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REVIEW: ANTIOXIDANT ACTIVITY OF INDONESIAN BANANA PEELS

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Abstrak

Pisang merupakan buah yang paling banyak dikonsumsi di dunia dan memiliki berbagai manfaat kesehatan. Kulit pisang, yang sering dianggap sebagai limbah, ternyata mengandung senyawa bioaktif dengan aktivitas antioksidan yang signifikan. Aktivitas antioksidan dari kulit pisang telah banyak dilaporkan, termasuk kulit pisang dari Indonesia. Review ini membahas aktivitas antioksidan kulit pisang Indonesia serta kandungan senyawa aktif di dalamnya. Sejumlah penelitian menunjukkan bahwa terdapat ekstrak kulit pisang dari Indonesia yang memiliki aktivitas antioksidan sangat kuat, antara lain ekstrak kulit pisang Ambon mentah, kulit pisang Barangan mentah, dan kulit pisang Muli. Penelitian juga menunjukkan bahwa kulit pisang yang masih mentah memiliki aktivitas antioksidan yang lebih tinggi dibandingkan dengan yang sudah matang, yang disebabkan oleh kandungan flavonoid dan tanin yang lebih tinggi. Potensi antioksidan dari kulit pisang terutama disebabkan oleh keberadaan flavonoid, saponin dan tanin yang berperan penting dalam menetralkan radikal bebas.

Kata Kunci: *Antioksidan, Flavonoid, Kulit pisang, Pisang Indonesia*

Abstract

Banana is the most widely consumed fruit with several health advantages. Banana peels, often considered waste, contain bioactive compounds with significant antioxidant properties. The antioxidant activity of banana peels has been widely reported, including banana peels from Indonesia. This review examines the antioxidant activity of Indonesian banana peels including their active compound content. Studies show that there are Indonesian banana peel extracts that exhibit very strong antioxidant activity, including unripe Ambon banana peel extract, unripe Barangan banana peel extract, and Muli banana peel extract. Studies also indicate that unripe banana peels exhibit stronger antioxidant activity than ripe ones due to higher flavonoid and tannin content. The antioxidant potential of banana peels is primarily attributed to flavonoids, saponins, and tannins which play a crucial role in neutralizing free radicals.

***Keywords*:** *Antioxidant, Flavonoid, Banana peel, Indonesian banana*

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INTRODUCTION

Banana is a herbaceous flowering plant that belongs to the family Musaceae and genus Musa. It is also an edible fruit (Sidhu & Zafar, 2018). The first bananas are estimated to have been cultivated in the Kuk valley of New Guinea in 8000 B.C., and they are thought to have originated 10,000 years ago. These later extended to the Philippines and other parts of Southeast Asia and the South Pacific before spreading in all directions throughout the tropics(Singh et al., 2016)

Banana is the most widely consumed fruit with several health advantages. The portion of the banana that is not used and is full of bioactive substances is the peel. Anticancer, antifungal, antibacterial, and antioxidant properties are present in the peel extract (Azarudeen & Nithya, 2021)

Antioxidants are essential in the body's fight against free radicals. Nucleic acids, proteins, and lipids are examples of macromolecules that can be harmed by an excess of free radicals. This causes tissue damage in a number of degenerative and chronic illnesses (Martemucci et al., 2022)

Natural antioxidants are predominantly derived from plant phenolics, which can be found in various plant parts, including fruits, vegetables, seeds, nuts, leaves, roots, flours, and barks. Through their metabolic processes, plants generate a wide range of secondary metabolites, such as flavonoids, essential oils, alkaloids, lignans, terpenes, terpenoids, tocopherols, phenolic acids, peptides, polyfunctional organic acids, and other bioactive compounds (Gulcin, 2020)

The antioxidant activity of banana peels has been widely reported, including banana peels from Indonesia. This article aims to review the antioxidant activity of Indonesian banana peels including their active compound content.

METHOD

The literature study approach was used to review this article. National and international publications that are published online between 2014 and 2024 are the literature that are used. The search was conducted using PubMed, Research Gate, and Google Scholar.

Inclusion Criteria: Studies focusing on the antioxidant activity of Indonesian banana peel extracts. Studies that provide IC50 values for antioxidant potential.

Exclusion Criteria: Studies focusing on banana fruit or other plant parts instead of the peel. There is no Latin name for the species of banana. Studies only phytochemical screening with no antioxidant activity. Articles that were not published between 2014 and 2024. Studies whose data have already been included in meta-analyses or comprehensive reviews.

RESULTS AND DISCUSSIONS

Antioxidant activity of Indonesian banana peels

Antioxidant activity of Indonesian banana peel extracts have been studies. It summarized in table 1. It showed that antioxidant activity test was using DPPH (1,1-diphenyl-2-picrylhydrazyl) and ABTS (2,2-azinobis-3-etilbenzitiazolin-6-sulfonat) methods.

The DPPH method provides information on the reactivity of the tested compounds with a free radical. DPPH exhibits strong absorption at a wavelength of 517 nm with a dark violet color. DPPH, which acts as a free radical, reacts with antioxidant compounds, converting into diphenylpicrylhydrazine, a non-radical form. This occurs because the antioxidant compounds donate hydrogen radicals to the DPPH radical, reducing it to DPPH-H. This reaction is indicated by a color change from purple to pale yellow (Gulcin & Alwasel, 2023).

The color change in the ABTS antioxidant method occurs due to the reduction of the ABTS radical cation by antioxidants. Initially, ABTS is oxidized by potassium persulfate (PP), generating the ABTS radical, which gives the solution a strong bluish-green color. When an antioxidant is introduced, it donates electrons to ABTS, converting it back to its colorless ABTS form, leading to a proportional decrease in color intensity. This reduction reaction can be measured using a spectrophotometer, where a decrease in absorbance indicates antioxidant activity (Ilyasov et al., 2020).

Table 1. Antioxidant activity of Indonesian banana peel extracts

Species	Origin name	Sample	Method	IC50 (µg/ml)	Reference
Musa acuminata Colla	Ambon	Ethanol extract	DPPH	88.12	(Himawan et al., 2018)
M. acuminata Colla	Ambon	Methanol extract-unripe	DPPH	11.78	(Malik et al., 2023)
	Ambon	Methanol extract-ripe	DPPH	151.56	
M. acuminata var. Jarum	Jarum	Ethanol extract	DPPH	362-60	(Souhoka et al., 2019)
		Methanol extract		558.07	
		Acetone extract		310.08	
M. acuminata Linn	Barangan/ Medan	Ethanol extract-unripe	DPPH	34.06	(Arista & Siregar, 2023)
		Ethanol extract-ripe		98.08	
M. acuminata Linn	Muli	Methanol extract	DPPH	27.56	(Yulis et al., 2020)
		Ethanol extract	DPPH	62.31	(Ulmillah et al., 2023)
M. acuminata x *balbisiana*	Kepok	Water extract - unripe	ABTS	60.50	(Pantria Saputri et al., 2020)
		Water extract-ripe		95.85	
		Water extract-very ripe		68.74	
	Kepok	Ethanol extract-macerated	DPPH	34.493	(Iman et al., 2023)
		Ethanol extract-refluxed		28.203	
		Ethanol extract-UAE		23.147	
	Kepok	Ethanol extract	DPPH	9.35	(Ulmillah et al., 2023)
M. paradisiaca	Tanduk	Ethanol extract	DPPH	48.49	(Ulmillah et al., 2023)
M. paradisiaca L. var Kepok	Kepok	PEF-Water extract	DPPH	13.086	(Hendrawan et al., 2019)
M. paradisiaca formatypica	Kepok	Methanol extract	DPPH	479.77	(Yulis et al., 2020)
M. paradisiaca var. Sapientum	Raja	Methanol extract	DPPH	46.82	(Jami'ah et al., 2018)
	Raja	Water fraction	DPPH	358.395	(Pusmarani et al., 2022)
		Ethyl acetate fraction		139.498	
		n-hexane fraction		875.539	
M. paradisiaca	Candi	Ethanol extract	DPPH	3374.13	(Laeliocattleya et al., 2018)
		Ethyl acetate	DPPH	40318.19	

Table 2. Pyhtochemical screening of Indonesian banana peels

Species	Origin name	Sample	Secondary Metabolites								Reference
			F	A	S	T	PH	ST	TR	TE	
Musa acuminata Colla	Ambon	Ethanol extract	+	-	+	+		-	-		(Himawan et al., 2018)
M. acuminata var. Jarum	Jarum	Ethanol extract	+	+	+		+	+		+	(Souhoka et al., 2019)

		Methanol extract	+	+	+		+	+		+	
		Acetone extract	+	+	+		+	+		+	
M. acuminata Linn	Muli	Methanol extract	+	-	+	+	+	+	+		(Yulis et al., 2020)
	Muli	Ethanol extract	+	+	+	+		+	+		(Ulmillah et al., 2023)
M. acuminata x balbisiana	Kepok	Ethanol extract	+	+	+	+		+	+		(Ulmillah et al., 2023)
M. paradisiaca	Tanduk	Ethanol extract	+	+	+	+		+	+		(Ulmillah et al., 2023)
M. paradisiaca formatypica	Kepok	Methanol extract	+	-	+	+	+	-	+		(Yulis et al., 2020)

Explanation: F: flavonoid
A: alkaloid
S: saponin
T: tanin
PH: phenol
ST: steroid/triterpenoid
TR: triterpenoid
TE: terpenoid

Table 1 also shows that the antioxidant activity in extract of unripe banana peels is higher than in extract of ripe banana peels, both in Ambon *(M. acuminata* Colla) banana peel, Barangan (*M. acuminata* Linn) banana peel, and Kepok (*M. acuminata x balbisiana*) banana peel. Unripe banana peels contain active compounds such as tannins and flavonoids (Malik et al., 2023) These compounds exhibit antioxidant activity. As the banana ripens, the content of these compounds degrades, leading to a decrease in antioxidant activity. This is in line with the research of Sundaram (2011) which stated that unripe banana peel contains a high amount of polyphenols (including tannins) with large molecular weight. During ripening, most of these high molecular weight polyphenols are degraded into lower molecular weight compounds, which are less effective as antioxidants (Sundaram et al., 2011).

Table 1 also shows that the antioxidant activity of the methanol extract from Kepok (*M. acuminata* x *balbisiana*) banana peel obtained UAE (Ultrasound Assisted Extraction) is the highest compared to the methanol extracts obtainedmaceration and reflux. UAE method exhibits stronger antioxidant activity compared to other extraction methods due to several key factors. The ultrasonic waves create acoustic cavitation, which disrupts cell walls and enhances the release of bioactive compounds like flavonoids and phenols, resulting in higher extraction efficiency. Additionally, UAE improves mass transfer and membrane permeability, allowing more antioxidant compounds to be extracted in a shorter time. Unlike reflux extraction, UAE operates at lower temperatures, preventing thermal degradation of sensitive compounds, which helps retain their antioxidant properties (Iman et al., 2023).

From table 1, it shows that methanol extract of Kepok banana peel with Pulsed Electric Field (PEF) pre-treatment has very strong antioxidant activity. It because PEF disrupts cell membranes through electroporation, allowing antioxidant compounds to diffuse more efficiently into the solvent. Unlike conventional heating methods, PEF does not use high temperatures, preventing the degradation of antioxidant compounds (Hendrawan et al., 2019).

Table 2 shows that the extracts of all species or types of banana peels contain flavonoid and saponin compounds. Flavonoids protect against free radical–induced damage through several mechanisms, one of which is by directly scavenging radicals. When radicals interact with flavonoids, the flavonoids become oxidized, forming a more stable and less reactive radical species. In this way, flavonoids neutralize reactive oxygen species by binding to the reactive components of the radicals. The presence of highly reactive hydroxyl groups in flavonoids plays a key role in rendering radicals inactive (Panche et al., 2016). Saponins can neutralize stable free radicals such as DPPH and ABTS by donating a hydrogen atom or an electron. (Khan et al., 2022). In addition to flavonoids and saponins, tannins are also present in almost all types of banana peels. Tannins can donate hydrogen atoms or electrons from their phenolic groups to neutralize free radicals (ROS, RNS, DPPH·, ABTS·). The resulting tannin radical is relatively

stable due to resonance stabilization within the aromatic structure (Sieniawska, 2015).

CONCLUSION

This review highlights the significant antioxidant activity of Indonesian banana peels, demonstrating their potential as natural sources of bioactive compounds. Studies show that there are Indonesian banana peel extracts that exhibit very strong antioxidant activity, including unripe Ambon banana peel extract, unripe Barangan banana peel extract, and Muli banana peel extract. Studies also indicate that unripe banana peels exhibit stronger antioxidant activity than ripe ones due to higher flavonoid and tannin content. The antioxidant potential of banana peels is primarily attributed to flavonoids, saponins and tannins which play a crucial role in neutralizing free radicals. Given their strong antioxidant properties, Indonesian banana peels have promising applications in pharmaceuticals, nutraceuticals, and functional food products. Further research is recommended to optimize extraction methods and explore their full therapeutic potential.

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