

Mini Review: Toxicity and Antimicrobial Activity of *Padina* sp.

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Keywords: Brown Macroalgae, Inhibition Zone, Lethality Concentration.

Abstract: *Padina* sp. is a species of the division Phaeophyta, belonging to the family Dictyotaceae, found on various substrates such as muddy sand, sandy mud and coral fragments. This review will discuss the antimicrobial activity and toxicity against *Artemia salina* Leach shrimp larvae from 2008 to 2023. Based on the results of a literature review, it is known that the methanol extract of *Padina* sp. has the highest zone of inhibition, namely 26.5 mm against *Escherichia coli* bacteria. Furthermore, the ethanol extract, ethyl acetate, diethyl ether and hexane of *Padina* sp. were reported to inhibit the growth of *Vibrio cholerae*, *Salmonella typhi*, *Porphyromonas gingivalis*, *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Shigella dysenteriae*, *Bacillus subtilis*, *Streptococcus pyogenes*, *Acinetobacter baumannii*, *Vibrio harveyi*, *Parahaemolyticus*, *Aeromonas hydrophila* and *Propionibacterium acnes* bacteria. For the toxicity of *Padina* sp., the ethanol solvent extract of *Padina* sp. has an LC50 value of 12.45 g/mL, indicating that it can be degraded and is extremely toxic to *Artemia salina* Leach.

1 INTRODUCTION

Indonesia is a maritime country with high marine biodiversity. One of them is widely used by Indonesian people is macroalgae. Macroalgae or seaweed is one of the plants that have a source of bioactive compounds. This can be seen from its ability to produce a variety of secondary metabolites with broad biological activities (Poonguzhali, 2013). Antibacterial, antioxidant and anticoagulant activities are the bioactive compounds found in seaweed (Bansemir, 2006).

One of the brown macroalgae is *Padina* sp. This species is found on various substrates such as sand, muddy sand, sandy mud and coral rubble. *Padina* sp. has a large size and is easy to see with the naked eye, its shape is like a fan (Wijayanti et al., 2020).

Padina sp. has both antimicrobial potential and toxicity. Antibiotics include a group of chemical compounds that are able to inhibit and kill the growth of bacteria. The level of bacterial resistance to this compound is quite high; therefore, alternative bioactive compounds derived from marine plants such as seaweed have a more tolerant (Husni et al. 2014).

Meanwhile, toxicity tests are carried out on macroalgae to determine the safety level of an extract. In general, toxicity tests are carried out using *Artemia*

salina Leach larvae with the Brine Shrimp Lethality Test (BSLT) method, which is expressed as the Lethal Concentration 50 (LC50) value. This review will provide some information on the antimicrobial activity and toxicity of the extract *Padina* sp.

2 METHODS

This review used data from Google Scholar with the keywords "antimicrobial activity and toxicity of extracts of *Padina* sp.". Primary data were obtained from national and international journals.

3 RESULTS AND DISCUSSION

3.1 Morphology of *Padina* sp.

Morphologically, *Padina* sp. is a species of macroalgae belonging to the phylum Phaeophyta (brown macroalgae). This species is fan-shaped with a diameter of 3 - 4 cm, growing in concentric circles with the following general characteristics: stem-shaped, with many leaves or sword-shaped, fan-shaped and brown in colour, forming thin leaf segments, the substance is gelatinous, yellowish-

brown in colour, the upper part of the lobes is slightly expanded, the roots are in the form of fibres called holdfast to adhere firmly to the substrate so that it can be used to adapt to wave movements in the intertidal zone, the holdfast structure is disc-shaped (Marcelet al. , 2015).



Figure 1: *Padina australis* from Harapan Island, Jakarta, Indonesia.

Padina australis is large and can be seen with the naked eye (Wijayanti et al., 2020). According to Kepel (2018), thallus *Padina* sp. has double concentric lines on the underside at the same distance from each other, about 2-3 mm.

3.2 Habitat, Distribution, and Classification of *Padina* sp.

Padina sp. is a species of marine algae belonging to the division Phaeophyta (brown algae), generally found in marine waters from shallow to deep. *Padina* sp. grows from the intertidal to the subtidal zone. This macroalgae can grow better on rocky substrates (Kautsari & Ahdiansyah, 2016), dead coral (Kemenangan et al., 2017) as well as environmental quality that supports the growth of *Padina* sp. Namely, water temperature 27-30OC, salinity 28-32 ppt, pH 7.5-8, current velocity 35-80 cm/s, brightness 2m (Meldi et al., 2022). According to Luning (1990),

the temperature range that is good for algal growth in tropical areas is 20-30°C. Thus, the observed average temperature is 26°C, which is good for the growth of the brown macroalgae *Padina* sp.

Padina sp. is classified as below:

- Kingdom: *Plantae*
- Divisi : *Phaeophyta*
- Class : *Phaeophyceae*
- Ordo : *Dictyotales*
- Family: *Dictyotaceae*
- Genus : *Padina*
- Spesies : *Padina* sp.

3.3 Antimicrobial Activity of *Padina* sp.

Antimicrobials are chemical substances that are formed and produced by microorganisms; these substances have the power to inhibit the activity of other microorganisms, even in small amounts (Waluyo, 2004). Antibacterial activity tests can be carried out using two methods, including the diffusion method and the dilution method. Therefore, well diffusion method by Igbinsosa (2009) where as disc diffusion method by Kirby-Bauer stated that it is useful for testing the effects of chemical drugs on bacteria (Francine, 2015).

Padina sp. extract with proven antibacterial activity. The antibacterial activity of *Padina* sp. can be demonstrated by measuring the inhibition zones of different concentrations using gram positive and negative bacteria (Purnama R, 2010). Inhibitory activity is defined as a weak category if the diameter of the inhibition zone in the diffusion test is less than 5 mm. If the size is 5-10 mm, it is classified as moderately inhibitory. Meanwhile, those categorised as strong measure 10-19 mm and the latter are categorised as very strong, measuring 20 mm (Liana., 2010).

Table 1: Antimicrobial Activity of *Padina* sp.

No	Species	Extract	Antimicrobial Test Method	Antibacterial Activity	Antifungal	Diameter of Inhibition Zone	Concentration	References
1	<i>Padina australis</i>	<i>Padina australis</i> ethanol extract	Disc Diffusion	<i>Vibrio cholerae</i> dan <i>Salmonella typhi</i>	-	19,48 mm dan 12,0 mm	80%	(aptari, 2015)
2	<i>Padina australis</i> Hauck	<i>Padina australis</i> ethanol extract	Disc Diffusion	<i>Porphyromonas gingivalis</i>	-	18,2 mm	-	Sari, 2016
3	<i>Padina australis</i>	<i>Padina australis</i> ethanol extract	Dilution	<i>Staphylococcus epidermidis</i>	-	-	90%	Alfan, 2015

Table 1: Antimicrobial Activity of *Padina* sp. (cont.).

No	Species	Extract	Antimicrobial Test Method	Antibacterial Activity	Antifungal	Diameter of Inhibition Zone	Concentration	References
4	<i>Padina australis</i>	<i>Padina australis</i> methanol extract	Disc Diffusion	<i>Escherichia coli</i>	-	14,37 mm	100%	Saptari, 2015
5	<i>Padina</i> sp.	Diethyl ether, ethyl acetate and ethanol extract of <i>Padina australis</i>	Disc Diffusion	<i>Staphylococcus aureus</i> and <i>Shigella dysenteriae</i>	-	12,66 mm dan 10,69 mm	-	Nuzul, 2018
6	<i>Padina pavonica</i>	<i>Padina pavonica</i> methanol and chloroform extract	Disc Diffusion	<i>Escherichia coli</i> dan <i>Staphylococcus aureus</i>	-	-	90 %	El-Fatimy, 2011
7	<i>Padina pavonica</i>	<i>Padina Pavonica</i> ethanol extract	Dilution	<i>Bacillus subtilis</i> , <i>Staphylococcus aureus</i> , <i>Streptococcus pyogenes</i> and <i>Acinetobacter baumannii</i>	-	(21,7 ± 1,5 mm; 1,95 mg/mL), (21,7 ± 0,58 mm; 1,95 mg/mL), 20,7 ± 1,2 mm; 1,95 mg/mL) and (20,1 ± 1,2 mm; 3,9mg/mL).	-	Al-Enazi, 2018
8	<i>Padina pavonica</i> Hauck	ethanol and ethyl acetate extract of <i>Padina pavonica</i> Hauck	Disc Diffusion	<i>Escherichia coli</i>	-	11,6 mm dan 12,6 mm.	-	Warsidah, 2022
9	<i>Padina</i> sp.	<i>Padina</i> sp. methanol extract	Disc Diffusion	<i>Escherichia coli</i> , dan <i>Salmonella thypimirium</i> .	-	26,5 mm dan 19 mm	-	Kolanus, 2017
10	<i>Padina australis</i> Hauck	hexane, ethyl acetate, acetone and ethanol extracts	Disc Diffusion	<i>Vibrio harveyi</i> , <i>Vibrio parahaemolyticus</i> and <i>Aeromonas hydrophilla</i>	-	(1,76 mm), (2,3 mm) dan (4,43 mm).	-	Latifah, 2019
11	<i>Padina australis</i>	<i>Padina australis</i> methanol extract	Disc Diffusion	<i>Aeromonas hydrophilla</i>	-	10,5 mm	-	Salosso, 2020
12	<i>Padina</i> sp.	<i>Padina</i> sp. ethanol extract	Disc Diffusion	<i>Escherichia coli</i> and <i>Staphylococcus aureus</i> .	<i>Aspergillus flavus</i>	9,75 – 11,55 mm dan 7,15 – 10,0 mm	-	Fanesha, 2023
13	<i>Padina australis</i>	<i>Padina australis</i> methanol extract	Disc Diffusion	<i>Propionibacterium acnes</i>	-	6,20 mm	30%	Mourena, 2021
14	<i>Padina gymnospora</i>	<i>Padina gymnospora</i> methanol extract	Disc Diffusion	<i>Staphylococcus aureus</i> dan <i>Proteus mirabilisa</i>	-	21,67 ± 1,15 mm dan 12,3 ± 0,58 mm	-	Punnam, 2014
15	<i>Padina australis</i> Hauck	Methanol, ethyl acetate and n-hexane	Disc Diffusion	<i>Vibrio harveyi</i>	-	12,55 mm	80%	Gazali, 2016

Table 2: Toxicity of *Padina* sp.

No	Species	Extract (solvent)	LC ₅₀ (ppm)	References
1	<i>Padina</i> sp.	Ethanol	12,45	(Nickson,2023)
2	<i>Padina australis</i>	Ethanol	177,83	(Saptari,2020)
3	<i>Padina</i> sp.	Fucoxanthin	145.586	(Yemima,2020)
4	<i>Padina australis</i>	Methanol, ethyl acetate and n-hexane	785,03; 73,3; and 300.	(Fitriyanti,2020)
5	<i>Padina gymnospora</i>	Methanol	1000	(Salamat,2022)

From Table 1, one of the elements that serves as a reference for the lowest inhibitory concentration that best inhibits it is the structure of the cell walls of each bacterium. According to this research, the size of the concentration used has an effect. The higher the concentration of an extract, the greater or better the antibacterial activity. In addition, the large diameter of the inhibition zone also determines the strength of the antibacterial activity.

3.4 Toxicity of *Padina* Sp.

The toxicity test using the BSLT method aims to determine the potential of a compound as a poison by knowing the level of toxicity of an extract (Puspitasari et al., 2018). The Brine Shrimp Lethality Test (BSLT) method uses shrimp larvae as test animals, taking into account *Artemia salina* Leach, which is easy to obtain because it is commercially available, a rapid method because active larvae can be obtained in 1-2 days, requires little equipment, does not require culture or maintenance of living organisms, and does not require a special laboratory (Triana, 2015). Toxic activity can be determined by the number of *Artemia salina* Leach mortalities, expressed as the Lethal Concentration 50 (LC50) value.

From Table 2. it can be concluded that from Nickson's (2023) research using ethanol solvent, a value of LC₅₀ 12.45 µg/mL was obtained, so it can be classified as very toxic to *Artemia salina* Leach.

4 CONCLUSIONS

According to the results of the literature review, the antibacterial activity of the methanol extract of *Padina* sp. has the highest zone of inhibition, namely 26.5 mm, against *Escherichia coli* bacteria. Furthermore, the ethanol solvent extract has an LC₅₀ value of 12.45 g/mL, indicating that it can be degraded and is highly toxic to *Artemia salina* Leach.

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