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ANALYSIS OF VITAMIN C CONTENT AND ANTIOXIDANT ACTIVITY OF GREEN COCONUT (*Cocos nucifera* L) USING THE DPPH METHOD

ANALISIS VITAMIN C DAN AKTIVITAS ANTIOKSIDANT PADA KELAPA HIJAU (*Cocos nucifera* L) MENGGUNAKAN METODE DPPH

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Abstract

Green coconut (*Cocos nucifera* L.) is one of the tropical horticultural commodities widely consumed by Indonesian people and is empirically believed to have health benefits due to its vitamin C and antioxidant compounds. This study aims to analyze the levels of vitamin C and antioxidant activity in water and green coconut meat using the *1,1-diphenyl-2-picrylhydrazyl* (DPPH) method. Vitamin C levels were determined using the iodimetric titration method, while antioxidant activity was measured based on the percentage inhibition of DPPH radicals at five concentration series (1,000-5,000 ppm) using a UV-Vis spectrophotometer, then expressed as an IC50 value through a linear regression equation. The results showed that the average vitamin C levels in coconut water were 29.35 ± 5.08 mg/100 g and in coconut meat were 28.48 ± 4.93 mg/100 g. The IC50 value of coconut water was 5,824.52 ppm and coconut meat was 5,423.78 ppm, both well above the 200 ppm threshold, so both samples were classified as having very weak antioxidant activity based on the DPPH test. Coconut meat showed a slightly lower IC50 than coconut water, but the difference was not substantial. The low levels of vitamin C in both parts of the green coconut fruit are suspected to be one of the main factors in the weak antioxidant activity detected. This study provides baseline data on the antioxidant potential of fresh green coconut without further extraction treatment, which can be a reference for future research on the processing or fortification of coconut-based food products.

Keywords: *green coconut,Cocos nucifera, vitamin C, antioxidant, DPPH*

Abstrak

Kelapa hijau (*Cocos nucifera* L.) merupakan salah satu komoditas hortikultura tropis yang banyak dikonsumsi masyarakat Indonesia dan secara empiris dipercaya memiliki khasiat kesehatan berkat kandungan vitamin C dan senyawa antioksidan di dalamnya. Penelitian ini bertujuan untuk menganalisis kadar vitamin C dan aktivitas antioksidan pada air dan daging kelapa hijau menggunakan metode 1,1-diphenyl-2-picrylhydrazyl (DPPH). Kadar vitamin C ditentukan menggunakan metode titrasi iodimetri, sedangkan aktivitas antioksidan diukur berdasarkan persen inhibisi terhadap radikal DPPH pada lima seri konsentrasi (1.000-5.000 ppm) menggunakan spektrofotometer UV-Vis, kemudian dinyatakan sebagai nilai IC50 melalui persamaan regresi linear. Hasil penelitian menunjukkan kadar vitamin C rata-rata pada air kelapa sebesar 29,35 ± 5,08 mg/100 g dan pada daging kelapa sebesar 28,48 ± 4,93 mg/100 g. Nilai IC50 air kelapa sebesar 5.824,52 ppm dan daging kelapa sebesar 5.423,78 ppm, keduanya jauh di atas ambang 200 ppm sehingga kedua sampel digolongkan

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memiliki aktivitas antioksidan yang sangat lemah berdasarkan uji DPPH. Daging kelapa menunjukkan IC50 sedikit lebih rendah dibandingkan air kelapa, namun perbedaannya tidak substansial. Rendahnya kadar vitamin C pada kedua bagian buah kelapa hijau diduga menjadi salah satu faktor utama lemahnya aktivitas antioksidan yang terdeteksi. Penelitian ini memberikan data dasar mengenai potensi antioksidan kelapa hijau segar tanpa perlakuan ekstraksi lanjutan, yang dapat menjadi rujukan bagi penelitian pengolahan atau fortifikasi produk pangan berbasis kelapa di masa mendatang.

Kata Kunci : kelapa hijau, *Cocos nucifera*, vitamin C, antioksidan, DPPH

INTRODUCTION

Coconut (*Cocos nucifera* L.) is a strategic plantation crop in Indonesia, with almost all parts of it being usable, from the roots and stems to the leaves and even the fruit (Sari et al., 2021). Among the various cultivated coconut varieties, the green coconut holds a special place in Indonesian culture, traditionally believed to possess health benefits, ranging from refreshing the body and aiding detoxification, to acting as a natural antidote for mild poisoning (Indriyani *et al*., 2021). Both the water and the flesh of the green coconut are widely consumed directly or processed into various functional food and beverage products. The nutritional content of green coconut includes carbohydrates, protein, fat, minerals such as potassium, sodium, and magnesium, and vitamins, including vitamin C and vitamin B complex (Budiastuti, 2019).

Vitamin C, or ascorbic acid, is an essential micronutrient that plays a vital role in the human body, acting as an enzymatic cofactor, supporting the immune system, and as a natural antioxidant capable of neutralizing free radicals (Safnowandi, 2022). Free radicals are molecules or atoms with unpaired electrons that are highly reactive and can trigger cell damage through oxidative stress reactions, thus contributing to various degenerative diseases such as atherosclerosis, cancer, and premature aging. The human body actually has an endogenous antioxidant defense system, but under certain conditions, exogenous antioxidant intake from food is still necessary to maintain redox balance in the body (Labola & Puspita, 2018).

One of the most widely used methods to test the antioxidant capacity of a material in vitro is the *1,1-diphenyl-2-picrylhydrazyl* (DPPH) method (Baihaqi *et al*., 2026). This method is popular because the procedure is relatively simple, fast, does not require complicated equipment, and is sensitive enough to detect compounds that can donate hydrogen atoms or electrons to DPPH radicals, indicated by a color change in the solution from purple to pale yellow. The strength of the antioxidant activity of a sample is expressed in the IC50 value, which is the concentration of the test solution required to inhibit 50% of DPPH free radicals; the smaller the IC50 value, the stronger the antioxidant activity of the material (Molyneux, 2004).

Various previous studies have examined the vitamin C content and functional components of various coconut varieties. For example, yellow coconuts are reported to have relatively high levels of vitamin C in their flesh, while coconut water is reported to be rich in potassium and contains significant amounts of vitamin C and B-complex vitamins (Budiastuti,

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2019). However, data on direct comparisons of vitamin C levels and antioxidant activity between water and fresh green coconut flesh using the DPPH method, without further extraction using organic solvents, are still limited to publications in national scientific journals. This information is crucial as a baseline for assessing the extent to which claims about the health benefits of green coconuts circulating in the community can be scientifically substantiated, particularly regarding their capacity as a source of natural antioxidants in their fresh, directly consumed form.

Based on the above description, this study was conducted to analyze vitamin C levels using the iodimetry method and measure antioxidant activity using the DPPH method in the water and flesh of green coconuts (Cocos nucifera). This study also aims to examine the relationship between vitamin C levels and antioxidant activity measured in both parts of the fruit. The results of this study are expected to contribute scientific data regarding the nutritional and functional potential of green coconuts in their fresh form, as well as serve as a reference for further research related to the development of coconut-based functional food products. in inhibiting the growth of *Curvularia* sp. with various extract concentrations.

RESEARCH METHODS

Types and Design of Research

This research, a quantitative, descriptive laboratory experiment, aimed to measure vitamin C levels and antioxidant activity in two parts of green coconuts: the water and the coconut flesh. Each test was conducted in triplicate to obtain representative data that could be analyzed descriptively.

Tools and materials

The tools used in this study include a *UV-Vis spectrophotometer*, analytical balance, burette and stand, measuring flask, Erlenmeyer flask, volumetric pipette and micro pipette, beaker, stirring rod, filter paper, blender, and cuvette. The materials used include fresh green coconut fruit (water and meat), *1,1-diphenyl-2-picrylhydrazyl* (DPPH) solution in methanol pa, 0.01 N iodine solution, 1% starch indicator, distilled water, and other supporting chemicals with pro analysis quality (pa).

Sample Preparation

Fresh green coconuts were peeled and the water and flesh separated. The coconut water was filtered to remove impurities, while the coconut flesh was ground using a blender, then squeezed and filtered to obtain the filtrate. Each sample (water and coconut flesh) was then used for vitamin C analysis and antioxidant activity testing, with three replicates.

Determination of Vitamin C Levels (*Iodimetry Method*)

Vitamin C levels were determined using the iodimetric titration method, which is based on the principle of the oxidation reaction of ascorbic acid by iodine solution. A certain

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amount of sample (water or coconut meat filtrate) was pipetted into an Erlenmeyer flask, a few drops of 1% starch indicator were added, then titrated with 0.01 N iodine solution until a stable blue-black color formed which marked the end point of the titration. The volume of titrant used was recorded for each repetition, then the vitamin C levels were calculated and converted into milligrams per 100 grams of sample (mg/100 g) based on the volume equivalence factor of iodine to ascorbic acid.

Determination of Antioxidant Activity *(DPPH Method)*

Antioxidant activity was determined using the DPPH free radical scavenging method. DPPH solution was prepared by dissolving DPPH powder in methanol to a certain concentration. Coconut water and meat samples were prepared in five concentration series, namely 1,000, 2,000, 3,000, 4,000, and 5,000 ppm. Each concentration series was reacted with a certain volume of DPPH solution, then incubated in a dark room at room temperature for ± 30 minutes to complete the radical scavenging reaction. The absorbance of the solution was measured using a UV-Vis spectrophotometer at the maximum DPPH absorption wavelength (range 515-520 nm). The inhibition percentage (%) was calculated using the formula:

$$\% \text{ Inhibition} = [(\text{Control absorbance} - \text{Sample absorbance}) / \text{Control absorbance}] \times 100\%$$

The IC50 (Inhibition Concentration 50) value, which is the sample concentration capable of inhibiting 50% of DPPH free radicals, is determined through a linear regression equation between the sample concentration (x-axis) and the percentage of inhibition (y-axis) for each sample.

Data analysis

Data on vitamin C levels and percent inhibition are presented descriptively as the average ± standard deviation (SD) from three replications. The IC50 values obtained are interpreted based on the commonly used antioxidant activity strength categories, namely very strong (IC50 < 50 ppm), strong (IC50 50-100 ppm), moderate (IC50 100-150 ppm), weak (IC50 150-200 ppm), and very weak (IC50 > 200 ppm) (Molyneux, 2004).

RESULTS AND DISCUSSION

Vitamin C Content of Water and Green Coconut Flesh

The results of the analysis of vitamin C levels in green coconut water and flesh determined using the iodimetric titration method are presented in Table 1.

Table 1. Results of Analysis of Vitamin C Levels in Green Coconut Water and Flesh

Sample	Test	Titrant Volume (mL)	Content (%)	Content (mg/100 g)
Coconut water	1	0.3	0.0264	26.42

Sample	Test	Titrant Volume (mL)	Content (%)	Content (mg/100 g)
Coconut water	2	0.3	0.0264	26.42
Coconut water	3	0.4	0.0352	35.22
Coconut Meat	1	0.6	0.2563	25.63
Coconut Meat	2	0.6	0.2563	25.63
Coconut Meat	3	0.8	0.3417	34.17

Table 2. Average Vitamin C Content of Water and Flesh of Green Coconuts

Sample	Average Vitamin C Content (mg/100 g)	Elementary School
Coconut water	29.35	± 5.08
Coconut Meat	28.48	± 4.93

Based on Table 1 and Table 2, the average vitamin C content in green coconut water is 29.35 ± 5.08 mg/100 g, while in green coconut flesh it is 28.48 ± 4.93 mg/100 g. These two values are relatively close and do not show a significant difference between the two parts of the fruit, even though structurally coconut water is a liquid while coconut flesh is a fibrous solid. This indicates that the distribution of vitamin C in green coconuts is relatively even between the liquid and solid parts, and is not concentrated predominantly in one part only.

The vitamin C levels obtained in this study are lower than those of previous studies on coconuts of different varieties and maturity levels, for example, yellow coconut flesh, which is reported to have much higher vitamin C levels. This difference is likely due to several factors, including differences in coconut varieties, the ripeness of the fruit at the time of sampling, the agroclimatic conditions of the growing area, and the analytical method used. Vitamin C is a relatively unstable compound and is easily oxidized by heat, light, oxygen, and the enzyme ascorbate oxidase, which is naturally present in plant tissue. Therefore, measured levels are strongly influenced by the speed of sample handling from the time the fruit is picked until it is analyzed in the laboratory (Hendriyani, 2018). The longer the time interval between picking and analysis, the greater the chance of vitamin C degradation, which can ultimately result in measured levels being lower than their original state (Hakim et al., 2024).

Antioxidant Activity of Water and Green Coconut Flesh (*DPPH Method*)

The results of measuring antioxidant activity based on the percentage of inhibition against DPPH radicals at various concentrations of water and green coconut flesh are presented in Table 3 and Table 4.

Table 3. Results of the DPPH Antioxidant Activity Test on Green Coconut Water

Concentration (ppm)	Absorbance (nm)	% Inhibition	IC50 (ppm)
1,000	0.466	20.88	5,824.52
2,000	0.404	31.41	5,824.52

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Concentration (ppm)	Absorbance (nm)	% Inhibition	IC50 (ppm)
3,000	0.440	25.30	5,824.52
4,000	0.380	35.48	5,824.52
5,000	0.294	50.08	5,824.52

Table 4. Results of the DPPH Antioxidant Activity Test on Green Coconut Flesh

Concentration (ppm)	Absorbance (nm)	% Inhibition	IC50 (ppm)
1,000	0.436	25.98	5,423.78
2,000	0.308	47.71	5,423.78
3,000	0.340	42.28	5,423.78
4,000	0.341	42.11	5,423.78
5,000	0.310	47.37	5,423.78

The data in Tables 3 and 4 show that in general the percentage inhibition against DPPH radicals tends to increase with increasing sample concentration, although the pattern of increase is not completely linear in both samples. In coconut water, the percentage inhibition increases from 20.88% at a concentration of 1,000 ppm to 50.08% at a concentration of 5,000 ppm, but decreases at a concentration of 3,000 ppm (25.30%) before increasing again. A similar pattern is also observed in coconut meat, with the highest percentage inhibition occurring at a concentration of 2,000 ppm (47.71%), then relatively stagnant at a concentration of 3,000-4,000 ppm, and increasing again at a concentration of 5,000 ppm (47.37%). These fluctuations are likely caused by the complex nature of the green coconut sample matrix, containing sugar, protein, and other components that can affect the clarity of the solution and absorbance readings, as well as the possible influence of interactions between components in the sample that have not gone through the extraction and purification process, so that not all of them are active compounds that donate hydrogen atoms to DPPH radicals.

The IC50 value obtained through a linear regression equation between concentration and percent inhibition shows that green coconut water has an IC50 of 5,824.52 ppm, while green coconut flesh has an IC50 of 5,423.78 ppm. Both values far exceed the threshold of 200 ppm commonly used as the limit for the very weak antioxidant category (Molyneux, 2004), so that fresh green coconut water and flesh without further extraction treatment can be classified as having very weak antioxidant activity based on the DPPH test. For comparison, pure ascorbic acid compounds that are often used as positive controls in various studies generally have IC50 values of only around 2-3 ppm, which is considered very strong. The very large difference between the IC50 of green coconut samples and the IC50 of pure ascorbic acid indicates that the levels of vitamin C and other antioxidant compounds in fresh green coconut water and flesh are in much more dilute concentrations and therefore have not been able to provide a significant free radical scavenging effect in the test concentration range used.

Interestingly, although the vitamin C content of coconut water (29.35 mg/100 g) was slightly higher than that of coconut flesh (28.48 mg/100 g), the IC50 value of coconut flesh

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was slightly lower than that of coconut water, indicating that coconut flesh exhibited relatively slightly better free radical scavenging activity. This phenomenon indicates that the antioxidant activity measured by the DPPH method is not solely determined by the vitamin C content, but is also influenced by the presence of other bioactive compounds such as phenolic compounds, tocopherols, or lipophilic components that may be present in coconut flesh in greater amounts than in coconut water. Thus, the correlation between vitamin C content and antioxidant activity in this study was relatively weak, indicating that vitamin C is not the sole determining factor in the total antioxidant capacity of a food ingredient.

Implications and Limitations of the Research

The results of this study illustrate that although green coconut is empirically believed to have health benefits, its antioxidant capacity in its fresh, unprocessed form is classified as very weak when measured using the DPPH method at a concentration range of 1,000-5,000 ppm. This does not mean that green coconut is not beneficial for health, because the DPPH method only measures the scavenging capacity of a particular type of synthetic radical and does not fully represent all antioxidant mechanisms that can occur physiologically in the body. In addition, the content of electrolytes, minerals, and other bioactive compounds in green coconut still contributes positively to health through different mechanisms, for example as a source of natural electrolytes and rehydration fluid (Stefany & Noer, 2025).

Several limitations in this study require attention for further research. First, the test concentration range used (1,000-5,000 ppm) was not able to directly reach the 50% inhibition point in most samples, so the IC50 value was obtained through extrapolation of a linear regression equation that could potentially produce bias if the relationship between concentration and percent inhibition is not completely linear over a wider range. Second, the samples used were fresh coconut water and flesh without an extraction process using organic solvents, so that semipolar or nonpolar antioxidant compounds may not have been fully measured. Third, this study only used a single source of green coconut fruit without varying levels of ripeness, so it cannot describe the variation in vitamin C levels and antioxidant activity at various stages of fruit ripeness. Further research is recommended to use a wider concentration range, involve the extraction process and sample concentration, and compare other antioxidant testing methods such as FRAP (Ferric Reducing Antioxidant Power) or ABTS to obtain a more comprehensive picture of the antioxidant capacity of green coconut.

CONCLUSION

Based on the results of the study, it can be concluded that the average vitamin C content in green coconut water is 29.35 ± 5.08 mg/100 g and in green coconut flesh is 28.48 ± 4.93 mg/100 g, with relatively close values between the two parts of the fruit. Antioxidant activity measured using the DPPH method showed an IC50 value of 5,824.52 ppm for coconut water and 5,423.78 ppm for coconut flesh, both of which are classified as very weak antioxidant activity because they far exceed the threshold of 200 ppm. Coconut flesh showed

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slightly better antioxidant activity than coconut water even though the vitamin C levels of both were relatively equal, which indicates that factors other than vitamin C also contribute to the total antioxidant capacity of green coconut. This study provides baseline data on the antioxidant potential of fresh green coconut and recommends further research with a wider concentration range, extraction process, and complementary antioxidant test methods to obtain a more comprehensive picture.

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