The Antioxidant Activity Analysis of the Ethanolic Extract of Banana Peel (*Musa paradisiaca* forma *typica*) with DPPH Method

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Abstract: Oxidative stress is one of the triggers of various degenerative diseases and metabolic syndrome. Antioxidants are compounds that exhibit the activities of neutralizing and scavenging radical molecules, which induce the process of oxidative reactions in the body. One of the many antioxidant compounds found in plants is flavonoids. Banana peels are known to contain flavonoid compounds. This study aimed to determine the antioxidant activity of the ethanolic extract of banana peel (*Musa paradisiaca* forma *typica*). The ethanolic extract of banana peel (*Musa paradisiaca* forma *typica*) was prepared using maceration with 96% ethanol as the solvent. The product was concentrated in a vacuum rotary evaporator and water bath. The antioxidant activity test was performed with the DPPH method using various concentrations of extract, namely 1, 2, 3, and 4 ppm. This research found that the ethanolic extract of banana peel (*Musa paradisiaca* forma *typica*) had an IC_{50} value of 4.4 ppm. The ethanolic extract of banana peel (*Musa paradisiaca* forma *typica*) has a very strong antioxidant activity.

1 INTRODUCTION

Banana plants are fruit-producing plants widely available in Indonesia, and one of them is the *Kepok banana* (*Musa paradisiaca* forma *typica*). Regarding plantation area and commodity production in Indonesia, bananas occupy the first place among the other types of fruits. Nevertheless, their utilization in the community is so far limited to the fruits alone. They can be consumed either directly or indirectly after being processed first into snack foods, but either way, the banana peel is disposed of as a waste product without adequate options of optimum application (Khorudin, 2016).

Chemical compounds, existing with different properties in many plants, are spread throughout the plant's organs. Banana peel contains flavonoid compounds whose properties include the potential for antioxidants (Atun *et al*., 2007). It also contains many carbohydrates, minerals such as potassium and sodium, and cellulose. Based on a phytochemical analysis of banana peel extract, Salau and Ajani (2012) affirm that banana peels contain secondary metabolites, such as saponins, tannins, alkaloids, flavonoids, phlobatannins, anthraquinones, and quinones, that have antibacterial activity (Fadhilah *et al*., 2014).

Flavonoids are active compounds that can have beneficial properties, for instance, they function as antioxidants (Sjahid, 2008; Sousa *et al*., 2004) and exhibit anti-dermatosis (Rajendra *et al*., 2004) chemo-preventive, anticancer (Galati and O'Brien, 2004), antiviral (Wei *et al*., 2004), antibacterial and anti-inflammatory activities (Sjahid, 2008). Horry and Jay in Harborne (1993) isolate and identify several flavonoid compounds from the banana peel of *M. acuminata* species. These compounds are cyanidin, delphinidin, petunidin, and malvidin-3-ramnosil-1,6-glucoside.

This study aimed to determine the antioxidant activity of the ethanolic extract of banana peel (*Musa paradisiaca* forma *typica*). *Musa paradisiaca* forma *typica* is still considered one family with *Musa acumianta,* which chemotaxonomically has similar secondary metabolite compounds.

2 MATERIALS AND METHODS

2.1 Materials

The tools and materials used in the research were a UV-Visible Spectrophotometer (Thermo Scientific™),

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DPPH (1,1-diphenyl-2-picrylhydrazyl), and *Kepok* banana *(Musa paradisiaca* forma *typica)* from Jaro Village, Tabalong Regency, South Kalimantan.

2.2 Methods

The ethanolic extract of *Kepok* banana (*Musa paradisiaca* forma *typica*) was obtained from extraction by maceration method. The antioxidant activity testing was conducted by creating a stock solution with a concentration of 1,000 ppm using 96% ethanol as the solvent and then preparing a series of solutions with different concentrations, namely 1 ppm, 2 ppm, 3 ppm, and 4 ppm. Each concentration was added with the DPPH (1,1-diphenyl-2-picrylhydrazyl) solution, and its absorbance was measured with a UV-Vis spectrophotometer at a wavelength of 515 nm.

2.3 Data Analysis

The stages analysis of antioxidant activity of the ethanolic extract of banana peel that is as follows:

2.3.1 The Calculation of Antioxidant Activity

The antioxidant activity was expressed in percent (%) and calculated with the formula (1).

$$\text{Antioxidant Activity (\%)} = \frac{(\text{Abs of control-Abs of sample})}{(\text{Abs of control})} \times 100\% \quad (1)$$

2.3.2 The Calculation of IC50 (Inhibitor Concentration)

The IC_{50} of the ethanolic extract of banana peel was estimated with linear regression using the formula (2).

$$y = bx + a \quad (2)$$

where:
y: % inhibition
x: % radical damping
a: sample's concentration
b: % antioxidant activity

3 RESULTS AND DISCUSSION

This research was conducted in several stages. The first stage determined the maximum wavelength, which aimed to identify the maximum absorbance of DPPH. The maximum wavelength represents maximum sensitivity; and, therefore, it can produce the greatest absorbance value (Kusumawardhani, Sulistyarti and Veteran, 2015). The maximum wavelength obtained in this stage was 517 nm (Figure 1). The second stage was the measurement of the sample's absorbance. It started with measuring the absorbance of the control solution (DPPH), followed by the absorbance of samples from the lowest to the highest concentration. The results showed that extracts with the highest concentration had the lowest absorbance value and the greatest percentage of antioxidant resistance. The results of the absorbance measurements can be seen in Table 1.

The absorbance measurement results were continued with the calculation of the antioxidant activity (%) (Table 2). Then, the final step was classifying the resultant antioxidant activity based on the IC_{50} values. IC_{50} is the concentration required to reduce DPPH by 50%. In this research, it was determined using a linear regression equation (Figure 2). A smaller IC_{50} value would result in higher antioxidant activity, meaning that the compound can counter DPPH as a free radical effectively (Kristiana, Ariviani and Khasanah, 2012). As proposed by

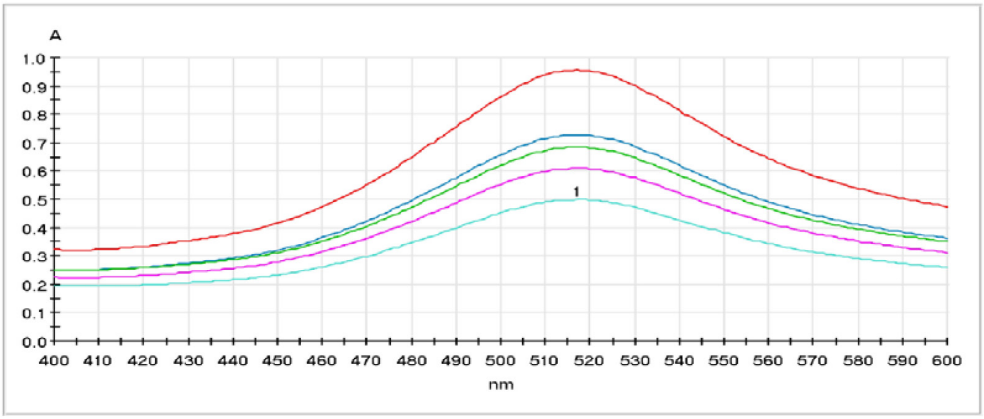

Figure 1: The maximum wavelength of DPPH.

Table 1: The absorbance values of the samples used in the antioxidant activity testing.

No	Samples	Absorbance
1	DPPH	0.966
2	DPPH + Extract 1 ppm	0.735
3	DPPH + Extract 2 ppm	0.691
4	DPPH + Extract 3 ppm	0.614
5	DPPH + Extract 4 ppm	0.500

Table 2: The antioxidant activity (%) of the ethanolic extract of banana peels.

No	Samples	% Antioxidant Activity
1	DPPH + Extract 1 ppm	24.00
2	DPPH + Extract 2 ppm	28.50
3	DPPH + Extract 3 ppm	36.47
4	DPPH + Extract 4 ppm	48.29

Molyneux (2004), the antioxidant activity was classified based on the IC_{50} value (Table 3).

Based on the linear regression equation, the R^2 was 0.9606, and the IC_{50} value was 4.44 ppm (Table 4). This IC_{50} value indicates that the banana peel extract exhibits excellent activity and ability to absorb free radical from DPPH compound. Therefore, it can be used as an additional therapy or prevention in increasing the body's antioxidants and, consequently, the free-radical scavenging activity. The antioxidant activity of banana peel extract was visible from the color change in the DPPH solution. The original DPPH solution was purple (violet), and this color

Table 3: The classification of antioxidant activity based on IC50 value (Molyneux, 2004).

Antioxidant Activity	IC_{50} Value
Very strong	<50 ppm
Strong	50-100 ppm
Average	100-200 ppm
Weak	>200 ppm

faded after its reactions with the extract solution. This change occurred because of DPPH reduction, i.e., a process where the antioxidant compounds in the extract donate protons or hydrogen to DPPH resulting in the formation of new stable or non-reactive radicals (1,1-diphenyl-2-picrylhydrazyl).

The antioxidant activity originates from the secondary metabolites contained in the banana peel extract, namely alkaloids, flavonoids, tannins, and saponins (Ariani and Riski, 2018). Flavonoids are strong antioxidants that can reduce free radicals and produce flavonoid compounds (Middleton, Theoharides, and Kandaswami 2000).

Free radicals are highly reactive and harmful substances that can damage the tissues of organs and cause various diseases. Since antioxidants can inhibit free radicals and increase endurance simultaneously, their presence are crucial in countering the effects of free radicals in the body (Winarsi, 2011).

This research also offers another benefit, namely the optimization of the use and utilization of *Kepok* banana peel as antioxidants. Therefore, the most favorable utilization of bananas can include not only the fruit but also the peel to reduce waste production.

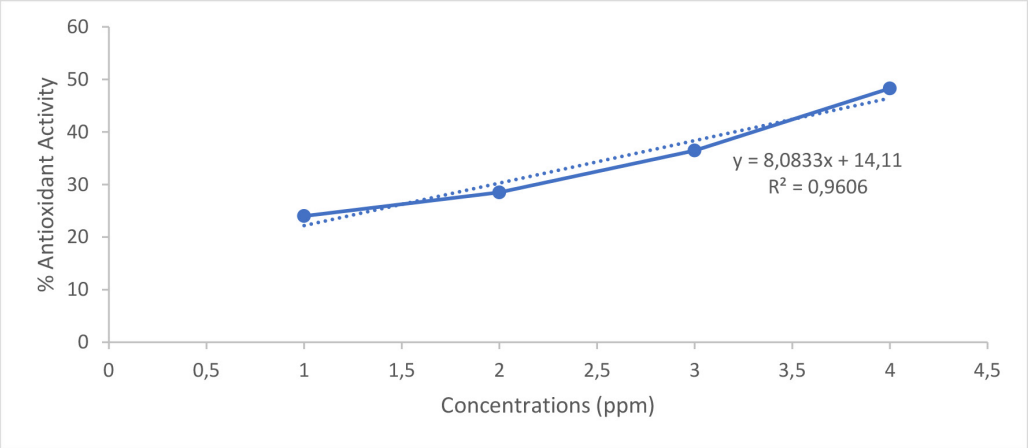

Figure 2: The XY graph showing the correlation between the sample's concentrations and the percentage of antioxidant activity.

Table 4: The calculation of the IC50 of the Kepok banana peel extract.

Concentrations (ppm)	% Antioxidant Activity	Linear Regression Equation	IC_{50}	Classification
1	24.00	y = 8.0833x + 14.11 R^2 = 0.9606	4.44 ppm	Very Strong
2	28.50			
3	36.47			
4	48.29			
4	48.29			

4 CONCLUSIONS

The ethanolic extract of the raw banana peel (*Musa paradisiaca* forma *typica*), originating from Jaro Village, Tabalong Regency, South Kalimantan, has very strong antioxidant activity with an IC_{50} value of 4.44 ppm. This study proves that banana peel extract can be used as an additional therapy or prevention in increasing the body's antioxidants, which play a significant role in free-radical scavenging.

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