

Bioactive Compounds in Barangan Banana Peel (*Musa acuminata* Colla.) as an Alternative for Antibacterial Drug Development

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Abstract. Barangan banana (*Musa acuminata* Colla.) is one of the banana varieties which is often found in Indonesia and is widely consumed so that banana peels become organic waste and need to be processed further. The novelty of this research is to prove the antibacterial activity of the ethanol extract contained in banana peels on the *Pseudomonas aeruginosa* bacteria which is supported by the GCMS instrument to show the active compounds contained which can be used in the development of anti-bacterial drugs. *Pseudomonas aeruginosa* is an opportunistic pathogen that is widespread and inhabits the homeland and environments in contact with humans and animals. These bacteria can attack infections of the skin, blood, lungs and digestive tract. The ethanol extract was tested against *Pseudomonas aeruginosa* using the agar well diffusion method. the compounds contained in the samples were analyzed using Phytochemical Test obtained alkaloids, flavonoid, terpenoids, steroids, saponins and tannins were obtained. There are six active compounds:

Palmitinic acid ($C_{16}H_{32}O_2$), Cyclopentanol acetate ($C_7H_{12}O_2$), 1-(2-Thienyl) Ethanone oxime (C_6H_7NOS), 2-Furancarboxaldehyde ($C_5H_4O_2$), 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- ($C_6H_8O_4$), and 2(3H)-Furanone, 5-methyl- ($C_5H_6O_2$) with percent area respectively : 3,49, 12,60, 26,46, 20,85, 3,82, and 2,98 %. Antibacterial activity with inhibition zone diameters at concentrations of 100, 50, 25, and 12.5 mg/ml were 12.80, 10.70, 5.00 and 2.00 mm, respectively. This work will advance the development of antimicrobial drugs.

Keywords: Banana, GCMS, *Pseudomonas aeruginosa*, antibacterial, ethanol.

INTRODUCTION

Bananas have more than 200 species spread throughout the Indonesian archipelago, each type has its own uniqueness and characteristics [1][2]. Banana of Barangan (*Musa acuminata* Colla.) is a banana that is popular in Indonesia because it has a sweet and delicious

taste and contains nutrients and vitamins that are good for health [3]. The nutritional content per 100 grams of banana flesh is energy (4-5%), protein (2%), fat (1%), carbohydrates (18%), minerals (Ca 0.5%, Co 8%, Mn 13%, Mg 7%, P 3%, Se 2%, Zn 1%, Potassium (K) 8%, Fe 2%, and vitamins (Vit. A 2%, Vit. C 15%, Vit. E and K 1%)[4][5].

Banana peels have not been used optimally. Banana peels contain phenolic compounds, pectin, carbohydrates and other minerals[6]. The presence of these compounds can function as antioxidants and anti-inflammatories[2]. Apart from that, banana peels have higher antioxidants than the flesh of the fruit. Galo catechin is a class of flavonoid compounds that can function as an antioxidant[5]. Ethanol and Methanol Extracts from *Musa acuminata* are very effective against *Candida albicans*. The active compounds contained in it are lycopene, phenol, saponins, alkaloids, tannins, terpenoids and anthocyanins which may also be effective against *Pseudomonas aeruginosa* [7]. Antibacterial test of Kepok Banana Peel Extract (*Musa paradisiaca* x *balbisiana*) Raw Against Growth *Staphylococcus aureus* bacteria have been studied. Ethanol extract is used in the extraction process for 3 x 24 hours with various concentrations. The results obtained show that treatment with a concentration of 100% is the best treatment in inhibiting the growth of *Staphylococcus aureus* bacteria with the lowest number of colonies, namely 8.7 x 10⁴ colonies[8]. The maceration method is very popular to produce active compounds in bananas. Water solvents are often used because they are easy and cheap but decrease quality in yields, so the Hydrogen Rich Water (HRW) method was developed. However, this research is still limited to bananas and not fruit skin. Ethanol extract instead of water was chosen as an alternative to improve the quality of fruit peel extract to obtain more active compounds [9].

Pseudomonas aeruginosa is capable of producing toxins and enzymes that cause death in humans[10]. These bacteria produce enzymes which have a histotoxic effect and facilitate the invasion of these organisms into the blood vessels[11]. Methanol extract of *Musa acuminata* banana leaves was able to inhibit *Staphylococcus aureus* ATCC 6538 and *Escherichia coli*. However, the antibacterial activity of ethanol extract from banana peel below 100 mg/ml against *Pseudomonas aeruginosa* bacteria has not been reported so this research was carried out.

METHODOLOGY

Collecting sample, materials and equipment.

Barangan banana (*Musa acuminata* Colla.) peels were collected from the Medan Helvetia area in June 2023.

Materials: The chemicals used were distilled water, 70% ethanol, ethanol p. a, 1% sulfuric acid solution, 1.175% barium chloride solution, chloroform (CHCl₃), NH₄OH, Mayer's reagent, Salkowski test, Liebermann-Burchard, FeCl₃, 10% NaOH, Fehling reagent A, Fehling B reagent, dimethyl sulfoxide (DMSO) and other supporting materials. The media used were Mueller Hinton Agar (MHA), Mueller Hinton Broth (MHB), Nutrient Agar (NA). The test microorganism was *Pseudomonas aeruginosa*.

Equipment: autoclaves, evaporator cups, refrigerators, water bath, digital scales, tube clamps, sterile tweezers, rotary evaporator, laminar air flow, and GCMS Agilent 7890 B and MS Agilent 5977A MSD.

Preparation and extraction

The Banana peel was done by collecting the skin then washing it, draining it and drying it with absorbent paper. After that, it is chopped, then weighed, then dried in a drying cupboard at a temperature of 40-50°C [12], then blended into powder, weighed, and stored in a tightly closed container. Extraction of active compounds from banana peel was carried out using the maceration method, the solvent used was ethanol. Maceration was carried out at room temperature[13]. The macerate was separated and then evaporated using a rotary vacuum evaporator at a temperature of 60°C until a thick ethanol extract was obtained.

Phytochemical Test and Antibacterial Activity test

Phytochemical Test have been carried using alkaloids, Flavonoid, Terpenoids, steroids, saponin, and tannin test. Antibacterial activity test was carried out using the agar-well diffusion method against *P. aeruginosa* bacteria. The first stage was tested with each concentration of banana peel extract. *P. aeruginosa* bacteria were inoculated on Mueller Hilton Broth (MHB) growth medium

and incubated for 24 hours at 37°C. As much as 10% of the incubated MHB medium was added to the agar medium and shaken. In a sterile petri dish, 10 ml of Mueller Hilton Agar (MHA) was poured and allowed to stand until it solidified. 0.1 ml of bacterial inoculum suspension was added, then 25 ml of MHA media was added to the petri dish and homogenized. Test extract solution with each concentration and blank (dimethyl sulfoxide mixture) with positive blank (chloramphenicol) with a concentration of 100 mg/ml; 50mg/ml; 25mg/ml; 12.5 mg/ml; 6.25 mg/ml; and 3.125 mg/ml) each of which is input as much as 0.1 ml in the available wells. Immediately cover the petri dish and let stand for 30 minutes, then incubate at $35 \pm 2^{\circ}\text{C}$ for 24 hours. Observations were made by measuring the clear area that forms a circle using a caliper. Antibacterial activity was calculated by the zone of inhibition in diameter with units of mm.

Put it in a micro tube containing 0.5 gram of banana peel extract and 1.5 ml of methanol solvent, then vortexed for 1 minute, then centrifuged for 3 minutes at 9000 rpm. The supernatant formed was continued for GCMS testing. The time is set for 60 minutes with an injector temperature of 260°C, detector 250°C, and column 325°C. The carrier gas used is helium gas as the carrier at a constant flow rate of 1 ml/min. The identification process using the GCMS tool to produce several bioactive compounds can be seen from the peaks of the chromatogram as identification of data from chromatography and mass spectrometry (MS) results seen from the mass spectrum with the molecular weight of each bioactive compound[14].

Phytochemical Screening Test of Ethanol Extract

Table 1. Phytochemical Screening Test

Phytochemical tests were carried out using the method of Harborne method. The results of the phytochemical screening test of Barangan banana peel extract showed that there were secondary metabolites, namely alkaloids, flavonoids, triterpenoids, steroids, saponins, and tannins.

GCMS data is shown in Figure 1 below:

Figure 1. Chromatogram of Banana peel extract

Table 2. GCMS Data

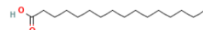
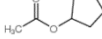
No.	Retention Time	% Area	Compounds	Structure
1	18,443	3,49	Palmitinic acid (C ₁₆ H ₃₂ O ₂)	
2	12,707	12,60	Cyclopentanol, acetate (C ₇ H ₁₂ O ₂)	
3	10,701	26,46	1-(2-Thienyl) ethanone oxime (C ₆ H ₇ NOS)	
4	9,666	20,85	2-Furancarboxaldehyde (C ₅ H ₄ O ₂)	
5	8,354	3,82	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- (C ₆ H ₈ O ₄)	
6	3,934	2,98	2(3H)-Furanone, 5-methyl- (C ₅ H ₆ O ₂)	

Table 2 shown the main active compounds (six compounds) contained in Banana peel extract, namely: Palmitinic acid (C₁₆H₃₂O₂), Cyclopentanol, acetate (C₇H₁₂O₂), 1-(2-Thienyl) Ethanone oxime (C₆H₇NOS), 2-Furancarboxaldehyde (C₅H₄O₂), 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- (C₆H₈O₄), and 2(3H)-Furanone, 5-methyl- (C₅H₆O₂) with percent area respectively : 3,49, 12,60, 26,46, 20,85, 3,82, and 2,98 %.

Antibacterial Activity

The results of the antibacterial activity test of Baraga banana peel extract against *Pseudomonas aeruginosa* using Mc Farland shown in Table 2.

Table 2. Antibacterial activity test

Ethanol Extract Concentration (mg/ml)	Inhibition Zone Diameter (mm)
3.125	0
6.25	0
12.5	2,00
25	5,00
50	10,70
100	12,80
B ⁺	14,45
B ⁻	0

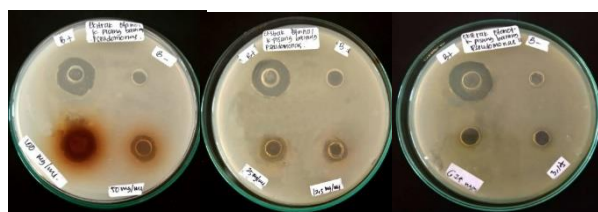


Figure 2. Results of antibacterial activity test of Barangan banana peel extract (*Musa acuminata* Colla.) against *Pseudomonas aeruginosa* at concentrations of 100 mg/ml, 50 mg/ml, 25 mg/ml, 12.5 mg/ml, 6.25 mg/ml, 3.125 mg/ml, control +, and control -.

Table 2 shown that the greater the concentration, the greater the diameter of the bacterial inhibition zone. This is in accordance with Figure 2. The inhibitory power of ethanol extract on bacterial growth is due to the content of secondary metabolite compounds contained in the extract. At concentrations of 6.25 mg/ml and 3.125 mg/ml it did not show inhibitory effect. The antibacterial activity of the ethanol extract of Barangan banana peel is influenced by the content of secondary

metabolites it has. Secondary metabolite compounds that play a role in antibacterial activity are flavonoids, tannins, alkaloids, steroids/terpenoids, and saponins. However, this work will advance the development of antimicrobial drugs.

CONCLUSION

The antibacterial activity of the ethanol extract of Barangan banana peel can be tested on *Pseudomonas aeruginosa* using the agar well/hole diffusion method and identification using GCMS. The secondary metabolites of the ethanol extract obtained from the research results are alkaloids, terpenoids, steroids, saponins, and tannins. Antibacterial activity with inhibition zone diameters at concentrations of 100, 50, 25, and 12.5 mg/ml were 12.80, 10.70, 5.00 and 2.00 mm, respectively.

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REFERENCE

- [1] K. Berawi, N. Perkasa, and S. Rachmanisa, "The Effect of Ethanol Extract of Banana Peel (*Musa paradisiaca*) on Glucose Levels in the Rat Strain (Sprague dawley) Induced Alloxan," *Med. Fac. Lampung Univ.*, vol. 1, pp. 111–114, 2014.
- [2] A. B. Sutjiatmo *et al.*, "Antioxidant and Anticancer Potential of Raja Bulu Banana Peel and Blossom (*Musa acuminata* Colla (AAB group)) Ethanol Extracts in MCF-7 Cell Lines," *Maj. Obat Tradis.*, vol. 26, no. 1, pp. 49–58, 2021, doi: 10.22146/mot.55333.
- [3] B. Rusdi, O. Rohaeni, M. A. Khairinisa, and U. Yuniarni, "Prebiotic Activity of Ambon Lumut Banana (*Musa acuminata* AAA) Peel Pectin," *Pharmacol. Clin. Pharm. Res.*, vol. 7, no. 3, pp. 142–148, 2022, doi: 10.15416/pcpr.v4i3.41598.
- [4] I. R. Resaputra, S. R. Habibi Wiwik, and M. I. Sukadana, "Aktivitas Antibakteri Ekstrak Metanol Kulit Pisang Pecah Seribu (*Musa x paradisiaca* L.) Terhadap Bakteri *Staphylococcus aureus* dan *Escherichia coli*," *Cakra Kim. (Indonesian E-Journal Appl. Chem.)*, vol. 8, no. 2, pp. 82–91, 2020.
- [5] Wimpy, T. Harningsih, and W. T. Larassati, "Uji Aktivitas Antioksidan dan Tabir Surya Kombinasi Ekstrak Kulit Buah Pisang Kepok (*Musa paradisiaca* Linn) dan Ekstrak Kulit Buah Alpukat (*Persea americana* Mill)," *J. Ilm. Manuntung*, vol. 6, no. 2, pp. 231–239, 2020.
- [6] A. Talukder and M. Z. Hossain, "Prevalence of Diabetes Mellitus and Its Associated Factors in Bangladesh: Application of Two-level Logistic Regression Model," *Sci. Rep.*, vol. 10, no. 1, pp. 30–33, 2020, doi: 10.1038/s41598-020-66084-9.
- [7] Mohammad Kanedi, Kusuma Handayani, and Wawan Abdullah Setiawan, "Studies on the antimicrobial potential of plant extract of banana (Genus *Musa*) in Indonesia," *World J. Adv. Res. Rev.*, vol. 17, no. 2, pp. 386–392, 2023, doi: 10.30574/wjarr.2023.17.2.0252.
- [8] H. Y. Pratama, E. Ernawati, and N. R. A. Mahmud, "Uji Antibakteri Ekstrak Kulit Buah Pisang Kepok (*Musa paradisiaca* x *balbisiana*) Mentah Terhadap Pertumbuhan Bakteri *Staphylococcus aureus*," *Sainsmat J. Ilm. Ilmu Pengetah. Alam*, vol. 7, no. 2, p. 147, 2018, doi: 10.35580/sainsmat7273672018.
- [9] G. I. Budiarti, E. Sulistiawati, N. Septiani, and W. Septianindi, "Karakteristik Tepung Kulit Pisang Modifikasi Menggunakan Hydrogen Rich Water," *J. Rekayasa Bahan Alam dan Energi Berkelanjutan*, vol. 5, no. 1, pp. 28–32, 2021.
- [10] Odebisi-Omokanye, A. E.-I. A. M., A. S. O., and O. M. A., "Comparative Assessment of Antibacterial Efficacy of four popular hand sanitizers sold in Nigeria," *Fountain J. Nat. Appl. Sci.*, vol. 4, no. 1, pp. 1–9, 2015.
- [11] S. Hegstad, H. Z. Khiabani, L. Kristoffersen, N. Kunøe, P. P. Lobmaier, and A. S. Christophersen, "Drug screening of hair by liquid chromatography-tandem mass spectrometry," *J. Anal. Toxicol.*, vol. 32, no. 5, pp. 364–372, 2008, doi: 10.1093/jat/32.5.364.
- [12] M. Taufik, D. Ardilla, B. Cahyady, Z. Alfian, and M. Razali, "A Simple Extraction

- Method for the Determination of Nicotine from Saliva,” *Asian J. Chem.*, vol. 34, no. 8, pp. 2119–2122, Aug. 2022, doi: 10.14233/ajchem.2022.23745.
- [13] M. Taufik, D. Ardila, M. Razali, and Z. Alfian, “Investigation of Lard on Pork Nuggets using UV Spectrophotometry,” *Indian J. Sci. Technol.*, vol. 12, no. 02, pp. 1–4, Jan. 2019, doi: 10.17485/ijst/2019/v12i2/138333.
- [14] M. Taufik, “Analysis of User’s Hair Cannabinoid of Narcotic Type of Marijuana (<i>Cannabis Sativa L.</i>) Using GCMS Technic,” *Am. J. Biomed. Life Sci.*, vol. 4, no. 1, p. 1, 2016, doi: 10.11648/j.ajbls.20160401.11.