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Research Article

Antibacterial Activity Test of Ethanol Extract of Red Macroalgae (Acanthopora Spicifera) Against *Staphylococcus Aureus* Bacteria

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Abstract

Bacterial infection *Staphylococcus aureus* has become a significant global health problem, mainly due to increasing resistance to existing antibiotics. To overcome this problem, research is continuing to find new sources of natural antibacterial agents. Red macroalgae *(Acanthopora sp.)* has promising biological potential, including activity as an antimicrobial. This study aims to determine the effect and how much concentration of red macroalgae ethanol extract *(Acanthopora sp.)* which is close to the value of the inhibition zone of the positive control Amoxicillin in inhibiting bacterial growth *S. aureus*. This research is a laboratory experimental research. The stages of the research began with taking red macroalgae samples *(Acanthopora sp.)* collected from Pandanan beach, North Lombok Regency, West Nusa Tenggara by the method *simple random sampling* and identified morphologically, manufacture of simplicia, manufacture of red macroalgae ethanol extract *(Acanthopora sp.)* with 99.99% ethanol solvent (absolute p.a), phytochemical screening tests, and antibacterial activity tests using a Completely Randomized Design (CRD) were carried out by well diffusion method with concentration variations of 2%, 4%, 6%, 8% and 10%, Amoxicillin as positive control and aquadest as negative control and ethanol as solvent control. Antibacterial activity test results from the crude extract of red macroalgae *(Acanthopora sp.)* against bacteria *S. aureus* incubated during *overnight* (16-18 hours) in an incubator with a temperature of 37^{O}C. The results showed that the phytochemical analysis of the ethanol extract of red macroalgae identified the presence of flavonoids and saponins which are known to have potential as antibacterial agents. The presence of these compounds supports the antibacterial activity of red macroalgae against *S. aureus.* Red macroalgae ethanol extract *(Acanthopora sp.)* has antibacterial activity against *S. aureus*. The antibacterial activity of the ethanol extract showed a concentration-response pattern, where the higher the concentration of the extract, the greater the inhibition zone formed. The concentration of 10% ethanol extract showed the largest inhibition zone with an average diameter of 23.5 mm with the sensitive category.

Keywords: Antibacterial, Ethanol, *Acanthopora sp.*, *Staphylococcus aureus*.

1. Introduction

S. aureus bacterial infection is a serious global health problem because it can cause various kinds of infections, ranging from skin infections to systemic infections that can be life-threatening. Skin disease is one of the health problems that is often found in Indonesia. According to the 2020 Indonesian Health Profile, Indonesia has a prevalence rate of skin disease of 0.49 (49%) cases per 10,000 population and new skin disease cases of 4.2 cases per 100,000 population. *S. aureus* bacteria are known as gram-positive bacteria and are often found on human skin and nasal mucosa (Otto, 2013).

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The presence of *S. aureus* bacteria in the human body does not actually always cause health problems, but if the body is weak or there is an injury to the skin, the *S. aureus* bacteria can cause detrimental infections and inflammation (Murray et al., 2015).

Treatment of S. aureus bacterial infections can be done using antibiotics, however excessive use of antibiotics can cause bacterial resistance to these antibiotics (Spellberg et al., 2016). Therefore, research is needed to find alternative treatments for *S. aureus* bacterial infections that are safer and more effective. One of them is by exploring the potential of the red macroalgae *Acanthopora spicifera (Acanthopora sp.)* as an antibacterial against *S. aureus.*

Acanthophora sp. is a type of red macroalgae that contains many nutrients and bioactive compounds, such as polysaccharides, phenolics and terpenoids, which have biological activities such as antibacterial, antiviral and antitumor. Acanthophor sp. can be found in tropical and subtropical waters.

In line with other research by Salosso (2019), he conducted research on the Agar Content and Active Compounds of Red Macroalgae found in Arubara Waters, Ende Regency. This research uses descriptive data analysis with the help of tables and graphs. The research results show that the dominant red macroalgae found in Arubara Beach Waters, Ende district, are *Gracillaria sp, Amphiroa sp, Acantophora sp, Catinela sp, Galaxaura sp*. The content of red macroalgae Gracillaria sp. namely 16.0 ± 14.0 %, Acantophora sp. 15.3 ± 26.6% and Catinela sp. 16.0 ± 14.0%. The results obtained by each sample of red macroalgae contained active compounds of flavonoids, phenolics, tannins and saponins and did not contain alkaloids. From the research above, not much research has been carried out to explore the potential antibacterial activity of *Acanthopora sp*. against *S. aureus* bacteria. Based on the description above, it is very necessary to carry out research on testing the antibacterial activity of ethanol extract of red macroalgae *(Acanthopora spicifera)* against *Staphylococcus aureus* bacteria using maceration and evaporation methods.

2. Materials and Methods

2.1 Tools and Materials

The tools used in the research were a blender, sieve, analytical balance, container, rotary evaporator, shaker, filter paper, glass funnel, stirring rod, aluminum foil, Erlenmayer, measuring cup, beaker glass, test tube, cotton swab, dropper pipette, micropipette, microtube, L rod, incubator, petri dish, wire loop, Bunsen burner, hot plate, magnetic stirrer, label paper, autoclave, vortex, ruler, Laminar Air Flow (LAF).

The materials used in the research were red macroalgae extract *(Acanthopora s.),* magnesium, concentrated Hydrogen Chloride (HCL), 1% Ferric Chloride (FeCl3) solution. ammonia, dragendorff, acetic acid, concentrated sulfuric acid, 99.99% absolute ethanol, 50% ethanol, sterile distilled water, Amoxicillin drug solution, spirit, 70% alcohol, tissue, Nutrient Agar (NA), and *S. aureus* bacteria.

2.2 Method

Sampling

The red macroalgae *(Acanthopora sp.)* obtained were collected in the afternoon when the sea water was slightly low, making the sampling process easier. Samples were collected as much as 1 kg of red macroalgae *(Acanthopora sp.)* which was taken on the coast of Pandanan, North Lombok Regency. Sampling was carried out using the simple random sampling method. The sampling technique uses the simple random sampling method, which is a random and simple sampling method, namely a technique for determining locations and samples randomly by determining the number of samples to be studied and can represent the research area in overall sampling (Harahap, 2018).

Making Simplicia

After being taken, the samples are washed and wet sorted to separate dirt or other materials from the plants. Washing is carried out to clean foreign materials and other impurities in the samples by washing three times and soaking for 5 minutes in each process so that the salt content in the macroalgae can be minimized. After that, chop it with the aim of simplifying the drying process and making simplicia powder. Drying of red macroalgae seaweed *(Acanthopora sp.)* is carried out by airing it in a room with a temperature of 25^{o}C and protected from sunlight. Finally, dry sorting is carried out with the aim of separating foreign objects in unwanted plant parts and other impurities that are still present and left behind in the dried simplicia (BPOM, 2012). Dried red macroalgae *(Acanthopora sp.)* were ground using a blender. The fine red macroalgae *(Acanthopora sp*.) powder was then sieved using a Mess 30 sieve.

Sample Extraction

Weighed 56 grams of crushed simplicia, then put it into a container, then added 150 mL of 99.9% absolute ethanol using a glass funnel and extracted for 3 x 24 hours. This maceration process was carried out three times in a place protected from light. After that, the resulting maserate is filtered using filter paper. The liquid extract is then filtered using an Erlenmayer as well as a funnel and filter paper to separate the macerate from the dregs. The filtrate liquid is put into a round bottom flask connected to a rotary vacuum evaporator until a thick extract is formed using a temperature of 50^{o}C (Lantah, 2017).

Phytochemical Test

Red macroalgae extract *(Acanthopora sp.)* was taken at 0.1 gram, which had been dissolved in 99.99% absolute ethanol. Then add magnesium (Mg) powder and 1 mL of concentrated HCl, then shake vigorously. A positive test is indicated by the formation of a red or orange color (Jannah, 2020).

The saponin test was carried out by taking 0.1 gram of red macroalgae *(Acanthopora sp.)* extract, which had been dissolved in 99.99% absolute ethanol then added with 10 mL of heated distilled water, in a test tube then cooled and shaken until foam appeared. Let the solution sit for 2 minutes, then add 2-3 drops of 2% HCL. If it produces foam that remains stable for 10 minutes with a height of 1-3 cm, then the extract is positive for containing saponin (Jannah, 2020).

Antibacterial Activity Test

Antibacterial activity testing used the well diffusion method on Nutrient Agar (NA) media and was carried out in Laminar Air Flow (LAF). The antibacterial activity test used crude extract obtained from evaporation (with concentration variations of 2%, 4%, 6%, 8%, 10%). The activity test also used a positive control in the form of the drug Amoxicillin (the same concentration variation as the macroalgae crude extract), a solvent control in the form of ethanol (the same concentration variation as the macroalgae crude extract) and a negative control using sterile distilled water.

100 µL of the suspended *S. aureus* bacterial stock was pipetted into 5 petri dishes containing Nutrient Agar (NA) media, spread using an L stick and flattened using a sterile cutton bud. After that, wells were made for each macroalgae extract sample, positive control, negative control and solvent control where 1 petri dish was divided into 4 parts.

Next, pipet 75-100 µL (depending on the thickness of the media) of each sample according to the concentration and put into the well until it is completely full. Once completed, incubation is carried out overnight (16-18 hours) in an incubator at a temperature of 37oC. Antibacterial activity is shown by the formation of a clear zone or inhibitory zone around the well (Edy, 2019).

Data analysis

The data obtained from this research is the diameter of the inhibition zone with variations in the concentration of red macroalgae extract *(Acanthopora sp.)* on *S. aureus* bacteria. The data obtained was processed using Microsoft Excel to be presented in the form of graphs and tables.

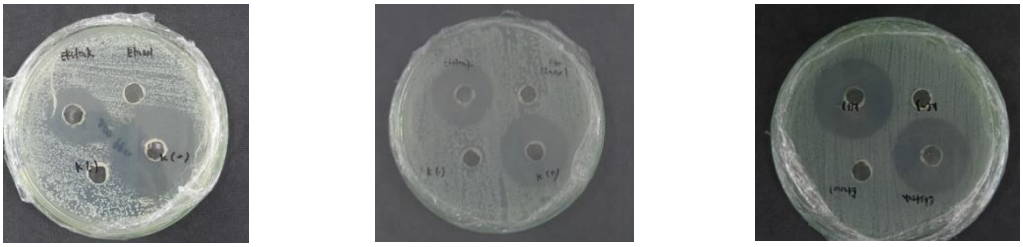
3. Results and Discussion

3.1 Result

Table 1. Average Observation Results of the Inhibition Zone of Red Macroalgae Extract *(Acanthopora spicifera)*, Positive Control *(Amoxicillin)*, and 50% Ethanol Solvent

Treatment	Extract	Positive Control	Negative Control	Ethanol Solvent
Concentration 2%	11 mm	12,5 mm	0 mm	0 mm
Concentration 4%	14,5 mm	15,67 mm	0 mm	0 mm
Concentration 6%	16 mm	18 mm	0 mm	0 mm
Concentration 8%	18,17 mm	19,5 mm	0 mm	0 mm
Concentration 10%	23,5 mm	20,17 mm	0 mm	0 mm

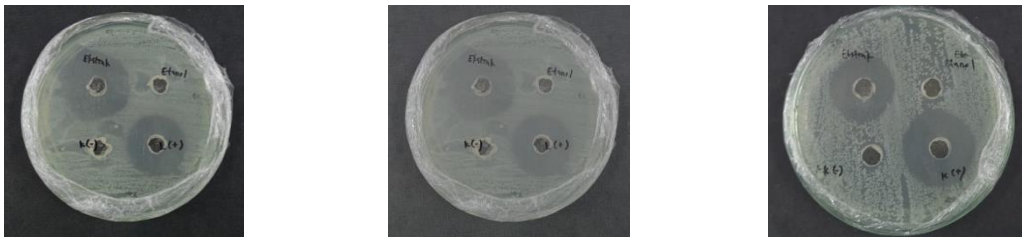
Concentration 2%



Percobaan 1 Percobaan 2 Percobaan 3

Figure 1. Observation results of the antibacterial activity test of red macroalgae extract *(Acanthopora spicifera)* at 2% concentration against *S. aureus* bacteria

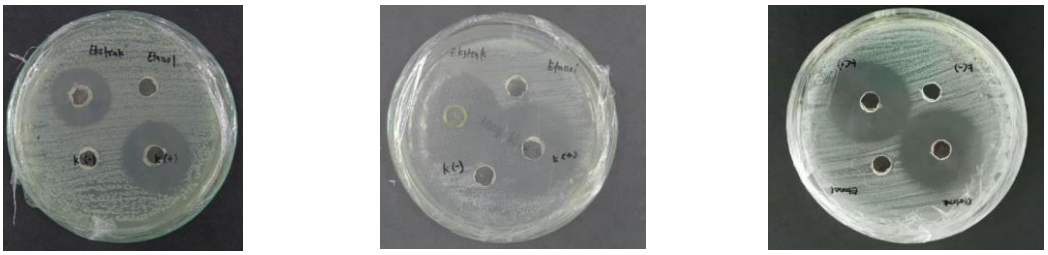
Concentration 4%



Percobaan 1 Percobaan 2 Percobaan 3

Figure 2. Observation results of the antibacterial activity test of red macroalgae extract *(Acanthopora spicifera)* at 4% concentration against *S. aureus* bacteria

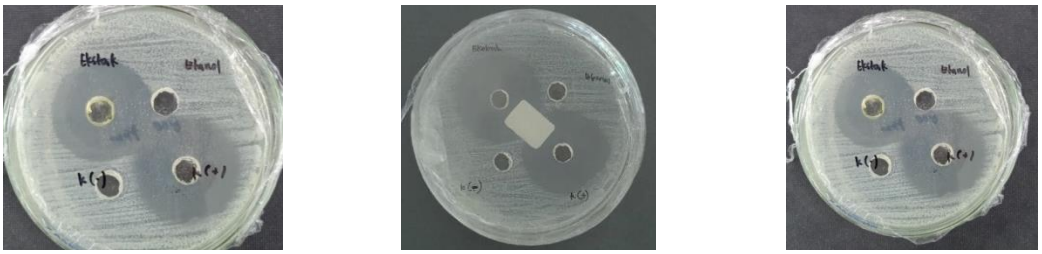
Concentration 6%



Percobaan 1 Percobaan 2 Percobaan 3

Figure 3. Observation results of the antibacterial activity test of red macroalgae extract *(Acanthopora spicifera)* at 6% concentration against *S. aureus* bacteria

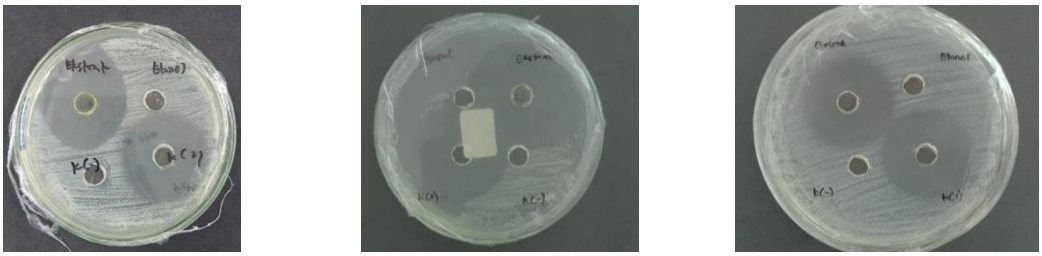
Concentration 8%



Percobaan 1 Percobaan 2 Percobaan 3

Figure 4. Observation results of the antibacterial activity test of red macroalgae extract (Acanthopora spicifera) at 8% concentration against S. aureus bacteria

Concentration 10%



Percobaan 1 Percobaan 2 Percobaan 3

Figure 5. Observation results of the antibacterial activity test of red macroalgae extract *(Acanthopora spicifera)* at 10% concentration against *S. aureus* bacteria

3.2 Discussion

Based on the results of the table above with 3 repetitions of each treatment. Where each treatment has a different diameter of the inhibition zone at each concentration of the extract and positive control. Meanwhile, the negative control (distilled water) and 50% ethanol solvent control had an average concentration of 0 mm.

The results show that overall, the average zone of inhibition in the different treatments shows significantly different results. At an extract concentration of 2%, the

average inhibitory zone diameter was 11 mm in the resistant category. A 4% concentration has an average inhibitory zone diameter of 14.5 mm in the resistant category. A 6% concentration has an average inhibitory zone diameter of 16 mm in the intermediate category. A concentration of 8% has an average inhibitory zone diameter of 18.17 mm in the intermediate category. And a concentration of 10% has an average inhibitory zone diameter of 23.5 mm in the sensitive category.

Meanwhile, the positive control (Amoxicillin), at a concentration of 2% had an average inhibitory zone diameter of 12.5 mm in the resistant category. A 4% concentration has an average inhibitory zone diameter of 15.67 mm in the intermediate category. A 6% concentration has an average inhibitory zone diameter of 18 mm in the intermediate category. A concentration of 8% has an average inhibitory zone diameter of 19.5 mm in the intermediate category. And a concentration of 10% has an average inhibitory zone diameter of 20.17 mm in the intermediate category.

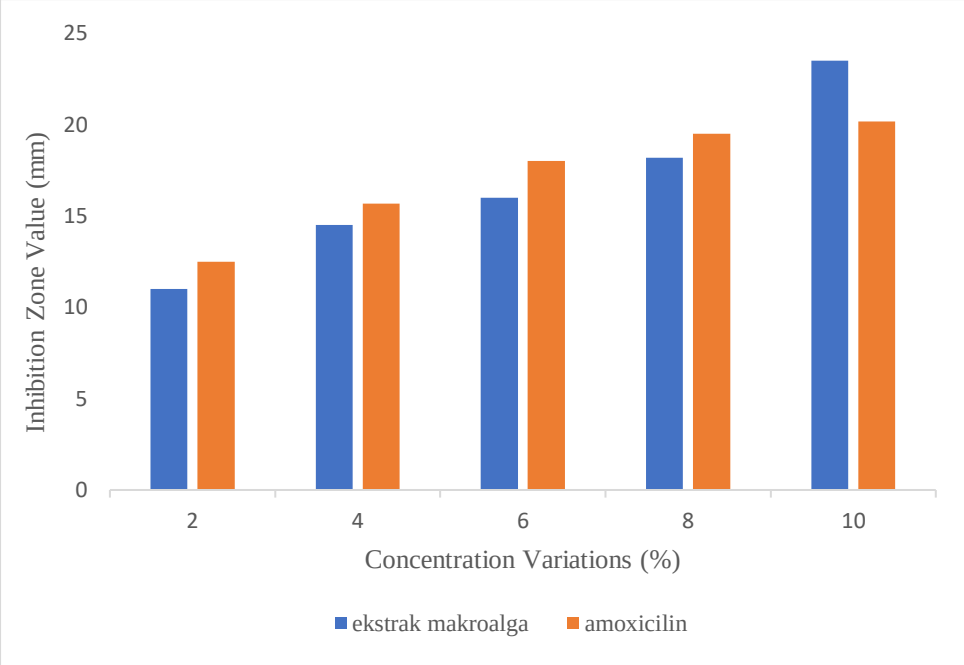


Figure 6. Comparison graph of inhibition zone values (in mm) of macroalgae extract and amoxcilin in various concentrations

From the average results of measuring the inhibition zone of antibacterial activity using red macroalgae extract *(Acanthopora sp.)* and Amoxicillin as a positive control, it can be seen that the antibacterial activity of red macroalgae extract *(Acanthopora sp.)* against the growth of *S. aureus* bacteria produces an average value of the average inhibitory zone is adjacent and in equally strong categories. Meanwhile, 10% extract produces a very strong average inhibition zone. Therefore, it can be concluded that the higher the concentration of red macroalgae extract *(Acanthopora sp.),* the larger the inhibition zone formed. The large diameter of the inhibition zone formed is caused by the greater content of antibacterial substances at higher concentrations. The formation of an

inhibitory zone for bacterial growth shows that the extract *(Acanthopora sp.)* has active antibacterial compounds (Magvirah et al., 2020).

The diameter of the antibacterial inhibition zone is in accordance with the Clinical and Laboratory Standard Institute (CLSI) standards, where the interpretation of inhibition is categorized based on the value of the diameter of the inhibition zone as follows (Yunita, 2020):

Table 2. Inhibition Zone Diameter Categories

No	Category	Diameter of Inhibition Zone
1	Resisten	Inhibition zone ≤ 15 mm
2	Intermediet	Inhibition zone 16-20 mm
3	Sensitif	Inhibition zone ≥ 21 mm

The inhibition zone value for macroalgae extract is greater than the inhibition zone value for Amoxicillin at a concentration of 10% with a value of 23.5 mm for macroalgae extract and 20.17 mm for Amoxicillin. This shows that macrolag extract at a concentration of 10% is able to beat the inhibition zone value of Amoxicillin at the same concentration. This is caused by the levels of flavonoids and saponins in the extract obtained from the extraction and evaporation processes which are very concentrated so they have quite high inhibitory zone values.

Conclusion

Based on the research that has been carried out, it can be concluded that variations in the concentration of red macroalgae ethanol extract *(Acanthopora sp.)* have an influence on antibacterial activity (*S. aureus* bacteria) where the higher the concentration value, the higher the inhibition zone or activity. The concentration of red macroalgae extract *(Acanthopora sp.)* which has an inhibition zone is greater than Amoxicillin at a concentration of 10% with an inhibition zone diameter value of 23.5 mm which is in the very strong category, so red macroalgae extract *(Acanthopora sp.)* can be recommended as an antibiotic.

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