The Utilization of Seaweeds as An Inexpensive Source of New Drugs Agent

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Abstract. The human population growth has been followed by an infection rate increase of pathogenic bacteria. The continual use of synthetic antibacterial chemicals has negative effects, pathogenic bacterial resistance of high doses. Therefore, the discovery of a new antibacterial agent is an urgent need. The search for new drug agents as antibacteria has expanded to marine organisms, especially seaweeds. This research aimed to measure the clear zone of seaweeds against bacterial tests and to evaluate the ability of seaweed as an antibacterial agent. The seaweed samples were collected from Pantai Panjang, Bengkulu, Indonesia, using a purposive sampling method. Maceration method used to extract the antibacterial agent from seaweeds. Agar diffusion method was used as an antibacterial activity assay against Escherichia coli, Salmonella typhii, and Staphylococcus aureus as the tested bacteria. There were three species of seaweeds found in the location e.g., Halimeda discoidea, Halimeda micronesica, and Caulerpa taxifolia. The antibacterial assay indicated that H. discoidea and C. taxifolia have the antibacterial activity against all tested bacteria with a clear zone that categorized into moderate and high. Meanwhile, H. micronesica had the potential as an antibacterial agent against E. coli and S. typhii with a clear zone categorized into moderate and high. In the future, it could be a potential new drug agent, especially for an antibacterial agent.

1. Introduction

The uses of antibacterial synthesis continuously have a negative impact not only on patients but also on the bacteria [1]. Bacteria have developed new strategies to survive and to evade the action of antibiotics, leading to multiple drug-resistant bacterial strains. With the increasing resistance of antibiotics, there is an important purpose for exploring and developing cheaper and effective natural antimicrobial agents with better potential, fewer side effects than antibiotics, and minimal toxicity [2].

The search for new bioactive compounds as new drugs agents in the recent decade has been explored from marine organisms [3, 4, 5]. Over one thousand new drug agents were isolated worldwide from marine organisms that have potential against cancer, viruses, and bacteria [6,7, 8, 9]. Marine organisms live in various and complex conditions and associate with other communities in high competition. For their existence in ecological pressure, they produce some secondary metabolites compounds as a response to survive [10].

Seaweeds, as a kind of marine sessile organism, have synthesized bioactive compounds which able to defend themselves against grazer, epiphytes, and fouling organisms [11]. The bioactive compounds that produced from green, red, and brown algae can be useful as an antibacterial agent. A recent study
reported that extracts of *Turbinaria conoides*, *Padina gymnospora*, and *Sargassum tenerrium* have an antibacterial activity attack *Enterococcus* sp., *Aeromonas* sp., *Staphylococcus aureus*, *Bacillus subtilis*, and *Salmonella* sp. [12]. On the other hand, an extract of *Padina* sp., *Sargassum* sp., *Gelidium* sp., could inhibit *Bacillus subtilis* activity [13]. The objective of this work was to evaluate the antibacterial activities of seaweeds from Pantai Panjang, Bengkulu, Indonesia, against pathogenic bacteria.

2. Methods

2.1 Sample Collection

Samples of seaweeds were collected from Pantai Panjang, Bengkulu, Indonesia. Fresh seaweeds were rinsed using fresh water to remove any associated epiphytes, salt, and other suspended materials. All the samples were placed into a plastic bag and brought into the laboratory for further treatments.

2.2 Extraction of antimicrobial compounds

All the samples were dried in an oven at 40 °C for 48 hours and ground in an electric blender. The powder was extracted using the maceration method of methanol solvent for 24 hours and the extracts were dried using the oven at 30 °C [14].

2.3 Bioassay of antibacterial activity

Antibacterial activity was assayed in duplicate using a standard paper disc method [15]. Antibacterial activity was tested against the pathogenic bacteria of *Escherichia coli*, *Salmonella typhii* and *Staphylococcus aureus*. 25 µL of each extract was loaded on paper discs and incubated at 30 °C for 24 hours. The diameters of any inhibition zone forms around the paper discs were measured using a caliper.

2.4 Qualitative phytochemicals analysis

For the phytochemical screening, fresh samples were used. Five grams of fresh sample weighed and homogenized with 50 mL of water, HCl (1%), ethanol, ethyl acetate, methanol, chloroform, and benzene and petroleum ether solutions separately. The extract was boiled for one hour, cooled and filtered. The filtrate was used for screening phytochemicals by using the standard procedure [16]. In a preliminary phytochemical screening of four different constituents such as triterpenoid, alkaloid, flavonoid, and saponin.

3. Results

In the present study, three species of seaweed were collected from Pantai Panjang, Bengkulu, Indonesia. They were identified as *Caulerpa taxifolia*, *Chaetomorpha crassa*, and *Padina australis*. All the seaweeds were extracted using methanol solvent and tested against pathogenic bacteria to know their ability [14]. Although the exploration of new antibiotic agents, especially for antibacteria from marine organisms are still in the laboratory stage, various new antibacterial active compounds have been explored in the past few years. Table 1 shows the inhibition zone from secondary metabolite extracted from seaweeds that potential as a new antibacterial agent. Inhibition zone from extract ranged 0 – 14.48 mm. Extract from *P. australis* showed positive activity against all pathogenic bacteria. On the other hand, both extracts of *C. taxifolia* and *C. crassa* have a positive response against *E. coli* and *S. typhii*. The maximum inhibition zone was obtained in *E. coli* 14.48 mm from the extract of *C. crassa*, lower was 0 mm in *S. aureus* from both extracts of *C. taxifolia* and *C. crassa*.

Table 1. Inhibition zone from secondary metabolites of extract seaweeds from Pantai Panjang, Bengkulu Indonesia against *E. coli*, *S. typhii*, and *S. aureus*.

| Samples                | Inhibition zone (mm) |
|------------------------|----------------------|
|                        | *E. coli*            | *S. typhii*          | *S. aureus*         |
| *Caulerpa taxifolia*   | 6.38 ± 5.65          | 11.11 ± 2.39         | 0 ± 0               |
| *Chaetomorpha crassa*  | 14.48 ± 1.47         | 11.57 ± 1.34         | 0 ± 0               |
| *Padina australis*     | 12.61 ± 1.17         | 11.51 ± 1.32         | 2.33 ± 4.04         |
Table 2. Qualitative analyses of phytochemical substances of extract seaweeds from Pantai Panjang, Bengkulu Indonesia.

| Samples            | Triterpenoid | Alkaloid | Saponin | Flavonoid |
|--------------------|--------------|----------|---------|-----------|
| Caulerpa taxifolia | +            | +        | -       | +         |
| Chaetomorpha crassa| -            | +        | -       | +         |
| Padina australis   | +            | +        | -       | +         |

Phytochemical screening of four different chemical compounds (triterpenoids, alkaloids, saponins, and flavonoids) was tested in all extracts. The phytochemical screening was performed with methanol extract of all samples. Saponins did not show any positive results for their presence in all samples tested, as shown in Table 2. The presence of maximum number (3) compounds was performed by extract of *C. taxifolia* and *P. australis*. The extract of *C. crassa* showed two compounds. Triterpenoids were found in *C. taxifolia* and *P. australis*. Alkaloid and flavonoid showed their presence in all tested samples.

4. Discussion

There are three species of seaweed found and identified from Pantai Panjang, Bengkulu. Strong waves and the position of Pantai Panjang located in the Indian ocean lead to low diversity of seaweed. It has a similar result that reported the low diversity of seaweed from Mentawai Island, located in the Indian Ocean [17]. Seaweed commonly lives close to the slow-wave shore. Based on bioassay results, it was indicated that all the samples have potential as an antibacterial agent. Similar results reported that isolated antibacterial compounds from seaweeds against pathogenic bacteria [12]. Another study reported that seaweed extracts have the potential for an antibacterial agent [13]. Seaweeds produced secondary metabolites which enable to self-defense against a predator, prevent ultraviolet radiation, and as competition substances, and antibacteria [11].

The qualitative analyses of phytochemical substances showed the absence of saponins in all extracts. Similar results have also been reported [18]. Otherwise, Alkaloid and flavonoid found active in all extracts. Alkaloids have cytotoxic activity due to the presence of microtubule interfering agents and can inhibit the formation of the mitotic spindle fiber required for cell division [19]. Flavonoids have antimicrobial, antiviral, and antioxidant activities. Meanwhile, triterpenoids compounds recorded positive in *C. taxifolia* and *P. australis*. Triterpenoids from seaweeds contained cytotoxic, nematicidal activity, and antitumor activities [20, 21, 22].

5. Conclusion

This study concludes that extract of seaweed from Pantai Panjang, Bengkulu, Indonesia has potential as an antibacterial agent against pathogenic bacteria. Extract of *P. australis* has a positive result against all tested pathogenic bacteria. All the extracts contained several chemical compounds, including triterpenoids, alkaloids, and flavonoids, but lack saponins.

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