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Antioxidant activity potential of 96% ethanol extract from jackfruit (*Artocarpus integer*) peel based on IC_{50} value

Esa Indah Ayudia[1], Miftahurrahmah[2], Lipinwati[3], Hasna Dewi[4], Hafizah[5], Denok Tri Hardiningsih[6]

[1] Department of Physiology, Faculty of Medicine and Health Sciences, Universitas Jambi, Jambi, Indonesia
[2] Department of Surgery, Faculty of Medicine and Health Sciences, Universitas Jambi, Jambi, Indonesia
[3] Department of Microbiology, Faculty of Medicine and Health Sciences, Universitas Jambi, Jambi, Indonesia
[4] Department of Histology and Anatomical Pathology, Faculty of Medicine and Health Sciences, Universitas Jambi, Jambi, Indonesia
[5] Department of Physiology, Faculty of Medicine and Health Sciences, Universitas Jambi, Jambi, Indonesia
[6] Department of Phytopharmacology, Faculty of Medicine and Health Sciences, Universitas Jambi, Jambi, Indonesia

*Coressponding Authors: esa_indah.at@unja.ac.id

Abstract

Background: Jackfruit (*Artocarpus integer*) peel is an agricultural waste with potential as a source of bioactive compounds. **Objective**: This study aims to evaluate the potential antioxidant activity of cempedak fruit peel extract using a 96% ethanol solvent. The extract, tested as fraction F3P, is believed to contain phenolic and flavonoid compounds that act as free radical scavengers. Extraction was performed using the maceration method. **Methods:** Antioxidant activity was tested in vitro using the DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical scavenging method at various concentrations, ranging from 20 ppm to 100 ppm. Based on the percentage inhibition data obtained, the IC50 (Inhibitory Concentration 50%) value was calculated through logarithmic/linear regression analysis. **Results:** The calculation results show that the 96% ethanol extract of cempedak fruit peel (fraction F3P) has an IC50 value of 8.872 ppm. This IC50 value, which is below 50 ppm, indicates that the extract has very strong antioxidant activity. The active compounds within it can reduce 50% of DPPH free radicals at very low concentrations. **Conclusion:** This study concludes that the 96% ethanol extract of cempedak fruit peel is a highly potent and valuable source of natural antioxidants. Utilizing jackfruit peel waste can be a solution for developing functional food products or health supplements.

Keywords: Jackfruit Peel; 96% Ethanol; DPPH, Antioxidant; IC50; *Artocarpus integer*.

Cite This Article

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INTRODUCTION

Free radicals are highly reactive molecules, usually in the form of Reactive Oxygen Species (ROS), that are naturally produced during the body's metabolic processes [1]. An imbalance between free radical production and the body's endogenous antioxidant defense capacity will trigger a condition known as oxidative stress [1, 2]. Oxidative stress is a critical etiological factor in the onset of various chronic degenerative diseases, including cardiovascular disease, cancer, and neurodegenerative disorders [1, 2]. To neutralize these free radicals, antioxidants play a crucial role by donating electrons without becoming unstable themselves [10]. Therefore, the search for natural antioxidant sources derived from plants continues to be a major focus in pharmacological and nutritional research [3, 4]. The therapeutic potential of extracts from fruit peels, which are often classified as waste, has garnered significant attention as a source of bioactive compounds [4].

One potential natural resource that is often overlooked and treated as agricultural waste is the peel of the jackfruit (*A. integer*) [5]. Although typically discarded, jackfruit peel is believed to be rich in secondary metabolite compounds with potential activity [6, 4]. Previous phytochemical studies have consistently suggested the presence of high levels of phenolic and flavonoid compounds in jackfruit peel extract [7, 8, 9]. Flavonoid compounds, in particular, are known to have a potent mechanism of action as effective free radical scavengers and ROS stabilizers [2, 10].

The presence of these compounds makes jackfruit peel highly relevant for quantitative antioxidant activity evaluation. *In vitro* antioxidant activity testing is often performed using the DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical scavenging method, which is fast and sensitive for determining an extract's ability to donate hydrogen or electrons [11, 13]. By using a 96% ethanol solvent, which is effective at attracting polar compounds such as phenolics and flavonoids, this study aims to quantitatively test and measure the antioxidant activity potential of jackfruit peel extract, with the key parameter being the IC50 (*Inhibitory Concentration 50%*) value [7, 9, 14]. This IC50 value will serve as the benchmark for the extract's antioxidant strength

METHODS

Material extraction

The initial step was the preparation of the jackfruit peel extract. The extraction process was carried out using the maceration method, which involves soaking the powdered sample in a solvent for 2 x 24 hours (48 hours). The chosen solvent was 96% ethanol, which is polar and effective for extracting phenolic and flavonoid compounds hypothesized to be contained in the material. The filtrate from the maceration was then concentrated using a rotary evaporator at a controlled temperature (around 500C) until a viscous extract was produced.

Antioxidant activity test

Antioxidant activity testing was conducted in vitro using the spectrophotometry method based on the scavenging of DPPH (2,2-diphenyl-1-picrylhydrazyl) free radicals [11, 12]. This procedure involves incubating the jackfruit peel extract (F3P fraction) with the DPPH solution, where a color change occurs and its absorbance is measured to determine the extract's ability to capture free radicals [13]. Testing was performed at a series of determined concentrations, ranging from 20 ppm to 100 ppm.

Data analysis and IC50 calculation

After the absorbance data and inhibition percentage (% inhibition) at various extract concentrations were obtained, the IC50 value was calculated. The IC50 value, which defines the concentration of the extract required to scavenge 50% of the free radicals, was determined through logarithmic/linear regression analysis [14, 11]. The regression results describing the relationship between concentration and inhibition percentage were the basis for establishing the extract's antioxidant strength.

RESULTS

Inhibition percentage and concentration data

The antioxidant activity testing of the 96% ethanol jackfruit peel extract (F3P fraction) was performed by measuring the extract's ability to scavenge DPPH free radicals. The tested extract concentrations varied from 20 ppm to 100 ppm. The progressive increase in extract concentration correlated with an increase in the percentage of free radical inhibition. The inhibition percentage data (% inhibition) obtained from the average absorbance then became the basis for regression analysis. In general, the test results showed a linear relationship between the extract concentration used and its inhibitory power against DPPH free radicals.

Table 1. Inhibition Percentage and Concentration Data of 96% Ethanol Jackfruit Peel Extract (F3P Fraction).

Concentration (ppm)	In concentration	1	2	Average (Absorbance)	Sample abs	% inhibition
20	2.996	0.938	0.938	0.938	0.938	52.434
40	3.689	0.92	0.92	0.920	0.920	53.347
60	4.094	0.909	0.909	0.909	0.909	53.905
80	4.382	0.877	0.877	0.877	0.877	55.527
100	4.605	0.857	0.857	0.857	0.857	56.542

Regression Analysis and IC50 Determination

The IC50 value was obtained through linear/logarithmic regression analysis of the curve illustrating the relationship between extract concentration (X-axis) and inhibition percentage (Y-axis).

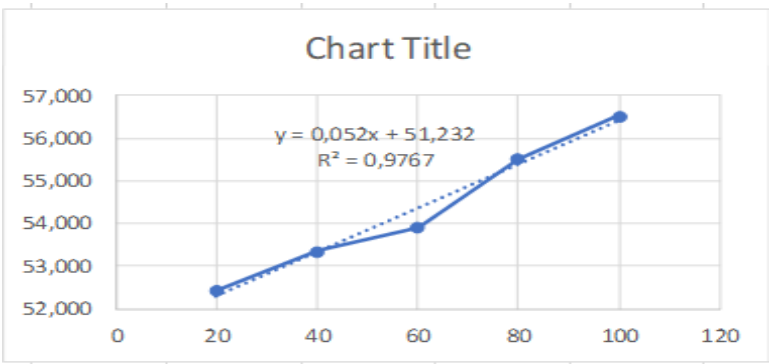

Figure 1. Regression Curve of Concentration (ppm) vs. % Inhibition

The coefficient of determination (R^2) obtained was 0.9767. This value is very close to 1.0, indicating a strong and significant linear relationship between the extract concentration and its inhibitory activity. Based on the logarithmic/linear regression calculation of the measured inhibition percentage data, the Inhibitory Concentration 50% (IC_{50}) value for the 96% ethanol jackfruit peel extract (F3P fraction) was 8.872 ppm. This figure represents the concentration point at which the extract is capable of scavenging 50% of the DPPH free radical activity.

DISCUSSION

The IC_{50} value is the gold standard parameter for measuring antioxidant potential, where a smaller IC_{50} value inversely indicates a stronger potential of a substance [15]. The IC50 value obtained in this study is 8.872 ppm. Based on general criteria used in pharmacological research, antioxidant activity is classified as very strong if its IC50 value is less than 50 ppm [15, 16]. With a value of 8.872 ppm, this 96% ethanol jackfruit peel extract is definitely categorized as having very strong antioxidant activity.

This very low IC_{50} value indicates that the extract has exceptional efficacy, as only a very small concentration is required to neutralize half of the DPPH free radicals [9]. This is significantly more potent compared to some other plant extracts, which often have IC_{50} values above 100 ppm or even in the 50–100 ppm range (strong) [15]. This high antioxidant strength is strongly supported by the secondary metabolite content that has been previously identified [6]. The 96% ethanol solvent was chosen due to its effectiveness in attracting polar compounds, which are the primary antioxidants, namely phenolics and flavonoids [7, 8]. Flavonoid compounds act through a free radical scavenging mechanism by donating their hydrogen atoms (HAT mechanism) or transferring electrons (SET mechanism), which is very effective in stabilizing free radicals such as DPPH [2, 10, 13].

The finding that jackfruit peel, which has been considered agricultural waste, is a source of very potent antioxidants [5] opens up significant utilization prospects. Instead of ending up in landfills, jackfruit peel can become a high-value raw material [17]. This potential can be followed up for the development of: (1) Functional Foods or Health Supplements: With such strong antioxidant activity, this extract can be formulated into products that may help prevent or mitigate the risk of degenerative diseases triggered by oxidative stress [1, 17]; (2) Cosmetic Raw Materials: Natural antioxidants are also highly sought after in the cosmetic industry to combat premature aging caused by free radicals. Scientifically, this result reinforces the preliminary studies conducted by other researchers regarding the potential of Artocarpus integer [6, 9]. This study is also validated by the coefficient of determination (R2) value of 0.9767, which shows excellent linearity. This means the DPPH method used in this research is capable of measuring the dose-dependent response of the extract with a high degree of reliability.

CONCLUSIONS

This study concludes that the 96% ethanol extract of jackfruit peel (*Artocarpus integer*) is a very potent source of natural antioxidants [9]. This is supported by an IC50 value of 8.872 ppm, which is classified as very strong antioxidant activity. The linear regression analysis showed an excellent correlation between the increasing extract concentration and its inhibitory power against DPPH free radicals. The utilization of this waste offers a promising solution for the development of functional and health products. A recommendation for further research is the identification and

isolation of the specific active compounds (phenolics and flavonoids) responsible for this very strong antioxidant activity.

CONFLICT OF INTEREST

The authors declare that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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DECLARATION OF ARTIFICIAL INTELLIGENCE USE

We hereby confirm that artificial intelligence (AI) was not used during the data collection, analysis, and visualization stages. An AI-based language model was used for language refinement (improving grammar, sentence structure, and readability) and technical writing assistance (providing suggestions for more effective technical descriptions) during the preparation of this manuscript. The authors have critically reviewed all AI-assisted processes to ensure the integrity and reliability of the results. The authors alone make the final decisions and interpretations presented in this article.

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