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Antioxidant Effectiveness and Hedonic Test of Banana Stem Tea Bags (Musa paradisiaca), Widuri Flowers (Calotropis gigantea) and Their Combination

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Abstract:
Consuming antioxidants is necessary to combat the harmful effects of free radicals. The banana plant (Musa paradisiaca) is one of the plants that contains antioxidants and is widely available in Indonesia. This study aims to determine the comparative effectiveness of banana stem tea bags (F1), widuri flower tea bags (F2), a combination of banana stem and widuri flower tea bags (F3), and a combination of only additional ingredients, namely mint leaves and stevia leaves (F4). We conducted physical tests and phytochemical screening on the tea bag brewing water. We also conducted antioxidant tests using the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) method. Finally, we conducted a hedonic test to evaluate preferences. Results: All teas have a pH of 7. F1-F3 have a water content of 1%, and F4 has a water content of 0.95%. Only formulas F1 and F2 contained alkaloids, all formulas contained flavonoids, and all formulas except F4 contained tannins. The tea bags from F1-F4 had IC50s of 125, 256843 ppm, 121.913153 ppm, 42.7253669 ppm, and 147.505285 ppm, respectively. We classified the antioxidant value of F3 as strong. In the hedonic test, panelists tended to like the color of tea bags F1 and F1, the taste of F1, the aroma of F1 and F3, and the packaging of F1 and F2. According to the study's findings, banana stem tea bags infused with additional ingredients in the form of mint leaves and stevia leaves had moderate antioxidant activity. The combination with widuri flowers increased its antioxidant activity

Keywords: Antioxidant, Banana Stem, DPPH

1. Introduction:

The current environment contains many dangerous components, especially due to free radicals. Free radicals have an impact in the form of damage to cells, tissues and organ systems in the body if not handled properly. This will provide a high risk of prolonged oxidative stress which can trigger degenerative diseases, including cancer, diabetes and others (Sharifi-Rad et al., 2020). Degenerative diseases are a major health problem in the world, with data from the World Health Organization (WHO) causing the death of 17 million people per year. These free radicals can be counteracted or weakened by antioxidants (Sharifi-Rad et al., 2020).

Antioxidants are compounds that can inhibit oxidation by exposure to free radicals in our bodies. In addition to being found naturally in the body, antioxidants can also come from outside the body through chemical compounds and natural compounds. One of the natural antioxidant compounds comes from the Banana plant (Musa paradisiaca). The content of secondary metabolites includes phenol compounds such as saponins in large quantities, glycosides, flavonoids, terpenoids and tannins. These compounds are found in the trunk, stem, and heart. Research on the effects that have been carried out on banana plants includes antibacterial, antidiabetic and antiseptic antioxidants (Tunny, Umar, & Siompu, 2022).

Banana plants, especially the stem, need to be studied further, considering that there has been no research to support it. The stem is also a part that is often used as a vegetable ingredient and a rarely used ingredient. As a form of effort to utilize it, it is necessary to test antioxidants in the form of banana stem tea bags. The advantage of this preparation is that the preparation lasts longer because it is a dry preparation (Novitriani, Suhartati, Gusnanda, & Nugraha, 2021). This study aims to determine the effectiveness of antioxidants from banana stem tea bags and their combination with other additional ingredients. Then a hedonic test was conducted on the four tea preparations to determine how the panelists responded to the tea bag preparations made.

2. Material and Method

Research Design

The type of research used is experimental research. Physical quality test of the preparation, identification of secondary metabolites, antioxidant test, and hedonic test were carried out on four tea bag formulas.

Materials

The materials used were banana stems (Musa paradisiaca) and widuri flowers (Calotropis gigantea), 2,2-Diphenyl-1-picrylhydrazyl (DPPH), mint leaves, and stevia leaves. Plant determination was carried out at the Indonesian Institute of Sciences, UPT Center for Plant Conservation, "Eka Karya" Bedugul Botanical Garden**.**

Tools and Instruments

The tools used were analytical scales, ovens, knives, tea bags, plastic trays, scissors, UV-Vis spectrophotometers.

Work Procedure

1. Sample Preparation

The kepok banana stem sample was taken from a part of the stem that had never borne fruit from the Buruan area, Penebel Tabanan, while the tea combination material, namely widuri flowers, was taken from the Balangan beach area, Jimbaran, Bali. The samples were harvested in the morning. The samples were thinly sliced. Then the plants were washed until clean and then dried at a temperature of 65oC for 7 hours.

2. Tea Formulation

Four tea formulas were prepared in this study as shown in table 1. Each tea formula was put into a tea bag. The tea solution was prepared by brewing it in 150 ml of water at a temperature of 80 while dipping and stirring.

Tabel 1. Tea Bag Preparation Formulation

Composition	Formulation (gram)			
	F1	F2	F3	F4
Simplisia Banana Steam	2,7	0	1,35	0
Simplisia Thistle Flower	0	2,7	1,35	0
Mint Leaves	0,15	0,15	0,15	0,15
Stevia Leaves	0,15	0,15	0,15	0,15

3. Evaluation of Physical Quality of Tea Preparations

Physical quality testing includes organoleptic tests, pH tests, and water content tests.

a. Organoleptic Test

Organoleptic tests are carried out by observing the taste, aroma, and color of the tea preparations that have been made.

b. pH Test

The pH test is carried out by dipping the pH meter into the tea bag preparation that has been brewed. Then the pH meter is observed with a universal indicator.

c. Water Content Test

The water content test is carried out by drying a porcelain cup in an oven at 105 for 15 minutes, then cooled in a desiccator for 30 minutes, weighing the weight of the porcelain cup. After weighing the porcelain cup, put the preparation into the porcelain cup and put it in an oven at 550 for 6 hours, then put it in a desiccator and weigh the weight of the preparation and sample.

The percentage of water content can be calculated using the formula:

$$\text{Water content } (\%) = \frac{B1-B2}{B} \times 100\%$$

Note:

B = Sample weight (g)

B1 = Weight of sample + cup before drying (g)

B2 = Sample weight + cup after drying (g)

4. Identification of Secondary Metabolites

Identification of secondary metabolites consisting of identification of alkaloids, saponins, flavonoids, tannins, and quinones using phytochemical screening procedures according to research reference standards from (Cahyaningsih, Yuda, & Santoso, 2019).

5. Antioxidant Test

Antioxidant testing using the DPPH method according to (Handayani, Ahmad, & Sudir, 2014). The mother liquor was made in a concentration of 500 ppm. Then diluted to a concentration of 50 ppm, 100 ppm, 150 ppm, 200 ppm, and 250 ppm. Next, a standard DPPH solution of 40 ppm concentration was added and its absorbance was measured using a Uv-Vis spectrophotometer at a wavelength of 516 nm.

6. Hedonic Test

Hedonic test was conducted on 30 panelists voluntarily by considering the inclusion and exclusion criteria set by the researcher. The inclusion criteria included male or female students aged 20-30, male or female, and willing to volunteer. And the exclusion criteria were students in good physical and mental health. Panelists were given 1 glass to drink and gave an assessment of the aroma, color, and taste. Panelists' assessment of the tea preparation was categorized into 5 levels, namely 5 = very much like, 4 = like, 3 = quite like, 2 = less like, and 1 = very much dislike.

Data Analysis

The antioxidant activity of banana stem tea and widuri flower tea was measured using the inhibition concentration (IC50) parameter. Data analysis was carried out by calculating the percentage (%) of antioxidant activity obtained from absorbance data, then the IC50 calculation was carried out using the regression equation (Himawan, Masaenah, & Putri, 2018). Kategori antioxidant intensity based on IC50 values is listed in table 2.

Table 2. Antioxidant Intensity Categories Using DPPH Method

Intensity	Value of IC_{50}
Very strong	<50
Strong	50-100
Moderate	100-250
Weak	250-500
Very Weak	<500

3. Result

This study was conducted to determine the antioxidant activity and evaluation of preparations from banana stem tea bags, widuri flower tea bags, a combination of banana stem tea bags and widuri flowers and a combination of mint leaf tea bags and stevia leaves. In conducting this study, banana stem and widuri flower plants were selected. The banana plants selected were raja bananas obtained from the Denpasar area, Bali, banana plants selected on the young and unfruitful stem parts. The selection of widuri plants was obtained from the Balangan Beach area, Jimbaran, Bali. The sample was chosen because many people do not know the benefits of the plant. Therefore, the examiner conducted further testing, where in this study it is expected to be able to provide solutions to the community regarding the benefits of banana plants and widuri plants.

Physical Quality Evaluation of Tea Preparations

The results of the organoleptic test of tea bag preparations are shown in table 3. The four tea bag preparations made with the same concentration of preparations but with different herbal ingredients showed different organoleptic results. Additional ingredients such as mint leaves provide a cool and minty or cold taste, while stevia leaves provide a sweet taste. The brown color in F1-F3 occurs because the banana stem herbal and widuri flower herbal have dark brown and light brown colors which can affect the color of each preparation.

Table 3. Organoleptic Test Results

Formula	Aroma	Flavor	Colour
F1	Typical smell of banana stems and mint	Slightly bitter and cool taste	Brown
F2	Rancid and mint smell	Bitter	Brown
F3	Distinctive smell	Bitter	Brown
F4	Mint smell	lightly sweet and cool taste	Yellow

The pH test aims to determine whether the pH level can be accepted by the body's pH or not. The pH value is used to indicate the acidity or alkalinity of a product. In general, the pH of food ingredients has a pH ranging from 3.0 to 8.0 and microorganisms can usually grow at pH 5.0-8.0. Increasing the pH of the product has an effect on the antioxidant activity of tea. Based on research that has been conducted, the pH of the four tea preparations has a pH of 7, where pH 7 is included in the pH range of food preparations.

The water content test is a measurement of the water content in the material, which aims to provide a minimum limit or range of the amount of water content in the material. Based on research that has been conducted, it shows that banana stem tea bags, widuri flower tea bags, a combination of banana stem tea bags with widuri flowers have a water content of 1% while the combination of mint leaf tea bags shows a water content of 0.95%. This is in accordance with the BPOM (Food and Drug Supervisory Agency) standards which state that the water content should be less than 10%.

Secondary Metabolite Identification

Phytochemical screening tests were conducted to provide an overview of the compound groups contained in the plants being studied. The five components tested were alkaloids, flavonoids, saponins, tannins, and quinones. The test results can be seen in table 4.

Table 4. Results of Phytochemical Screening Test of Tea Bag Formula

Sampel	Alkaloid	Flavonoid	Saponin	Tanin	Kuinon
F1	+	+	-	+	-
F2	+	+	-	+	-
F3	-	+	-	+	-
F4	-	+	-	-	-

In the phytochemical screening test of alkaloid compounds in banana stem tea bags, positive results were shown with the dragendroff reagent and negative with the Mayer reagent. Banana stem tea bags also showed positive results for flavonoid and tannin compounds and negative for saponin and quinone compounds. The screening results were in accordance with the

screening results that had been carried out by (Wibowo & Prasetyaningrum, 2015) which states that banana stems contain saponins, triterpenoids, steroids, flavonoids, tannins, and quinones.

Widuri flower tea bags showed the same results as banana stem tea bags. This formula positively contains alkaloids, flavonoids, and tannins. These three compounds were also detected in research conducted by (Safrida, Mardiana, & Husna, 2021). The compound is a natural antioxidant compound, especially flavonoids. Flavonoids are polyphenol compounds that have the ability to donate hydrogen atoms to free radical compounds, so the antioxidant activity of polyphenol compounds can be produced in the free radical neutralization reaction. According to (Wardani, Kristiani, & Sucahyo, 2021) which states that the higher the phenolic compound content, the smaller the IC50. That phenolic compounds are correlated with antioxidant compounds, antioxidant activity is influenced by phenolic compounds. Phenolic compounds can act as antioxidants by breaking the free radical chain bonds directly and capturing various reactive species. The combination formula of banana stem and widuri flower tea bags was identified to contain only flavonoid and tannin compounds. While formula 4, which is an additional ingredient, was identified to contain only flavonoids. The limited compounds identified in these two formulas are likely due to the low content of active ingredients in the formula due to the low components of banana stem and widuri flower simplicia included in the tea bags.

Antioxidant Test

After making the tea bag preparation, the antioxidant activity test of the tea bag preparation was carried out. Antioxidant activity testing was carried out using the 2, 2-diphenyl-1-picryl hydrazyl (DPPH) method using a UV-Vis spectrophotometer with methanol solvent. DPPH is a stable free radical compound so that when used as a reagent in the free radical scavenging test, it is sufficient to dissolve it. The DPPH method was chosen because this method is easy to do, fast and requires a small sample.

IC50 tea bags from F1-F4 were respectively 125.26 ppm; 121.91 ppm; 42.73 ppm; and 147.51 ppm. This value is still higher than the results of the vitamin C test, as a standard, which is 3.58 ppm. Vitamin C is a natural antioxidant compound that is often used as a comparison compound in testing antioxidant activity, because natural antioxidant compounds are relatively safe and do not cause toxicity.

According to (Irianti, Sugianto, Nuranto, & Kuswandi, 2017), The antioxidant intensity specifications of banana stem tea bags are classified as moderate, widuri flower tea bags are classified as moderate, the combination of banana stem tea bags with widuri flowers is classified as strong, and the combination of mint leaf and stevia leaf tea bags shows moderate antioxidant intensity. The antioxidant activity of the combination of banana stems and widuri flowers has stronger antioxidant activity than banana stems and widuri flowers that are not combined. This is likely due to the synergistic effect between the two ingredients (Karole et al., 2019).

Hedonic Test

Hedonic tests are conducted to determine the level of public satisfaction regarding the products made. This is important to do to find out whether the products made are acceptable to the public. If in conducting a hedonic test the public still cannot accept the product made, then the product can be remade to be more attractive so that it can be accepted by the public. The hedonic test was conducted by distributing assessment forms to 30 panelists to assess the color, taste, aroma, and packaging of the products made. The results of the panelists' assessment of each

parameter are shown in table 5. For resource efficiency, only F1-F3 were assessed in this test. When categorized based on preference, panelists tend to like the color of F1 and F1 tea bags, the taste of F1, the aroma of F1 and F3, and the packaging of F1 and F2. In general, F1 tends to be preferred in every assessment. This is because the color of the banana stem tea preparation is better, namely brown, while the color of the widuri flower tea preparation is slightly cloudy brown. The aroma of the widuri flower tea bag preparation smells rancid which makes some panelists dislike the aroma of the widuri flower tea bag.

Table 5. Hedonic Test Results of The Celup F1-F3

Formulation	Colour	Flavour	Aroma	Packaging	Overall Product
F1	80.67%	78.67%	76.67%	82.67%	80.00%
F2	82.00%	72.00%	73.33%	83.33%	80.00%
F3	60.00%	68.00%	79.33%	78.67%	80.00%`

Description: (0-25%) don't like it, (26%-50%) quite like it, (51%-75%) like it, and (76%-100%) really like it.

4. Conclusion

Banana stem tea bags added with additional ingredients in the form of mint leaves and stevia leaves have moderate antioxidant activity. The combination with widuri flowers increases its antioxidant activity. Banana stem tea bags are proven to contain alkaloids, flavonoids, and tannins. This tea is preferred by panelists for its color, taste, aroma, and packaging

5. Conflist of Interest

No conflict of interest

6. Author Contribution

All authors contributed to the process of preparing this scientific article

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