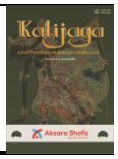
Kalijaga : Jurnal Penelitian Multidisiplin Mahasiswa
Volume 3, Nomor 1, Februari 2026 Hlm. 9-15
E-ISSN: 3062-6862 P-ISSN : 3048-2216
DOI : https://doi.org/10.62523/kalijaga.v3i1.59



Antioxidant and Antibacterial Activity of Local Ginger Rhizhome Extract from Panti Jember, East Java

Aktivitas Antioksidan dan Antibakterial pada Ekstrak Rimpang Jahe Lokal Asal Panti Jember, Jawa Timur

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ARTICLE INFO

Article history:
Received, March 1, 2026
Revised, April 17, 2026
Accepted, April 17, 2026
Available online, April 17, 2026

Kata Kunci:
Jahe (Zingiber officinale), antioksidan, antibakteri

Keywords:
Ginger (Zingiber officinale), antioxidant, antibacterial

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ABSTRAK

Jahe merupakan salah satu family Zingiberaceae yang berpotensi sebagai obat, contohnya sebagai antioksidan dan antibakteri. Tujuan dari penelitian ini adalah untuk mengidentifikasi aktivitas antioksidan dan antibakteri pada ekstrak rimpang jahe asal Jember, Jawa Timur. Metode yang digunakan dalam uji antioksidan menggunakan larutan DPPH sebagai kontrol negatif dan digunakan spektrofotometer UV-VIS 517 nm untuk mengukur nilai %inhibisi atau hambatan terhadap DPPH tersebut. Uji antibakteri dilakukan terhadap isolate bakteri pathogen S. aureus, dengan konsenterasi ekstrak rimpang jahe 25%, 50%, 75%, dan 100% serta antibiotik sebagai kontrol positif. Hasil dari penelitian ini adalah aktivitas antioksidan diperoleh hasil 70,6% inhibisi yang termasuk kategori kuat. Hasil uji antibakteri pada konsenterasi 25% dan 50% tidak menunjukkan aktivitas antibakteri, sedangkan pada konsenterasi 75% diperoleh zona bening 13,2 mm dengan kategori kuat, dan konsenterasi 100% diperoleh zona bening 46,2 mm dengan kategori sangat kuat. Aktivitas antioksidan dan antibaketri tersebut dikarenakan adanya kandungan senyawa fitokimia pada rimpang jahe seperti, zingiberene, curcumene, shogaol, dan gingerol.

ABSTRACT

Ginger is a member of the Zingiberaceae family that has potential medicinal uses, such as antioxidants and antibacterial agents. The purpose of this study was to identify the antioxidant and antibacterial activities of ginger rhizome extract from Jember, East Java. The method used in the antioxidant test used a DPPH solution as a negative control and a UV-VIS spectrophotometer with a wavelength of 517 nm to measure the % inhibition or inhibition value against DPPH. The antibacterial test was conducted on S. aureus pathogen isolates, with ginger rhizome extract concentrations of 25%, 50%, 75%, and 100% and antibiotics as a positive control. The results of this study showed that the antioxidant activity obtained was 70.6% inhibition, which is classified as strong. The antibacterial test results at concentrations of 25% and 50% did not show antibacterial activity, while at a concentration of 75%, a clear zone of 13.2 mm was obtained, which is classified as strong, and at a concentration of 100%, a clear zone of 46.2 mm was obtained, which is classified as very strong. The antioxidant and antibacterial activities are due to the phytochemical compounds in ginger rhizomes, such as zingiberene, curcumene, shogaol, and gingerol.

1. INTRODUCTION

Ginger is a plant belonging to the *Zingiberaceae family*, which is widespread in Southeast Asia, including Indonesia (Windarsih et al., 2021). The rhizome of ginger is often used by the community as a natural medicine, because the phytochemical content in ginger is considered beneficial to health (Sharifi-

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Rad et al., 2017). Utilization is needed to optimize the potential of ginger as a natural medicine, so that the general public does not rely too much on medical or pharmaceutical drugs.

According to research conducted by (Umeoka, 2024) ginger rhizomes contain phytochemicals such as shogaol, borneol, gingerol, zingiberol, and other compounds. These phytochemicals have biological activities that are beneficial to the human body, namely as antioxidants and antibacterials (Moorkoth et al., 2021). Antioxidants are one of the biological activities that can be caused by a metabolite compound from a plant. These antioxidants can boost the immune system (Yousfi et al., 2021). One method that can be used in the analysis of antioxidant activity in a plant sample is to use DPPH (*2,2-diphenyl-1-picrylhydrazyl*) as a free radical and a UV-VIS spectrophotometer to measure its absorbance value (Ansari et al., 2016).

The antibacterial activity in ginger is caused by the phytochemicals it contains. Its antibacterial properties can be determined by conducting tests on pathogenic bacteria. Previous research conducted by (Yousfi et al., 2021) proved that ginger samples from Jember, East Java, have antibacterial properties against *E. coli, S. aureus, P. aeruginosa*, and several other samples. One method that can be used in antibacterial testing is to grow bacteria on a specific medium and then add extracts with different concentrations (Setyati et al., 2024). Based on previous research, it is hoped that this can be done using samples from Jember, so that it can be disseminated to the local community. The purpose of this study is to identify the antioxidant and antibacterial activities in ginger rhizome extracts from Jember, East Java.

2. METHOD

Sample Preparation-Extraction

Ginger rhizome samples were collected from the Gunung Pasang Panti area, Jember Regency, East Java. Samples were collected on August 8, 2024, and washed in running water. The ginger rhizome samples were air-dried at room temperature for 60 minutes, then sliced thinly. Ginger rhizome samples were extracted at the Sub Botany Biology Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, University of Jember. The ginger rhizome samples were weighed at 30 grams, then placed in an Erlenmeyer flask and poured with 300 mL of 96% methanol. The samples were macerated for 3 days and 3 nights at room temperature. After maceration, the ginger rhizome samples were evaporated using a rotary evaporator to produce a crude extract that would be used for antioxidant and antibacterial testing (Ilmiah et al., 2025).

Antioxidant Test

Antioxidant testing was conducted at the Bioscience Laboratory of the Jember State Polytechnic. Antioxidant testing began with the preparation of a DPPH solution, which involved weighing 0.01 grams of DPPH powder and dissolving it in 20 mL of PA methanol. The solution was then stored in a dark bottle lined with aluminum foil for 30 minutes. The extracts used in this test had concentrations of 1000 ppm, 1500 ppm, and 2000 ppm. Absorbance measurements were then taken using a UV-VIS spectrophotometer with a wavelength of 517 nm (Sadeer et al., 2020). The results of the measurements taken with this device were then analyzed using the following formula (Nuraeni & Sembiring, 2018).

% Inhibition=.serapan blanko-serapan sampel/serapan blanko x 100%

Antibacterial Test

Antibacterial testing begins with sterilization, which is performed on all equipment to be used. The equipment is sterilized using an autoclave. Then, agar media is prepared using NA (Nutrient Agar) and NB (Nutrient Brooth), poured into tubes, heated, and incubated for 24 hours. The media is poured into Petri dishes in a laminar flow cabinet (LAF), which must be sterilized to prevent contamination. One milliliter of bacterial culture is grown using the pour plate method on 15 mL of NA media. Five holes are then made in the media using a well. The ginger extracts used in this study were 25%, 50%, 75%, and 100%, while the control used an antibiotic drug (Setyati et al., 2021). The parameter measured is the inhibition zone formed around the well. Antibacterial activity strength is categorized as low (<5 mm), moderate (5-10 mm), strong (11-19 mm), and very strong (≥20 mm) (Setyati et al., 2024).

3. RESULT AND DISCUSSION

Antioxidant activity testing on ginger rhizome extract was conducted using a UV-VIS spectrophotometer, a method that has been used in previous studies. The principle of this method is that samples are analyzed qualitatively based on their absorbance values, and an analysis of %inhibition in DPPH is performed. Based on the results of antioxidant testing of ginger rhizome extract using a UV-VIS spectrophotometer at a wavelength of 516 nm, the results are as follows.

Table 1. Results of antioxidant activity testing of ginger rhizome extract with DPPH

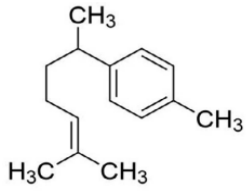
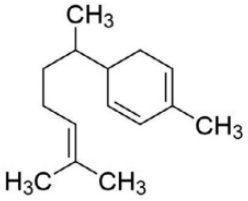
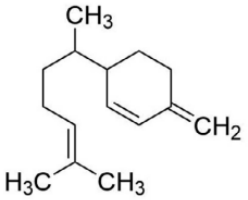
Sample	Repetition/Concentration	Absorbance	Average	% Inhibition
DPPH (negative control)	1	0.978	0.995	0.000
	2	0.997		
	3	1.011		
Ginger Rhizome Extract	1	0.286	0.292	70.697
	2	0.289		
	3	0.300		

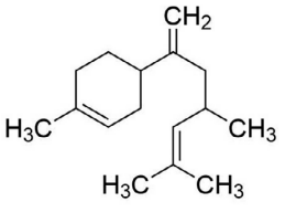
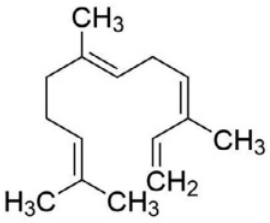
***Information on ginger rhizome extract, 1 = 1000 ppm, 2 = 1500 ppm, and 3 = 2000 ppm.**

The results of antioxidant activity testing on ginger rhizome extract using a UV-VIS spectrophotometer showed 70.6% inhibition. This value indicates that ginger rhizome extract has proven antioxidant activity. According to Halifa et al., (2024) the antioxidant activity of a sample has several categories of values, namely if it has a value of <50 ppm, then the extract has very strong antioxidant activity, a value of 50-100 ppm indicates strong antioxidant activity, a value of 100-150 ppm indicates moderate antioxidant activity, a value of 150-200 ppm indicates weak antioxidant activity, and a value of >200 ppm indicates very weak antioxidant activity. Based on these categories, ginger rhizome extract has strong antioxidant activity.

The antioxidant test in this study used DPPH as a negative control, because DPPH acts as a free radical (Nuraeni & Sembiring, 2018). Compounds that act as antioxidants will react with DPPH by adding electrons or hydrogen atoms, thereby neutralizing the DPPH (Lotter et al., 2019). The antioxidant activity of ginger rhizome extract is due to its phytochemical content. Previous research conducted by Yousfi et al., (2021), found that ginger contains several phytochemicals that have antioxidant potential.

Table 2. Phytochemical content in ginger rhizomes (Yousfi et al., 2021)

No.	Compound	Structure	Percentage(%)
1.	*Curcumene*		16.47
2.	*Zingiberene*		23.71
3.	*β-Sesquiphellandrene*		16.08

4.	*β-Bisabolene*		10.28
5.	*α-Farnesene*		8.24

The study identified that ginger rhizome extract contains several phytochemicals, including *Curcumene, Zingiberene, β-Sesquiphellandrene, β-Bisabolene,* and *α-Farnesene*. The results of the analysis, conducted using gas chromatography, showed that the dominant compound with the highest percentage was *Zingiberene* (23.71%).

Antibacterial activity testing was conducted on *Staphylococcus aureus* bacterial isolates, which are highly dangerous pathogens for humans. According to the literature, *S. aureus* has the potential to cause diseases such as infective endocarditis, toxic shock syndrome, scalded *skin syndrome, osteomyelitis, fascial necrosis,* and *necrotizing pneumonia* (Otto, 2014). The study used ginger rhizome extracts at concentrations of 25%, 50%, 75%, and 100%, while the positive control used antibiotics. The following are the results of testing ginger rhizome extracts against *S. aureus* bacterial isolates.

Table 3. Results of antibacterial testing of *S. aureus* using ginger rhizome extract

Sample Concentration	**Clear Zone (mm)**	**Description**
Concentrated ginger rhizome extract 25%	0	No antibacterial activity
Concentrated ginger rhizome extract 50%	0	No antibacterial activity
Concentrated ginger rhizome extract 75%	13,2	Strong
Concentrated ginger rhizome extract 100%	46,2	Very strong
Control (Antibiotics)	80	Very strong

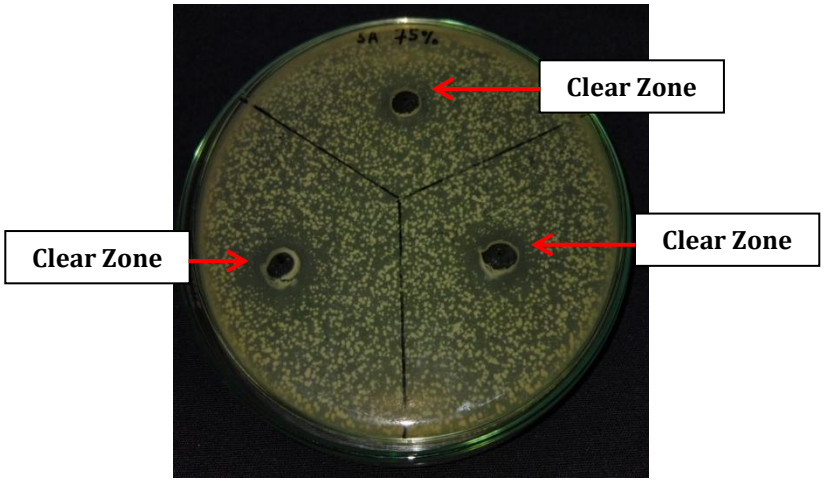


Figure 1. Antibacterial test results of local ginger rhizome extract against *S. aureus* bacteria in NA medium

Based on the results of the antibacterial test, the antibacterial activity of ginger rhizome extract depends on the concentration used. The data obtained shows that ginger rhizome extract with concentrations of 25% and 50% did not show a clear zone, indicating no antibacterial activity. However, at a concentration of 75%, a clear zone measuring 13.2 mm was observed, indicating strong antibacterial activity (11-14 mm). Meanwhile, at a concentration of 100%, the clear zone reached 46.2 mm, indicating very strong antibacterial activity (≥20 mm).

The results of the study indicate that the antibacterial activity of an extract is influenced by its concentration level. According to the study, the antibacterial properties of ginger rhizome are influenced by its phytochemical content, but its effectiveness is influenced by the concentration required to achieve the MIC (Minimum Inhibitory Concentration) (Felicia et al., 2022), concentrations of 25% and 50% did not meet the MIC threshold, so they could not produce antibacterial properties against *S. aureus* bacterial isolates. The results of the test were also influenced by the extraction method used. The concentrations of 25% and 50% were still too low to dissolve the phytochemical content in the ginger rhizome extract, so the concentration must be increased to produce antibacterial (Ghasemzadeh et al., 2016).

Based on the test results, in line with previous studies, ginger extract contains phytochemicals, namely shogaol and gingerol, which have strong antibacterial activity against pathogenic bacteria (Rathore & Kumar, 2022). Shogaol is a phenolic compound with a chemical structure almost identical to gingerol, but shogaol has a more complex side chain than gingerol (Siregar et al., 2022). Shogaol has biological activities that are very useful in the field of health, because it has antibacterial, anti-inflammatory, and antioxidant properties (Ramdhini et al., 2022) . Gingerol is a phenolic compound that gives ginger rhizomes their spicy taste. The biological activity of gingerol is still not as strong as that of shogaol, but gingerol still has antibacterial properties that can be utilized in the field of health (Sandrasari et al., 2023).

4. CONCLUSION

Ginger rhizome extract has antioxidant and antibacterial properties. Antioxidant testing showed 70.6% inhibition, indicating strong antioxidant activity. The antibacterial test was conducted on S. aureus bacterial isolates that are pathogenic. The results of the ginger rhizome extract antibacterial test depended on the concentration of the extract solution. Concentrations of 25% and 50% did not show antibacterial activity because these concentrations did not reach the MIC (Minimum Inhibitory Concentration) threshold. However, concentrations of 75% and 100% showed antibacterial activity. At a concentration of 75%, a clear zone of 13.2 mm was obtained with a strong antibacterial category, while at a concentration of 100%, a clear zone of 46.2 mm was obtained with a very strong antibacterial category. The presence of bacteria is influenced by the phytochemical content of shogaol and gingerol.

5. ACKNOWLEDGE

The author would like to thank the joint research team from Jember University and Man 2 Jember. This research is a breakthrough in inter-level collaboration, demonstrating that basic research can be conducted by senior high school students. This research is expected to provide scientific knowledge and insights to the people of Jember and the general public.

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