, and appreciated flavor for culinary purposes or its traditional medicinal properties (Teresa-Martínez et al., 2022). The antioxidant compounds in cardamom are beneficial for human health. Some studies have demonstrated that cardamom exhibits strong antioxidant activity, capable of safeguarding red blood cells from oxidative stress (Rajendra, Krishna, & Rao, 2016). The phenolic and flavonoid compounds in cardamom have potent antioxidant activity, helping protect cells from oxidative damage (Balakrishnan, Prasad, & Ravi, 2013). Cardamom typically comes in two forms, green cardamom (*Elettaria cardamomum*) and brown cardamom (*Amomum subulatum*). Cardamom seeds are rich in essential oils containing phenolic and flavonoid components. Starch, proteins, waxes, and sterols are other components of this oil (Rachmatulloh, 2017).

Sappan wood (*Caesalpinia sappan* L.) is a plant from the *Caesalpiniaceae* family used in traditional medicine. It also contains antioxidants, alkaloids, saponins, and tannins. The highest antioxidant activity is found in the stem of sappan wood, which contains the highest phenolic compounds (Mahbub & Swasono, 2017). Every part of sappan wood contains alkaloids, saponins, and tannins, which can act as antioxidants. Therefore, the highest antioxidant activity is obtained from its stem, which also contains the most phenolic compounds (Permadi, Mulyani, & Laurensia, 2022). Sappan wood is the result of cuttings or shavings from the *C. sappan* L. wood. It has no odor and has a taste somewhat similar to agar-agar. Typically, sappan wood grows as a shrub or is used as a barrier (Dianasari, 2009).

Natural antioxidants can protect the body from damage caused by reactive oxygen species and inhibit degenerative diseases and lipid peroxidation in food. They safeguard cells from damage by free radicals (Mahbub & Swasono, 2017). The presence of antioxidants is also essential to protect the body's cells from damage due to free radicals (Sibuea, 2021). The use of antioxidant compounds has been increasing in both food and pharmaceuticals (Rumangu, Yudistira, & Rotinsulu, 2019). The antioxidant activities of cardamom and sappan wood have not been extensively studied, necessitating further research.

The aim of this research is to assess the antioxidant activity and organoleptic properties of the beverage "Wedang Kapusecang," which contains cardamom and sappan wood in specific proportions. This study aims to identify the best treatment in terms of antioxidant activity and organoleptic properties.

2. Material and methods

2.1 Material

The ingredients used to make Wedang Kapusecang are cardamom and sappan wood purchased from the Gresik Market in the Gresik District of Gresik Regency. Empty tea bags are bought from an online shop. DPPH and methanol are used for analysis.

2.2 Methods

2.2.1 Implementation method

This research employed a randomized block design (RBD) with two factors. The first factor was the quantity of cardamom (K), with two levels, namely 0.5 grams and 1 gram. The second factor was the proportion of sappan wood (S), with three levels, namely 1 gram, 2 grams, and 3 grams. Each treatment combination was repeated twice.

K1S1 = Proportion of 0.5 grams of cardamom and 1 gram of sappan wood / 200 ml of water
K1S2 = Proportion of 0.5 grams of cardamom and 2 grams of sappan wood / 200 ml of water
K1S3 = Proportion of 0.5 grams of cardamom and 3 grams of sappan wood / 200 ml of water
K2S1 = Proportion of 1 gram of cardamom and 1 gram of sappan wood / 200 ml of water
K2S2 = Proportion of 1 gram of cardamom and 2 grams of sappan wood / 200 ml of water
K2S3 = Proportion of 1 gram of cardamom and 3 grams of sappan wood / 200 ml of water

The implementation process involved sorting, washing, packaging, brewing, and removing tea bags.

Sorting and Evaluation of Quality, Sorting and quality assessment are crucial for classifying food materials based on size and accuracy. Quality standards are determined by size, weight, purity, maturity, foreign matter, and freedom from food defects. The concept of damage includes physical, mechanical, microbiological, and insect damage (Mahbub & Swasono, 2017).

Washing, Materials were washed with a stream of clean water to remove contaminants attached to the materials. The main materials used in this study were cardamom seeds and sappan wood.

Packaging, Sorted and washed materials were then packed into empty tea bags that had been prepared to facilitate the brewing process.

Brewing: Brewing involves adding hot water to a substance (Mahbub & Swasono, 2017). Cardamom and sappan wood were first weighed, then placed into empty tea bags, and ground according to the given formula. Boil 250 ml of water over medium heat (100°C). Pour boiling water with a temperature of 95°C into a glass along with the tea bag containing cardamom and dried sappan wood. The brewing time for the beverage was 1 minute and 30 seconds.

The tea bag was then removed to separate the brew from the cardamom and sappan wood residue inside the bag. The resulting Wedang Kapusecang brew was collected in a 200 ml portion and allowed to cool.

2.2.2 Method Of Collecting Data

Data collection was carried out through chemical and organoleptic observations. The chemical method included measuring antioxidant activity using the DPPH method. The organoleptic method involved evaluating taste, aroma, and color with a panel of 25 non- expert individuals, using a similar scale from 1 (dislike) to 5 (very like).

2.2.3 Data analysis methods

The data were analyzed using ANOVA (analysis of variance) at a confidence level of 5% and 1%. If there was a significant effect, a least significant difference (LSD) test was conducted at the 5% level. Organoleptic analysis was performed using the Friedman test. The best treatment was identified through an effectiveness index.

3. Results and discussion

3.1 Antioxidant activity analysis

Based on the graphic image below, it can be observed that the average IC50 antioxidant activity ranges from 55.604 ppm (strong) to 108.294 ppm (moderate). Analysis of variance (ANOVA) confirms that the variation in the proportions of cardamom and sappan wood significantly influences the antioxidant activity of Wedang Kapusecang.

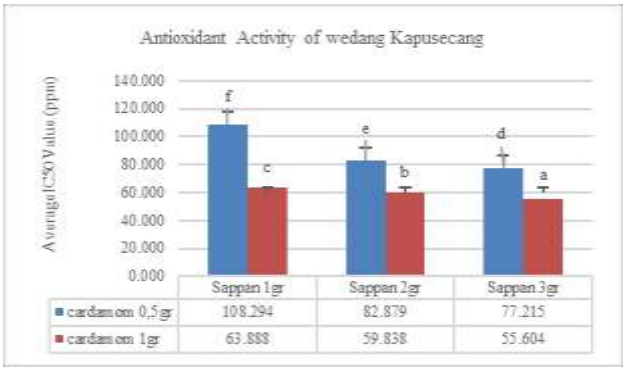

Figure 1. Histogram of mean antioxidant activity values of wedang kapusecang

The assessment of antioxidant activity levels in the samples was conducted by measuring the IC50 value (Inhibitory Concentration 50%), which is the concentration at which antioxidant activity reaches 50% (Ciptaningsih, 2012). A lower IC50 value (in ppm) indicates stronger antioxidant activity (Mahbub & Swasono, 2017). According to classification, an IC50 value of less than 50 ppm indicates very strong antioxidant activity, a value between 50-100 ppm indicates strong activity, 100-150 ppm indicates moderate activity, 150-200 ppm indicates weak activity, and more than 200 ppm indicates very weak activity (Bahriul, Rahman, & Diah, 2014).

Table 1. Antioxidant Activity Levels Using the DPPH Method

IC50 (ppm)	Description
<50	Very strong
50 – 100	Strong
101 – 150	Moderate
>150	Weak

Sources: (Mahbub & Swasono, 2017)

3.2 Organoleptic Analysis

Sensory evaluation is a well-established research method. Sensory tests require the engagement of all five senses to convey an impression, which can then be analyzed based on known impressions (Oktafa, Rizal Permadi, & Agustianto, 2017). Organoleptic testing encompasses acceptance testing, commonly referred to as hedonic testing. Organoleptic testing primarily focuses on assessing product preferences, known as hedonic testing. The purpose of this evaluation is to determine whether the product is acceptable to consumers. Panelists are asked to provide feedback on aspects they like or dislike about the product (Mahbub & Swasono, 2017).

The organoleptic testing of Wedang Kapusecang involved 25 non-expert panelists. Six different variations of Wedang Kapusecang samples received distinct treatments during the testing. This assessment covered the evaluation of taste, aroma, and color attributes for each sample.

3.2.1 Taste

Taste is a key factor in determining whether a product will be accepted by consumers. Taste is something perceived by the tongue (Lamusu, 2018).

The results of the organoleptic taste test on Wedang Kapusecang samples showed an average preference ranging from 2.76 (highest score) to 2.04 (lowest score). Statistical analysis indicated that the variations in the proportions of cardamom and secang wood had a significant impact on the taste of the product. Based on the statistical analysis using the Friedman test, the proportions of cardamom and secang wood had a significant difference in their effect on the aroma of Wedang Kapusecang (χ^2 table > χ^2 calculated).

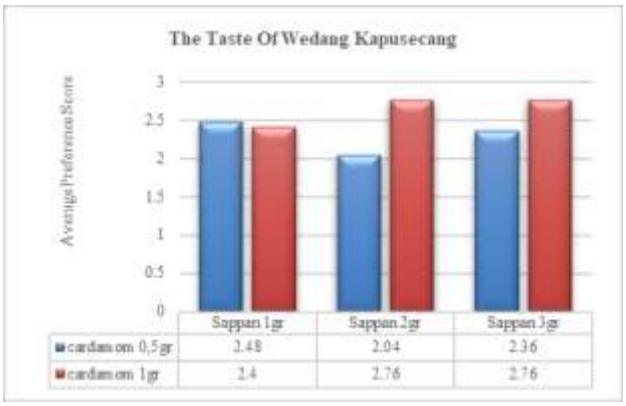

Figure 2. Histogram of organoleptic taste test

Based on the average preference scores in the organoleptic taste test of Wedang Kapusecang, the highest values were found in samples K2S2 (Cardamom 1g and Sappan Wood 2g) and K2S3 (Cardamom 1g and Sappan Wood 3g) with a score of 2.76. Conversely, the lowest score was observed in sample K1S2 (Cardamom 0.5g and Sappan Wood 2g). Therefore, the best results in terms of the average aroma preference for Wedang Kapusecang were found in samples K2S2 and K2S3, both with a cardamom proportion of 1g and Sappan Wood proportion of 2g and 3g, respectively, yielding an average preference score of 2.76. The average Friedman test scores were 3.74 for K2S2 and 4.00 for K2S3. Furthermore, the IC50 values were 59.838 ppm (strong) for K2S2 and 55.604 ppm (strong) for K2S3.

3.2.2 Aroma

Aroma is one of the essential flavor components when it comes to selecting preferred food ingredients for consumers, as it also determines the deliciousness of a meal (Mahbub & Swasono, 2017).

The average preference scores from the organoleptic aroma test for Wedang Kapusecang products ranged from 3.36 (highest score) to 2.68 (lowest score). Based on the statistical analysis using the Friedman test, there was a significant difference in aroma preference concerning the proportions of cardamom and Sappan Wood in Wedang Kapusecang (χ^2 table > χ^2 calculated).

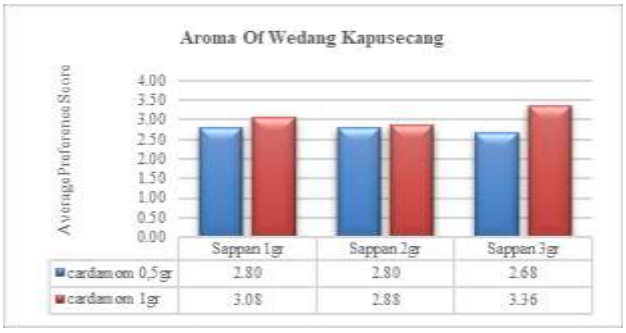

Figure 3. Histogram of organoleptic aroma test

Based on the average preference scores in the organoleptic aroma test of Wedang Kapusecang, the highest values were observed in sample K2S3 (cardamom 1g and Sappan Wood 3g) with a score of 3.36, while the lowest score was recorded in sample K1S3 (cardamom 0.5g and Sappan Wood 3g). Therefore, the best results in terms of the average aroma preference for Wedang Kapusecang were found in sample K2S3, with a cardamom proportion of 1g and Sappan Wood proportion of 3g, yielding an average preference score of 3.36 (like). Additionally, the IC50 value for K2S3 was 55.64 ppm (strong).

3.2.3 Color

Color is a crucial physical parameter of food materials. Consumer preferences for food can also be determined based on the color of the food (Syafi & Palupi, 2018).

The organoleptic color test results for Wedang Kapusecang samples showed average preference scores ranging from 3.68 (highest score) to 3.12 (lowest score). Statistical analysis indicated that variations in the proportions of cardamom and Sappan Wood significantly

affected the color of the product. Based on the statistical analysis using the Friedman test, there was a significant difference in color preference concerning the proportions of cardamom and Sappan Wood in Wedang Kapusecang (χ^2 table > χ^2 calculated).

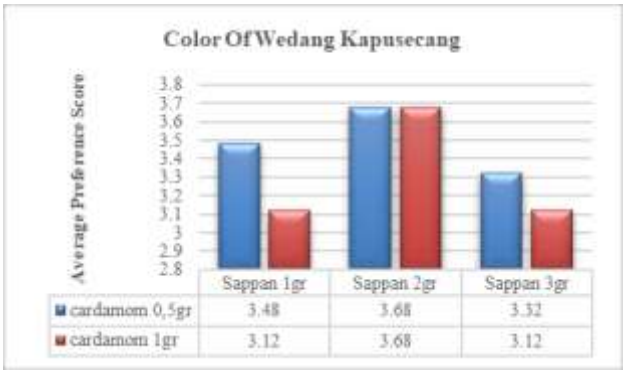

Figure 4. Histogram of organoleptic color test

Based on the average preference scores in the organoleptic color test of Wedang Kapusecang, two samples obtained the highest scores: sample K1S2 (cardamom 0.5g and Sappan Wood 2g) and sample K2S2 (cardamom 1g and Sappan Wood 2g), both with a score of 3.68. Conversely, the lowest scores were observed in samples K2S1 (cardamom 1g and Sappan Wood 1g) and K2S3 (cardamom 1g and Sappan Wood 3g) with a score of 3.12. Therefore, the best results in terms of the average color preference for Wedang Kapusecang were found in samples K1S2 and K2S2, both with a cardamom proportion of
0.5g and 1g, respectively, and Sappan Wood proportion of 2g, yielding an average preference score of 3.68 (like). Additionally, the IC50 value was 59.838 ppm (strong) for K2S2 and 82.879 ppm (strong) for K1S2.

3.3 Best organoleptic treatment

The results of the organoleptic effectiveness index calculation indicated that the best treatment combination was found in K2S2 (cardamom 1g and Sappan Wood 2g), which had an average taste score of 2.76 (moderately liked), an aroma score of 2.88 (moderately liked), and a color score of 3.68 (liked).

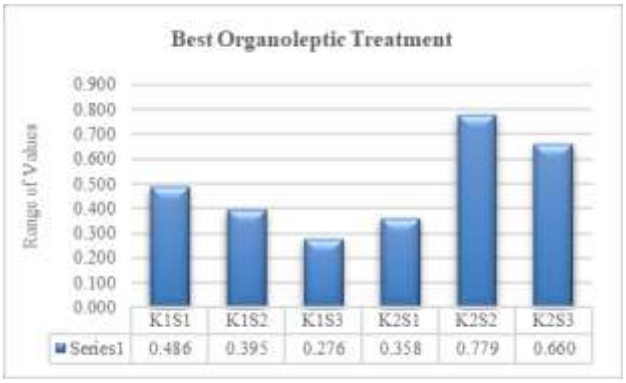

Figure 5. Histogram of best organoleptic treatment

3.4 Best treatment

The calculation of the effectiveness index results indicated that the best treatment combination was found in K2S2 (1g cardamom and 2g Sappan Wood), which had an average antioxidant activity IC50 value of 55.604 ppm (strong), a taste score of 2.76 (moderately liked), an aroma score of 2.88 (moderately liked), and a color score of 3.68 (liked).

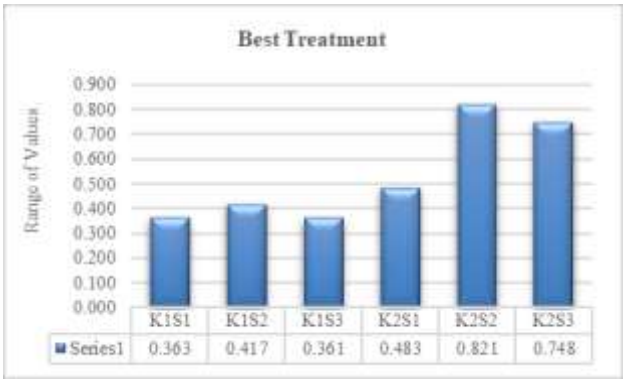

Figure 6. Histogram of Best Treatment

4. Conclusions

The results of this study yield the following conclusions:

1. The optimal proportion of cardamom and secang wood based on chemical properties, measured through the analysis of antioxidant activity with an IC50 test, was found in treatment K2S3 (1 gram of cardamom and 3 grams of secang wood) with an IC50 value of 55.604 ppm (strong).
2. The best proportion of cardamom and secang wood based on organoleptic properties, analyzed through the effectiveness index test, was observed in treatment K2S2 (1 gram of cardamom and 2 grams of secang wood). This treatment had an average taste score of 2.76 (moderately liked), aroma score of 2.88 (moderately liked), and color score of 3.68 (liked).
3. The optimal proportion of cardamom and secang wood based on both chemical properties (antioxidant activity) and organoleptic properties, as tested through the effectiveness index, was identified in treatment K2S2 (1 gram of cardamom and 2 grams of secang wood). This treatment had an average antioxidant activity with an IC50 of 55.604 ppm (strong), taste score of 2.76 (moderately liked), aroma score of 2.88 (moderately liked), and color score of 3.68 (liked).

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