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Utilization of Natural *Antifouling* Compounds from Mangroves on Payung Island, Sungsang, South Sumatra

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Abstract

Mangrove is a species of high-level plant whose growth is influenced by the tides of seawater. Antifouling is a system used to prevent marine life attached to an object that is submerged in seawater. The use of natural Antifouling is one of the efforts to reduce water and environmental pollution, such as natural Antifouling from the mangrove plants Rhizophora apiculata and Avicennia alba. The study was conducted in Sungsang, South Sumatra, Indonesia. Avicennia marina and Rhizophora apiculata are mangrove plants that are suspected to have Antifouling content, namely tannins, terpenoids, and steroids. This research aims to determine the effect of the addition of the Avicennia marina fraction and the Rhizophora apiculata fraction on oil paints on the area of macrofouling pasting on the test plate, how the effect of adding different Avicennia marina fractions on the sticking of macrofouling on the wood plate. Avicennia marina and Rhizophora apiculata contain secondary metabolite compounds as natural Antifouling that do not pollute the environment and meet the H0 hypothesis rejected and H1 accepted and suspected that there is no macrofouling on the plates that have been tested proven to reduce pasting.

Keywords : Antifouling, Avicennia marina, Mangrove, Rhizophora apiculata

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1. Introduction

Sungsang is located on the edge of the Musi river. Transportation that is widely used is sea transportation. Sungsang Wharf poles were found to be deterrent organisms that could be detrimental to marine transportation facilities.

The existence of *fouling* attachment causes biological *fouling* called *biofouling. Biofouling* is the growth of a melting organism on a substrate below the surface of the water. Based on its size, *biofouling* is divided into 2, namely *macrofouling* and *microfouling*. *Macrofouling* is a larger empeling organism such as barnacles, shellfish and others, while *microfouling* is a smaller empeping organism such as bacteria and algae [3].

The phenomenon of sticking *fouling* organisms affects several sectors including the fishing sector and the shipping industry. *Fouling* pasting can be overcome using *Antifouling* paint. *Antifouling* paints circulating in the market contain tributyltin (TBT) and cupper sulfate [2].

The use of TBT as a paint material can result in pollution in waters and the occurrence of imposex in female gastropods is quite high. Mangrove leaves are thought to have the potential as plants producing secondary metabolite compounds that can reduce *fouling* growth [2]. The objectives to be achieved are: (1) knowing the types of secondary metabolite compounds contained in the leaf fraction of *A. marina* and the leaf fraction of *R.apiculata*, (2) knowing the influence of the addition of leaf fraction of *A. marina* and leaf fraction of *R.apiculata* in reducing *macrofouling* pasting, (3) knowing the type of *macrofouling* in Sungsang Village.

2. Materials and Methods

The research was conducted in August-December 2022. Extraction, fractionation, and phytochemical screening are carried out at the Genetics and Biotechnology Laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences, Sriwijaya University. The data collected includes measurements of pasting area and

biomass, types of compounds and types of *macrofouling*, as well as ecologicial data.

2.1. Extraction of Leaves and Roots of *Avicennia marina* and *Rhizophora apiculata* Leaves

The extraction method used is maceration. The leaves of *A.marina* and *R.apiculata* are taken as much as 2 kg. Cleaned and dried in the oven and mashed (simplisia). Simplisia was taken as much as 250 gr macerated using a methanol solvent of 750 ml for 72 h with 2 repetitions. The extract is filtered, and evaporated until a thick extract is obtained.

2.2. Fractionation of *Avicennia marina* and *Rhizophora apiculata*

The extract is dissolved in methanol: water (1:1). The diffraction mixture with an n-hexane solvent of 250 mL (3 repetitions) obtained n-hexane fraction and residue. The residue is dissolved using ethyl acetate fractionated to obtain the residue

2.3. Phytochemical Screening

Alkaloid Test

A total of 0.1 gr of fraction is mixed with 5 ml of chloroform and ammonia. Plus 5 drops of sulfuric acid 2 N, shaken and let stand. The top of the filtrate is tested with dragendroft.

Steroids Test

A total of 0.1 gr of fraction is dissolved in 20 ml of ether, then filtered. 5 ml of filtrate is evaporated in an evaporating dish. Added 2 drops of concentrated sulfuric acid and 2 drops of anhydrous acetic acid.

Terpenoid Test

A total of 0.1 grams was added 2 mL of ethyl acetate and shaken. A layer of ethyl acetate is taken and dripped on the plate drip. Plus 2 drops of anhydrous acetic acid and 1 drop of concentrated sulfuric acid.

Tannin Test

A total of 0.1 gram of fraction is added 1 ml of FeCl3 1% solution. Observe the changes that occur.

Sapponin Test

A total of 0.1 gram of fraction plus 5 ml of aquadest, shaken until foam is formed, plus 1 drop of HCl 2N.

Flavonoid Test

A total of 0.1 gr of fraction plus 5 ml of ethanol, 5 drops of concentrated HCl and 1.5 grams of magnesium are added.

2.4. Antifouling Test of *A. marina* Leaf Fraction and *R. apiculata* Leaf Extract

Plate Preparation

The plate used is a steel plate with a length of 10 cm, a width of 7 cm and a thickness of 2 mm and a wooden plate 10 cm long, 7 cm wide and a thickness of 2 cm.

Paint Mixing and Painting

The paints used are those that do not contain *Antifouling* materials such as copper oxide (CuO) and zinc oxide (ZnO) boosters. Prepared fractions of leaves and roots of *A.marina* and *R.apiculata* concentration of 1250 ppm and control [3]. Each of them is mixed with paint 3 repetitions. Then the paint is applied to the plate. The plate is mounted on a support pole at the Sungsang Pier.

Test Plate Installation Process

The plate is installed 50 cm below the water level at the Sungsang Pier. The test plate was left for 4 weeks and the measured environmental parameters measurements were temperature, pH, and salinity [12].

Identification of Macrofouling Measurement of Pasting Area and Biomass of Biofouling

Observations are made once a week to identify and measure the area of *fouling* pasting. Identification was carried out using the identification book Laut Nusantara. Measure the length and width of *fouling* pasting using a ruler. Before soaking the plate is weighed to know the initial biomass and weighed after soaking to know the final biomass. According to [13] biomass *biofouling* the Accumulated It is known by subtracting the final weight by the initial weight of the plate.

2.5. Observation Parameters

The observation parameters in this research are good concentrations reducing pasting, pasting area, biomass as well as the type of *fouling* attached to the plate.

2.6. Data Analysis

This research used a Randomized Group Design. For comparison of area and biomass *fouling* was analyzed with ANOVA 95% confidence level and further test, namely Duncan test with 95% confidence level [4]. The results of the research are presented in the form of pictures, graph and tables. The percentage of pasting area can be calculated by the following formula:

% pasting area = $\frac{\text{pasting area}}{\text{Area of the test panel}} \times 100\%$

Tabel. 3.1. Percentage category of *biofouling* pasting area

No.	Percentage of Area	Category
1.	Less than 10 %	Low
2.	10% - 30%	A bit low
3.	30% - 50%	Moderate
4.	50% - 80%	High
5.	80% - 100%	Very high

Source: Xiangrong and Guiqiao (2005).

3. Results and Discussion

General Conditions of Sungsang Waters

Results of environmental parameters:

Parameter	Quality Standards	Week-			
		1	2	3	4
Salinity	33-34	2,25%	1,97%	2,24%	2,17%
Temperature	28-32	30℃	30,3℃	29,9℃	29,4℃
pH	7-8,5	6,51	6,83	6,7	6,53

Notes: Quality standards according to the Decree of the State Minister of the Environment No.51. Year 2004 Appendix III on Seawater Quality Standards for Marine Life

Salinity is known to be around 1.97 ‰-2.25 ‰, low salinity for seawater groups and still below the water quality standards for the growth of marine organisms. Decree of the State Minister of the Environment No. 51 (2004) optimal salinity for the life of marine organisms by 33-34%. According to [14], low salinity is affected due to the mixture between.

River water and fresh water so that salinity is abnormal. The resaerch site has a normal temperature of 29-30 °C, which is the optimum temperature for growth of marine organisms. According to [15], *biofouling* growth is influenced by factor environments such as salinity, pH, and temperature.

The pH at the Sungsang Pier, which is 6.01, is the optimal pH for the growth of marine organisms. According to [19], marine organisms live optimally with a pH of 6-9.

Phytochemical Analysis of Leaf Fractions of *Avicennia marina*

In the n-hexane fraction, there are the most metabolite compounds due to the nature of the n-hexane semi-polar which can attract polar and nonpolar compounds.

Tabel 4.1. Phytochemical Screening Test Results of *Avicennia marina* Leaves

Compounds	Methanol fraction	n-Heksan fraction	etil asetat fraction
Steroids	+	-	-
Tanins	-	+	-
Terpenoids	-	+	+
Alkaloids	-	+	-
Flavonoids	+	+	+
Saponins	+	+	+

The caption (+) signifies the presence of a compound, (-) indicates the absence of a compound.

Alhaddad's [5], *A.marina* leaf screening shows the presence of tannin compounds, steroids, flavonoids in methanol solvents, in ethyl acetate solvents there are compounds alkaloids, flavonoids, triterpenoids and n-hexane solvents contain flavonoid compounds as well as triterpenoids.

The mechanism of terpenoids as antibacterials reacts to trans membrane proteins that can cause bacterial cells to lack nutrients. Tannins are secondary metabolites that play a role in inhibiting bacterial growth [6]. Flavonoids and saponins have an unsubstituted hydroxyl group so they are polar. According to [7], the mechanism of alkaloids as antibacterials by disrupting the peptidoglycan component of bacterial cells, so that the cell wall layer is not formed intact causing cell death.

Phytochemical Analysis of Leaf Fractions of *Rhizohpora apiculata*

Table 4.2. Comparison of phytochemical test results of methanol, n-hexane, ethyl acetate fractions

Compounds	methanol fraction	n-Heksan fraction	etil asetat fraction
Steroids	+	-	-
Tanins	-	+	-
Terpenoids	-	+	+
Alkaloids	-	+	-
Flavonoids	+	+	+
Saponins	+	+	+

The caption (+) signifies the presence of a compound, (-) indicates the absence of a compound.

Based on phytochemical screening tests, it is known that the fraction contains secondary metabolite compounds of alkaloids, saponins, steroids, tannins, and flavonoids. Research conducted by [8], using ethanol *R.apiculata* contains secondary metabolite compounds of tannins, saponins, steroids, terpenoids, and flavonoids. The difference in the content of secondary metabolite compounds in plants is due to differences in environmental parameters, solvents used, and the geographical location of plants. Compounds used as natural *Antifouling* contain alkaloids, steroids, furanones, carotenoids, peptides, terpenoid lactones, and phenolics. According to [12] terpenoids, alkaloids and steroids can inhibit *fouling* growth. According to [9] the ability of triterpenoid compounds, tannins and saponins in inhibiting bacterial growth causes damage to the permeability of bacterial cell walls.

Triterpenoids include secondary metabolite compounds derived from terpenoids. According to [15] triterpenoids usually react with porin on the outer membrane of the bacterial cell wall which can cause bacterial cells to lack nutrients.

Saponins are one of the scondary metabolite compounds that have anti-bacterial and anti-fungal activities. According to [16] saponins can disrupt the tension on the surface of the cell wall, and when the surface tension on the cell wall is disturbed, antibacterial substances will be easier to enter the cell and interfere with metabolism and the bacteria will die.

Tannins are active compounds of secondary metabolites that have properties for health. According to [1], tannin can be used as a dye and tanner for fishing nets.

Plate checking

The plate placed on Sungang Pier is 50 cm below sea level so it is always submerged in the water. Checking the plate the first week, the plate that has been soaked for one week is not found *biofouling* attached to either the steel plate or the wooden plate, but the plate that has been soaked has little damage to the wire net used, this damage is caused by the current in the Sungsang pier area is very strong so that it can damage the wire.

The second and third weeks of checking found that no biofouling was found, but it is suspected that the formation of biofouling began to occur. The plate is physically damaged, the plate looks fragile, the paint part begins to peel off and there is a change in color. According to [18] The presence of *fouling* attachment on the surface of the object can damage the structure of the object, the object becomes more fragile due to the beginning of the formation of an acidic environment.

The fourth week still found no *biofouling* attached to the test plate. According to [17] the attachment of *biofouling* to objects is influenced by several factors such as chemical, physical and biological factors.

4. Conclusion

The results of phytochemical screening of leaf fractions of *Avicennia marina* and *Rhizophora apiculata* contain secondary metabolite compounds as natural *Antifouling* that do not pollute the environment and meet the H0 hypothesis rejected and H1 accepted and suspected that there is no *macrofouling* on the plates that have been tested proven to reduce pasting.

References

[1] Syahputra, F., dan T. M.H. Almuqaramah. 2019. Addition of Mangrove Bark Solution Extract to Oil Paint as *Antifouling*. *Aquatic Sciences Journal*.6(1): 38.

[2] Nur, R.M., dan Rahmawati. 2019. Combination of *Antifouling* Activity Test (*Rhizophora apiculata*) In Morotai Island District. Journal of Fisheries and Aquaculture Sciences. 14(1):19.

[3] Andayani, D. G. S, Anggraeni, S. R., Liviawaty, E., Chrisentia, R. M., & Srikandace, Y. 2018. Isolation, identification of alkaloids from Rhizophora mucronata and the activity of its methanol extract against barnacles In IOP Conference Series: Earth and Environmental Science (Vol. 160, No. 1, p 012005), IOP Publishing.

[4] Amin, D. N., Irawan, H., & Zulfikar, A. 2015. Relationship of Substrate Type to Vegetation Density of Rhizophora sp. in the Nyirih River Mangrove Forest, Tanjung Pinang District, Tanjung Pinang Dwi City. Repository *Journal* of Umrah. 1(1) : 1-15.

[5] Alhaddad, Z. A., Tanod, W. A., & Wahyudi, D. 2019. Antibacterial Bioactivity of Mangrove Leaf Extract Avicennia sp. *Journal of Marine Science:* Indonesian *Journal* of Marine Science and Technology. 12(1) : 12-22.
[6] Jayadi,F., Sukainah, A., and Rais, M.2020. Utilization ogf Jeruju Mangrove Leaf Flour (Acanthus ilicifolius) as a Natural Preservative for Chicken Meatballs. *Journal* of Agricultural Technology Education, 4, 1-13.
[7] Amalia, A., Sari, I., and Nursanty, R. 2017. Antibacterial Activity of Ethyl Acetate Extract of Sembung Leaves (Blumea balsamifera (L.) DC.) Against the Growth of Methicillin Resistant Staphylococcus aureus (MRSA) Bacteria. Biotic Proceedings, 4(1).
[8] Syawal, H., Yuharmen, Y., & Kurniawan, R. 2019. Sensitivity of *Rhizophora apiculata* Leaf Extract Inhibits Bacterial Growth.
[9] Aunurohim, Kurniawan, W. A., Nurilma, A. D., Desmawati, I., dan Albab, M. 2018. Field Optimation of Durio zibethinus as Macro-*Antifouling* at PT Dok and Shipping, Surabaya, Indonesia. *In IOP Conference Series: Earth and Environmental Science.* 197(1): 5-11
[10] Mamonto, R., Rumampuk, N., & Lasut, M. (2017). Estimation of the impact of tributyltin pollution using imposes symptoms on gastropods in Bitung waters, North Sulawesi. *Journal of Coastal and Tropical Seas*. 5(2) : 8-13.
[11] Plouguerne, E., C. Hellio., C. Cesconetto., M. Thabard., K. Mason., B. Veron., R.C. Pereira., and B.A. P. da Gama. 2010. Antifouling Activity as a Function of Population Variation in *Sargassum vulgare* from the Littoral of Rio de Janeiro (Brazil). *J Appl Phycol*. 22(6): 717-724.
[12] Qi, S. H., dan Xuan, M. 2017. Antifouling compounds from marine invertebrates. *Marine drugs.* 15(9): 2-14.
[13] Vedaprakash, L., Dineshram, R., Ratnam, K., Lakshmi, K., Jayaraj, K., Babu, S. M., & Shanmugam, A. (2013). Experimental studies on the effect of different metallic substrates on marine biofouling. *Colloids and Surfaces B*: Biointerfaces, 106, 1-10.
[14] Patty, S. I., & Akbar, N. (2018). conditions of temperature, salinity, pH and dissolved oxygen in the coral reef waters of Ternate, Tidore and its surroundings. *Journal of Archipelago Marine Science*, 1(2).
[15] Murniati, E., Notowinarto, N., and Ramses, R. 2015. Distribution and Diversity of Biofoulng Populations in Cultivated Seaweed Plants in Bulalang Waters, Batam. *SYMBIOSA*, 4(1).
[16] Karlina, C.Y., Muslimin, I., Guntur, T. 2013. Antibacterial Activity of Purslane Herb Extract (Portulaca oleracea L.) against Staphylococcus aureus and Escherichia coli. *Lentera Bio*. 2(1): 88-92
[17] Triwibisono, A., Indra, R.K., Sardono, S. 2012. Analysis of the Use of Impressed Current Antifouling (ICAF) as a Fouling Prevention in Linear Generators in Ocean Current Power Plants. *Journal of Engineering Pomits*. 1(1):2.
[18] Hadi, A. M., Irawati, M. H., & Suhadi, S. (2016). Morpho-anatomical Characteristics of Vegetative Structure of Rhizopora Apiculata (Rhizoporaceae) Species. *Journal of Education: Theory, Research, and Development*. 1(9) : 1688-1692.
[19] Romimohtarto, K. and S. Juwana. 2001. *Marine Biology Science of Marine Biota*. Jakarta: Djbatan.