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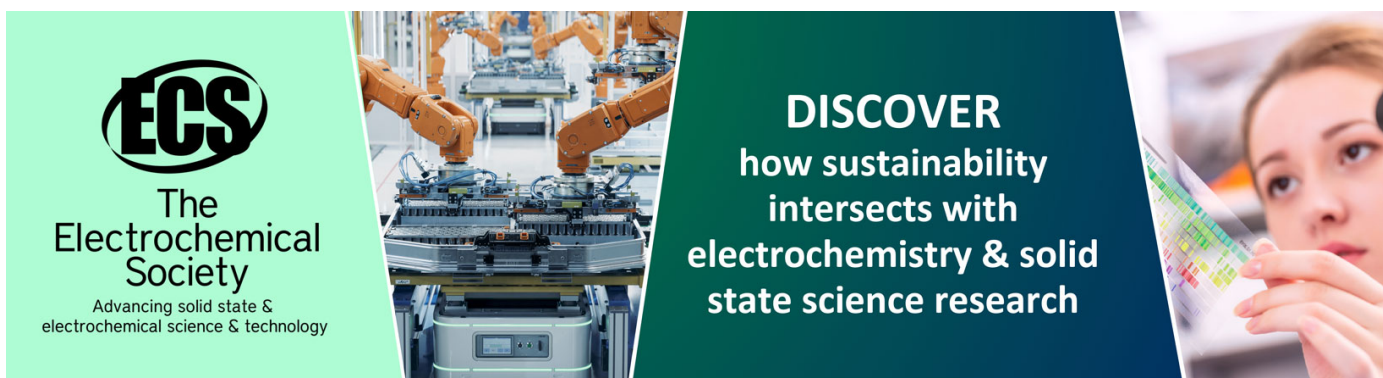
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Antibacterial effects of Kepok Banana bunch (*Musa paradisiaca* L.) against *Staphylococcus aureus*

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Abstract. Banana plants are well-known to contain diverse phytochemical compound. This study aimed to identify the antibacterial effects of Kepok Banana bunches (*Musa paradisiaca* L.) against *Staphylococcus aureus* bacteria. A laboratory analysis was carried out to determine the zone of bacterial inhibition. The experiment used completely randomized design with 3 treatments (50 µL, 70 µL Kepok Banana bunches extract and 50 µL Chloramphenicol as a positive control), each treatment replicated three times. The study was performed used wells agar diffusion. Data were analyzed by analysis of variance (ANOVA) and followed by Duncan Multiple Range Test (DMRT). Results showed that Kepok Banana bunches had potency as antibacterial agent. Treatments showed different ($P < 0.05$) results in bacterial inhibition zones. Chloramphenicol produces the highest inhibitory zone (34.78 mm), while the difference in the concentration of banana bunches produces the same inhibitory zone (50 µL: 11.52 mm; 70 µL: 15.52). It is concluded that Kepok Banana bunches has potency to use as an antibacterial against *Staphylococcus aureus*.

1. Introduction

Bananas are the leading fruit crop in the world. Its production reached 114 million tons world wide in 2017 [1]. Indonesia is one of the largest banana producers in the world with total production reaching 7.1 million tons in 2019 [2,3]. Large banana production also represents a large waste production, because only a small part of the plant can be used (the fruits) [4]. One banana plant only bears fruit once in a lifetime. When the plant is harvested, it will produce various organic wastes. Every tonne of banana harvest, will produce about 100 kg of rejected fruit and about 4 tons of other waste. Banana waste consists of rhizome, stem, bunch, leaves, peel and rotten fruits [4].

Every part of the banana plant is known to have many phytochemical compounds [5]. Each part of the plant at different age conditions, contain different phytochemicals. In the nature, phytochemicals are commonly used to protect plants from pests diseases [6]. On the other hand, phytochemicals can be used as antibacterial agent [7,8]. Bacteria that are resistant to many treatments but sensitive to phytochemicals are *Staphylococcus aureus*. These are gram-positive bacteria that live on the skin of animals, humans or plants [9].

Research on the antimicrobial effect of banana plants on the anti-bacterial activity of *Staphylococcus aureus* is mostly done on banana peels. Based on the various results of this study, it was proven that banana peel extracts of various types had quite good anti-bacterial effects [8,10–13].



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Based on this, we suspect that other parts of the banana plant may also have antibacterial activity. Thus, this study aims to determine the inhibitory power of banana bunches against *Staphylococcus aureus* bacteria.

2. Materials and methods

The material used in this research is Kepok banana bunches. Kepok banana bunches are taken from ripe bananas but the banana bunches are still fresh green. The method used includes two stages, namely the extraction of banana bunches and testing of bacterial inhibition. Testing for bacterial inhibition used a completely randomized design with three treatments. The treatments given were inoculation of 50 μ L and 75 μ L of banana bunch extract, and 50 μ L of chloramphenicol as a positive control. Each treatment was repeated three times.

The extraction process is carried out using ethanol extraction. The first step is to wash the fresh Kepok banana bunches thoroughly, then cut them into small pieces, thin and dry naturally for 7 days and after they dry the banana bunches are mashed. The dried banana bunches are weighed as much as 10 grams and then put in a three-neck flask which has been assembled with a reverse cooler, magnetic stirrer, thermometer, stativ and electric stove. The addition of 200 mL of 70% ethanol solvent into the three-neck flask and extraction was carried out until a thick extract was obtained, then extracted by reflux method using 70% ethanol solvent, temperature 70°C and time of 60 minutes.

After obtaining the banana bunch extract, the inhibition or antibacterial test was tested using the method of Garriga et al [14] which was also carried out by Fitriani et al. [15]. In this study, making a hole (well) was carried out aseptically with a well diameter of 6.4 mm, then inoculated with treatment. The agar medium used was Mueller Hinton agar (MHA) medium for *Staphylococcus aureus*. The measured zone of inhibition is the radius (r) in mm, which is the clear area around the well. Measurement of the radius of the zone of resistance around the well is carried out by measuring the distance from the edge of the well to the boundary of the zone of the resistance zone using a caliper (accuracy 0.01mm) on several sides of the well, then averaged. Furthermore, the value of the diameter (mm) of the inhibition zone is obtained by calculating $d = 2 \times r$.

Test data were analyzed by unidirectional analysis of variance. If there is an effect of treatment, continue the Duncan's New Multiple Range Test (DMRT). Data analysis was performed using SPSS22 software.

3. Results and discussion

Figure 1 shows the agar medium with *S. aureus* after receiving banana bunch extract and chloramphenicol treatment. The clear zone formed shows no growth of *Staphylococcus aureus* bacteria around the well. Kepok banana bunch extract diffuses evenly around the well and is able to form a clear zone which indicates a reaction to inhibit the growth of *Staphylococcus aureus* bacteria or as an antibacterial.

The phytochemical content contained in the banana bunch extract will spread around the well and provide an antibacterial effect. The content of banana bunch extract that allows antibacterial activity is flavonoids, tannins, saponins, alkaloids, and terpenoids. Flavonoids damage bacterial cells which cause bacterial lysis due to the release of intracellular compounds. Tannins inhibit the reverse transcriptase and DNA topoisomerase enzymes so that bacterial cells cannot form. Saponins reduce the surface tension of the bacterial cell walls because they have an active aglycone component which is membranolytic. Alkaloids have antibacterial properties by inhibiting nucleic acid synthesis. Terpenoids are thought to have antibacterial properties by involving the breakdown of the membrane by lipophilic components [5,7,8,12].



Figure 1. Zone of bacterial inhibition

Table 1 shows the area of the inhibition zone produced by the treatment in dealing with *S. aureus*. The results showed that there was an effect of treatment on the inhibition zone area of *S. aureus* ($P < 0.05$). The 50 μL and 75 μL banana bunch extract treatments produced an equivalent area of inhibition zone. However, both of them resulted in significantly lower inhibition than the use of chloramphenicol.

Table 1. Zone of bacterial inhibition of banana bunch against *Staphylococcus aureus*

Treatments	Inhibition zone <i>S. Aureus</i> (mm)
Kepok banana bunch extract 50 μL	11,52 ^a
Kepok banana bunch extract 75 μL	15,52 ^a
Chloramphenicol 50 μL	34,78 ^b
P. Value	<0,05

^{a b} Different superscript showed significantly different ($P < 0.05$)

The use of 50 μL and 75 μL has had an antimicrobial effect although it is not comparable to chloramphenicol. This indicates that secondary metabolites, such as the flavonoids, tannins, saponins and alkaloids, act as antibacterial, thus giving a greater effect in inhibiting bacterial growth. The use of banana bunch extracts in larger quantities allows an increase in the bacterial inhibition zone. The results of this study have a lower bacterial inhibition zone value than the study by Ningsih et al [16] who reported that the sap of Kepok banana bunch (*Musa. paradisiaca* L.) has the potential as an antibacterial against the growth of *Stapyloccus aureus* by 20.39 mm.

4. Conclusion

Based on the results of the study, it can be concluded that the Kepok banana bunch extract has antibacterial activity against *Stapyloccus aureus* although it is not comparable to chloramphenicol. Further studies using higher concentrations need to be carried out.

References

- [1] FAO 2020 *Banana market review February 2020 snapshot*
- [2] BPS 2019 Indonesia Statistic *Stat. Indones. 2019* (Jakarta: Badan Pusat Statistik)
- [3] Padam B S, Tin H S, Chye F Y and Abdullah M I 2014 *Banana by-products: an under-utilized renewable food biomass with great potential J. Food Sci. Technol.* **51** 3527–45
- [4] Abdullah N, Sulaiman F and Taib R M 2013 Characterization of banana (*Musa* spp.) plantation wastes as a potential renewable energy source *AIP Conf. Proc.* **1528** 325–30

- [5] Elayabalan S, Subramaniam S, Shobana V G and Ashok Kumar K 2017 An Overview on Phytochemical Composition of Banana (*Musa spp.*) *Indian J. Nat. Sci.* **7** 12408–19
- [6] Harlina and Pradana O P 2019 Analysis of stem and root extract of kepok banana (*musa paradisiaca* Linn.) in inhibit staphylococcus aureus growth *J. Dentomaxillofacial Sci.* **4** 45–8
- [7] Obiageli O A, Izundu A I, Helen O N and Pauline I A 2016 Phytochemical Compositions of Fruits of Three *Musa* Species at Three Stages of Development *ournal Pharm. Biol. Sci.* **11** 48–59
- [8] Ehiowemwenguan G, A. O E and J.E I 2014 Antibacterial and phytochemical analysis of Banana fruit peel *IOSR J. Pharm.* **4** 18–25
- [9] Troeman D P R, Van Hout D and Kluytmans J A J W 2019 Antimicrobial approaches in the prevention of *Staphylococcus aureus* infections: A review *J. Antimicrob. Chemother.* **74** 281–94
- [10] Behiry S I, Okla M K, Alamri S A, EL-Hefny M, Salem M Z M, Alaraidh I A, Ali H M, Al-Ghtani S M, Monroy J C and Salem A Z M 2019 Antifungal and antibacterial activities of *Musa paradisiaca* L. peel extract: HPLC analysis of phenolic and flavonoid contents *Processes* **7** 1–11
- [11] Chabuck Zainab A.G., Al-Charrakh Alaa H., Nada K. Hindi and Shatha K. Hindi 2013 Antimicrobial Effect of Aqueous Banana Peel Extract, Iraq *Res. Gate Pharm. Sci.* **1** 73–5
- [12] Kapadia S P, Pudukalkatti P S and Shivanaikar S 2015 Detection of antimicrobial activity of banana peel (*Musa paradisiaca* L.) on *Porphyromonas gingivalis* and *Aggregatibacter actinomycetemcomitans*: An in vitro study *Contemp. Clin. Dent.* **6** 496–9
- [13] Sutanti V and Destyawati A A 2019 The Use of Yellow Kepok Banana Peel Extract (*Musa paradisiaca* L. var bluggoe) as an Antibacterial for Chronic Periodontitis Caused by *Porphyromonas gingivalis* Viranda *J. Smart Bioprospecting Technol.* **01** 16–20
- [14] Garriga M, Hugas M, Aymerich T and Monfort J M 1993 Bacteriocinogenic activity of lactobacilli from fermented sausages *J. Appl. Bacteriol.* **75** 142–8
- [15] Fitrial Y, Astawan M, Soekarto S S, Wiryawan K G, Wresdiyati T and Khairina R 2008 Aktivitas Antibakteri Ekstrak Biji Teratai (*Nymphaea pubescens* Willd) Terhadap Bakteri Patogen Penyebab Diare *J. Teknol. dan Ind. Pangan* **19** 158–64
- [16] Ningsih A putri, Nurmiati and Aguestin anthoni 2013 Uji Aktivitas Antibakteri Ekstrak Kental Tanaman Pisang Kepok Kuning (*Musa paradisiaca* Linn.) terhadap *Staphylococcus aureus* dan *Escherichia coli* Antibacterial Activity of Crude Extracts of Pisang Kepok Kuning (*Musa paradisiaca* Linn.) Against *Staphylococc* *J. Biol. Univ. Andalas (J. Bio. UA.)* **2** 207–13