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Isolation and Antimicrobial Activity of Endophytic Fungi on *Avicennia marina* and *Sonneratia alba* Mangroves in Mengkapan Village, Sungai Apit District, Siak Regency

Isolasi dan Aktivitas Antimikroba Jamur Endofit pada Mangrove *Avicennia marina* dan *Sonneratia alba* di Desa Mengkapan, Kecamatan Sungai Apit, Kabupaten Siak

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ABSTRACT

This research was conducted from February to June 2023. A sampling of *Avicennia marina* and *Sonneratia alba* mangroves was conducted in the mangrove ecosystems of Mengkapan Village, Sungai Apit District, Siak Regency. This research aims to identify the species and test the antimicrobial activity of endophytic fungi found in the leaves and stems of *A. marina* and *S. alba* mangroves in the mangrove ecosystem of Mengkapan Village using survey and experimental methods. This research began by determining the sampling location and measuring the physical and chemical parameters of the mangrove environment. Then, sampling and preparation of *A. marina* and *S. alba* mangrove samples were carried out to isolate the endophytic fungi. After isolation, macroscopic and microscopic characterization was done to identify endophytic fungi. The diameter increase of the endophytic fungi was measured and calculated, and the antagonism activity test of the endophytic fungi was carried out. The antimicrobial index of endophytic fungi was measured against the pathogenic bacteria *Vibrio* sp and *E. coli*. This research obtained that 12 endophytic fungi were isolated from the mangroves *A. marina* and *S. alba*: two genera Rosellinia, two genera Pythium, four genera Hansfordia, and four genera Aspergillus. Based on the test results, all genera found in this research inhibited the growth of *E. coli* with inhibitions of 75.99% (*Rosellinia* sp), 87.70% (*Pythium* sp), 73.42% (*Hansfordia* sp) and 86.88% (*Aspergillus* sp). However, only three genera inhibited the growth of *Vibrio* sp by more than 50%, with inhibitions of 85.23% (*Rosellinia* sp), 87.87% (*Hansfordia* sp), and 86.07% (*Aspergillus* sp).

Keywords: Isolation, Antimicrobial activity, Endophytic fungi, *Avicennia marina, Sonneratia alba*

ABSTRAK

Penelitian ini dilaksanakan mulai dari bulan Februari-Juni 2023. Pengambilan sampel mangrove *Avicennia marina* dan *Sonneratia alba* dilakukan di ekosistem mangrove Desa Mengkapan, Kecamatan Sungai Apit, Kabupaten Siak. Penelitian ini bertujuan untuk mengidentifikasi spesies dan menguji aktivitas antimikroba jamur endofit yang terdapat pada daun dan batang mangrove *A. marina* dan *S. alba* di ekosistem mangrove Desa Mengkapan menggunakan metode survei dan eksperimen. Penelitian ini dimulai dengan penentuan lokasi pengambilan sampel serta pengukuran parameter fisika dan kimia lingkungan mangrove. Selanjutnya dilakukan pengambilan dan persiapan sampel mangrove *A. marina* dan *S. alba* untuk diisolasi jamur endofitnya. Setelah isolasi, dilakukan karakterisasi makroskopis dan mikroskopis untuk identifikasi jamur endofit. Lalu diukur dan dihitung pertambahan diameter jamur endofit serta dilakukan uji aktivitas antagonisme jamur endofit. Dilakukan juga pengukuran indeks antimikroba jamur endofit terhadap bakteri patogen *Vibrio* sp dan *E. coli*. Pada penelitian ini, jamur endofit yang diisolasi dari mangrove *A. marina* dan *S. alba* adalah sebanyak 12 isolat, yaitu 2 genus Rosellinia, 2 genus Pythium, 4 genus Hansfordia dan 4 genus Aspergillus. Berdasarkan hasil uji, semua genus yang ditemukan dalam penelitian ini mampu menghambat pertumbuhan bakteri *E. coli* dengan daya hambat sebesar 75,99% (*Rosellinia* sp), 87,70% (*Pythium* sp.), 73,42% (*Hansfordia* sp) dan 86,88% (*Aspergillus* sp). Namun, hanya tiga genus yang mampu menghambat pertumbuhan bakteri *Vibrio* sp. diatas 50 % dengan daya hambat sebesar 85,23% (*Rosellinia* sp), 87,87% (*Hansfordia* sp) dan 86,07% (*Aspergillus* sp.).

Kata Kunci: Isolasi, Aktivitas Antimikroba, Jamur Endofit, *Avicennia marina, Sonneratia alba*

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INTRODUCTION

Mengkapan Village is one of the 14 villages in the Sungai Apit District, Siak Regency, Riau Province. Mengkapan Village has the potential for a mangrove ecosystem with an 11.327 ha area, 40 ha of which is a mangrove area (BPS Kabupaten Siak, 2017). Mangrove forests are vegetation ecosystems found on tropical beaches with muddy substrates, and their life is influenced by sea tides (Yoswaty, 2021). Mangrove species often found in the coastal area of Mengkapan Village are *Avicennia marina* and *Sonneratia alba* (BPS Kabupaten Siak, 2017). The same was found by Efriyeldi et al. (2020) in Bungsur Village, which is adjacent to Mengkapan Village. Trees of this mangrove species protect the land from waves and sea winds. Mangrove ecosystems also have biodiversity in the form of microbes that can live in mangrove plant tissues called endophytic microbes.

Endophytic microbes produce secondary metabolites that help plant defenses. Endophytic microbes maintain the existence of host plants to survive and protect themselves from predators. This makes endophytic microbes continuously produce new chemical compounds to protect host plants. Endophytic microorganisms include fungi, bacteria, and viruses. Endophytic fungi produce more bioactive compounds that are the same as or similar to their hosts. Therefore, the isolation of these bioactive compounds does not have to cut down the host plant as a simplicia, and the biodiversity of these plants in nature is maintained (Rozirwan et al., 2018).

Endophytic fungi can produce anticancer compounds from the fungus species *Taxomyces andreanae* (Newman et al., 2020). HIV antiviral from the fungus species *Aspergillus* sp (Pang et al., 2017). Herpes antivirals from the fungus *Pleospora tarda* (Selim et al., 2018), *Aspergillus* sp (Ma et al., 2017), and *Aspergillus ruber* (Liang et al., 2018). Influenza antiviral from the fungus *Phoma* sp (Liu et al., 2019) and *Trichoderma* sp (Pang et al., 2017). Hepatitis antiviral form of the fungus species *Aspergillus versicolor* (Ahmed et al., 2017) and *Fusarium equiseti* (Hawas et al., 2017).

Besides being able to produce functional compounds for humans, endophytic fungi can also produce functional compounds for cultivated animals, such as fish and shrimp in the form of *Vibrio* sp from the fungus species *Cladorrhinum* sp, *Mycoleptodiscus* sp, *Nigrospora* sp, and *Nodulisporium* sp (Hariati et al., 2018). Antifungal *Fusarium* sp for fish and shrimp as well as chili and shallot plants from the fungus species *Trichoderma* sp (Putri, 2018), *Aspergillus* sp, *Penicillium* sp (Aji et al., 2022), and *A.porri* (Rachmatunnisa et al., 2017).

Almost all parts of the mangrove plant contain secondary metabolites, such as alkaloids, flavonoids, phenolics, steroids, and terpenoids, which were successfully extracted from the leaves, stems, bark, and fruit of the mangroves (Batubara et al., 2021). Situmorang et al. (2021); Khalimah & Ainy (2019) reported that endophytic fungi found on the leaves and stems of *A. marina* and *S.alba* mangroves could produce functional compounds in the form of antibacterials from the fungus species *A. flavus*, *A. niger* and *A. ochraceus* and antifungal species *Penicillium* sp, *Aspergillus* sp and *Microsporum* sp. These antimicrobials can inhibit the growth of *Staphylococcus aureus*, *E. coli*, and *Candida albicans*.

Endophytic fungi are essential as anticancer and antimicrobial agents, and they can lead to innovations in the health and cultivation of animals and plants. Endophytic fungi can be alternatives to anticancer and antimicrobial agents derived from natural ingredients, resulting in a minimal risk of resistance and a more affordable price than chemicals. Thus, it is necessary to isolate and test the antimicrobial activity of endophytic fungi on *A. marina* and *S. alba* mangroves, which are abundant in Mengkapan Village, Sungai Apit District, and Siak Regency.

MATERIALS AND METHOD

Time and place of research

Sampling of *A. marina* and *S. alba* mangroves was conducted in the mangrove ecosystems of Mengkapan Village, Sungai Apit District, Siak Regency (Figure 1). This research was conducted from February to June 2023. Furthermore, the samples were analyzed at the Laboratory of Marine Microbiology, Department of Marine Science, Faculty of Fisheries and Marine, Universitas Riau.

Sampling and preparation of *A. marina* and *S. alba*

The samples were small leaves and stems weighing ±200 g (stems) and 100 g (leaves). The isolated leaves are numbered one to four from the youngest tip and are green (Diana et al., 2021). The isolated stems are young, green to light brown in color, small in size, morphologically healthy, and show no signs of illness. The

sampling was performed using scissors. The sample was washed thoroughly with running water and placed in a sterile container containing a physiological NaCl solution. Samples in physiological NaCl solution were rinsed with distilled water and drained until completely dry. The sample was then placed in a plastic bag and cooler to maintain freshness. Subsequent samples were brought to the Marine Microbiology Laboratory, Department of Marine Science, Faculty of Fisheries and Marine, Universitas Riau.

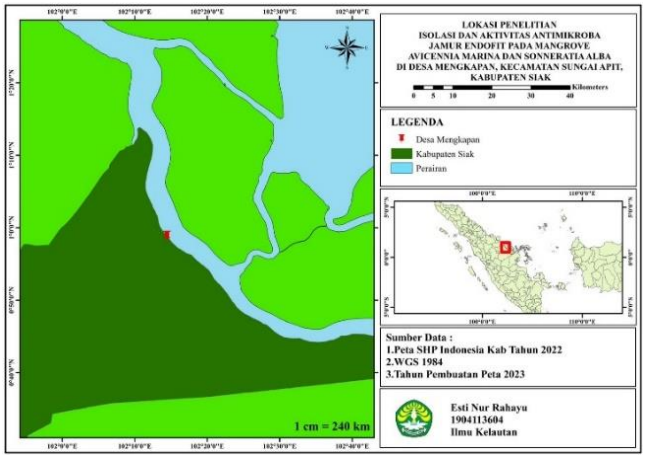

Figure 1. Research location

Isolation of endophytic fungi on Potato Dextrose Agar (PDA) media

The endophytic fungi in this research were isolated using a planting technique. The samples that had been washed clean were then cut to a size of 1×1 cm. The sample pieces were then immersed in 70% alcohol for one minute. Sample pieces were immersed in a sodium hypochlorite solution for two minutes. They were washed with 70% alcohol and rinsed thrice with sterile distilled water. The sample pieces were then isolated in PDA media that had previously been added with 0.5g/100 mL chloramphenicol to prevent bacterial contamination and incubated at ±25°C for seven days or until the fungi grew.

Characterization of endophytic fungi

Microscopic observations were performed using the Block Square method. The block square method was performed by placing a piece of new PDA medium measuring ±1x1 cm on a glass slide. Next, the PDA medium was cultured with endophytic fungi by taking the fungi hyphae using a looped needle and placing them on the sides of the PDA medium. Filter paper, ring u, cover glass, object glass, and tweezers were sterilized by boiling the tools using distilled water. The U ring was made using aluminum foil and arranged as shown in Figure 2.

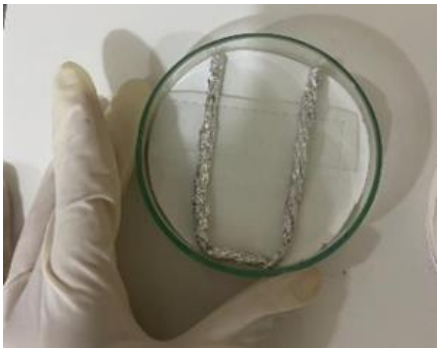

Figure 2. Block square method arrangement

The filter paper was placed on a sterile petri dish under slightly wet conditions to keep the petri dish moist. Then, the ring u, the glass object, the media that has been given the culture of endophytic fungi, is covered with a sterile glass cover. The medium was incubated for 5-7 days at 25°C (Heirina et al., 2020). Endophytic fungi cultures that grow stick to coverslips that cover the medium. A sterile glass slide was prepared, and a drop of lactophenol cotton blue was added to create a transparent effect on the fungi and make it easier to observe. The coverslips attached to the PDA medium were removed using sterile tweezers. The surface of lactofenol cotton blue was covered with a coverslip and observed under a microscope at a magnification of 40×10 (Situmorang et al., 2021).

Identification of endophytic fungi

Observations obtained from the macroscopic and microscopic characterization of endophytic fungi were used to identify endophytic fungi using the reference book Identifying Filamentous Fungi (St-Germain & Summerbell, 1996) and related journals and literature.

Diameter increases of endophytic fungi

The diameter increase of the endophytic fungi was measured and calculated to determine the growth phase of the endophytic fungi. The increase in the diameter of the endophytic fungi was measured using a caliper by observing the increase in the diameter of each endophytic fungi during the 11 days of observation and then calculated using the formula. The formula for measuring the increase in the diameter of endophytic fungi (D) is the horizontal diameter of the endophytic fungi (d1) and the vertical diameter of the endophytic fungi (d2) divided by two (Situmorang et al., 2021), as shown in Figure 3 as follows : $D\frac{d1+d2}{2}=$

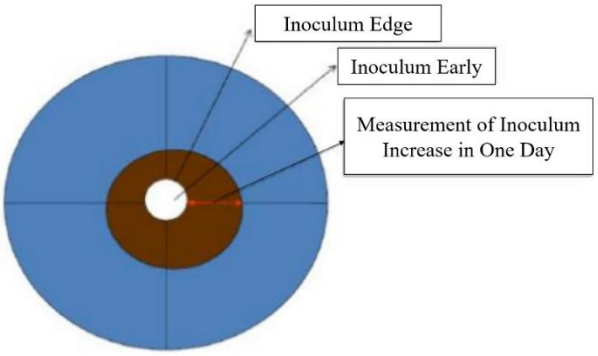

Figure 3. Diameter increase of endophytic fungi
(Source : Situmorang et al., 2021)

Endophytic fungi antagonism test

Antagonism test of endophytic fungi and pathogenic bacteria was carried out using a double culture method on MHA media, as seen in Figure 4. Endophytic fungi on PDA media were inoculated onto MHA media. Bacterial cultures of *Vibrio* sp or *E. coli* were also streaked on the MHA media side by side, as were the size of the pieces of PDA media. Media containing endophytic fungi and pathogenic bacteria isolates were incubated at ±25°C for nine days.

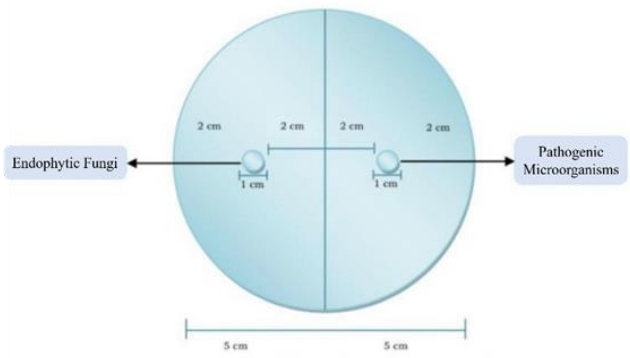

Figure 4. Endophytic fungi antagonism test design

Endophytic fungi antimicrobial index measurement

The antimicrobial index of endophytic fungi was determined by calculating the percentage growth inhibition (PGI) of endophytic fungi against pathogenic bacteria. The antimicrobial index of endophytic fungi for inhibiting the growth of pathogenic bacteria was calculated using the following formula: $I = \frac{R1+R2}{R1}\ x\ 100\%$

Where I is the percentage inhibition, R1 is the diameter of the pathogen colony on the control plate, and R2 is the diameter of the pathogen colony on the test plate. The percentage inhibition of the antimicrobial index of endophytic fungi was based on the Growth Inhibition Category (GIC) with three criteria for the percentage of growth inhibition (Izzatinnisa et al., 2020). These criteria are: low inhibition percentage= 0 – 39%; moderate = 40 – 69%; high = 70 – 100%.

RESULT AND DISCUSSION

Isolation and Identification of Endophytic Fungi

As many as 12 endophytic fungi have been isolated from the leaves and stems of *A. marina* and *S. alba* and showed almost the same characteristics. Six isolates were found in the stems and six isolates in the leaves. The characteristics of the isolates can be seen in Table 1.

Table 1. Isolation of endophytic fungi from leaves and stems of *A. marina* and *S. alba*

Isolate	Characteristics				
	Texture	Upper surface color	Lower surface color	Margin	Pattern
DSA 1	Velvet	White	White	Plain	Spread
DSA 2	Cotton	Grayish White	Grayish White	Plain	Spread
DSA 3	Velvet	White	White	Plain	Spread
BSA 1	Cotton	Grayish White	White	Plain	Spread
BSA 2	Cotton	Grayish White	White	Plain	Spread
BSA 3	Cotton	White	White	Plain	Spread
DAM 1	Cotton	White	Yellowish White	Plain	Spread
DAM 2	Velvet	White	Yellowish White	Plain	Spread
DAM 3	Cotton	White	Yellowish White	Plain	Spread
BAM 1	Cotton	White	White	Plain	Spread
BAM 2	Cotton	White	White	Plain	Spread
BAM 3	Cotton	White	White	Plain	Spread

Description: DSA = Leaves *S. alba*; BSA = Stem *S. alba*; DAM = Leaves *A. marina*; BAM = Stem *A. marina*.

Based on the results of this research, endophytic fungi isolates have almost the same macroscopic characteristics, especially on the margins and fungi colonies. The difference that can be seen immediately is the color of the upper and lower surfaces and the texture of the fungi colonies, as shown in Figure 5.

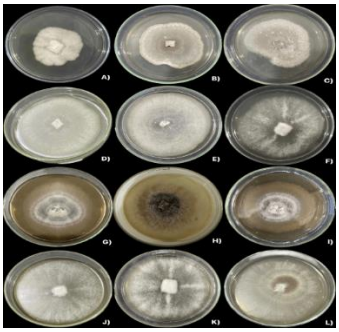

Figure 4. Endophytic fungi colonies A) Isolat DSA 1; B) Isolat DSA 2; C) Isolat DSA 3 ; D) Isolat BSA 1; E) Isolat BSA 2; F) Isolat BSA 3; G) Isolat DAM 1; H) Isolat DAM 2; I) Isolat DAM 3; J) Isolat BAM 1; K) Isolat BAM 2; L) Isolat BAM 3

Based on the results of this research, the endophytic fungi isolates were found to have almost the same microscopic characteristics. In general, the hyphae of the fungi isolates were septate, and only two isolates were non-septate. Another microscopic feature that shows the difference is the asexual (anamorphic) spores owned by endophytic fungi. Microscopic observations of the endophytic fungi are shown in Table 2.

Table 2. Microscopic observation of endophytic fungi

Isolate	Hyphae shape	Hyphae growth	Hyphae color	Conidia shape	Conidia color	Conidiophore shape
DSA 1	Septa	No Earrings	Hyalin	Round	Hyalin	Single
DSA 2	Septa	No Earrings	Hyalin	Round	Hyalin	Single
DSA 3	Asepta	No Earrings	Hyalin	-	-	-
BSA 1	Septa	Earrings	Hyalin	Round	Hyalin	Branched
BSA 2	Septa	Earrings	Hyalin	Round	Hyalin	Branched
BSA 3	Septa	Earrings	Hyalin	Round	Hyalin	Branched
DAM 1	Septa	Earrings	Hyalin	Round	Hyalin	Single
DAM 2	Septa	Earrings	Hyalin	Round	Hyalin	Single
DAM 3	Septa	Earrings	Hyalin	Round	Hyalin	Single
BAM 1	Septa	Earrings	Hyalin	Round	Hyalin	Branched
BAM 2	Asepta	No Earrings	Hyalin	-	-	-
BAM 3	Septa	Earrings	Hyalin	Round	Hyalin	Single

Description: (-) = do not have conidia and conidiophore.

Most endophytic fungi isolates belonged to the phylum Ascomycota, and only one belonged to the phylum Oomycota. This is based on the asexual spore forms of endophytic fungi. Based on the hyphae and asexual spores, the researchers grouped the endophytic fungi isolates into four genera, namely, two genera Rosellinia, two genera Pythium, four genera Hansfordia, and four genera Aspergillus. Identification was carried out by referring to the reference book Identifying Filamentous Fungi (St-Germain & Summerbell, 1996) and related books and journals. The results of endophytic fungi identification are shown in Table 3.

Table 3. Endophytic fungi identification results

Mangrove	Organs	Isolate	Endophytic fungi	Taxa
A. marina	Leaves	DSA 1	*Rosellinia* sp	Ascomycota
		DSA 2	*Rosellinia* sp	Ascomycota
		DSA 3	*Pythium* sp	Oomycota
	Stems	BSA 1	*Hansfordia* sp	Ascomycota
		BSA 2	*Hansfordia* sp	Ascomycota
		BSA 3	*Hansfordia* sp	Ascomycota
S. alba	Leaves	DAM 1	*Aspergillus* sp	Ascomycota
		DAM 2	*Aspergillus* sp	Ascomycota
		DAM 3	*Aspergillus* sp	Ascomycota
	Stems	BAM 1	*Hansfordia* sp	Ascomycota
		BAM 2	*Pythium* sp	Oomycota
		BAM 3	*Aspergillus* sp	Ascomycota

Diameter Increase of Endophytic Fungi

The results of the diameter growth rate of endophytic fungi carried out for 11 days of observation showed that *Pythium* sp and *Aspergillus* sp grew faster than *Hansfordia* sp and *Rosellinia* sp, as shown in Table 4.

Table 4. Diameter increases of endophytic fungi

Isolate	Species	Day (mm)											
		1	2	3	4	5	6	7	8	9	10	11	12
DSA 1	*Rosellinia* sp	*	*	16.9	21.9	32.3	44.4	58.1	59.2	**			
DSA 2	*Rosellinia* sp	*	*	15.5	28.4	31.1	41.7	55.3	66.4	**			
DSA 3	*Pythium* sp	*	*	11.5	27.5	36.9	43.3	51.9	63.9	**			
BSA 1	*Hansfordia* sp	*	*	12.1	21.7	34.9	42.6	51.7	63.3	77.9	78.1	83.6	**
BSA 2	*Hansfordia* sp	*	*	19.8	22.3	31.7	42.1	53.0	62.2	73.3	74.4	86.6	**
BSA 3	*Hansfordia* sp	*	*	17.3	21.0	33.0	44.5	53.5	61.1	75.7	76.8	**	
DAM 1	*Aspergillus* sp	*	*	14.6	27.0	34.9	47.7	54.5	67.7	72.0	73.1	85.3	**
DAM 2	*Aspergillus* sp	*	*	11.3	27.3	38.6	48.8	52.3	66.6	73.3	74.4	86.6	**
DAM 3	*Aspergillus* sp	*	*	10.9	25.9	37.3	41.3	54.5	65.4	73.1	74.2	86.4	**
BAM 1	*Hansfordia* sp	*	*	16.2	25.2	31.3	46.6	56.6	64.9	**			
BAM 2	*Pythium* sp	*	*	13.5	28.7	34.6	42.3	52.1	65.3	**			
BAM 3	*Aspergillus* sp	*	*	11.7	28.9	32.2	48.8	57.1	67.6	**			

Endophytic Fungi Antagonism Test

After identification, as many as seven isolates of endophytic fungi from different species and organs of mangrove plants were tested for culture with *Vibrio* sp and *E. coli*. Based on the test results, each endophytic fungi had a different ability to inhibit the growth of pathogenic bacteria. The results of the antagonism activity test of endophytic fungi can be seen in Figure 6-7 and Table 5.

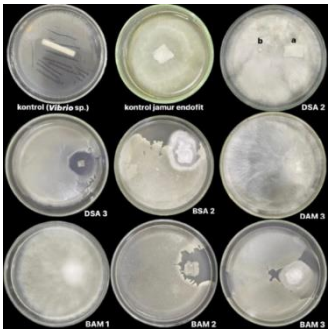

Figure 6. Endophytic fungi antagonism activity against *Vibrio* sp. (a) Endophytic fungi; (b) Bacterial pathogens

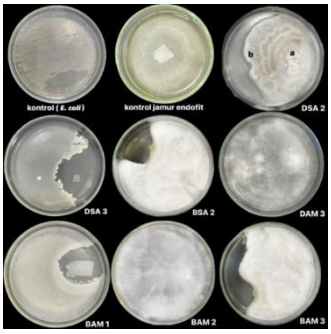

Figure 7. Endophytic fungi antagonism activity against *E. coli* (a) Endophytic fungi; (b) Bacterial pathogens

Growing endophytic fungi with pathogenic bacteria side-by-side tested the antagonistic activity of the double culture method. This was performed to determine the mechanism of antagonism of endophytic fungi against pathogenic bacteria. Antagonistic properties will appear in endophytic fungi and pathogenic bacteria due to competition for space and nutrients for growth (Aji et al., 2022).

Table 5. Endophytic fungi antagonism activity

Mangrove	Organs	Isolate	Endophytic Fungi	activity	
				Vibrio sp	*E.coli*
A. marina	Leaves	DSA 2	*Rosellinia* sp	Bactericidal	Bacteriostatic
		DSA 3	*Pythium* sp	Antibiotics	Antibiotics
	Stems	BSA 2	*Hansfordia* sp	Bacteriostatic	Bacteriostatic
S. alba	Leaves	DAM 3	*Aspergillus* sp	Bactericidal	Bactericidal
	Stems	BAM 1	*Hansfordia* sp	Bactericidal	Antibiotics
		BAM 2	*Pythium* sp	Antibiotics	Bactericidal
		BAM 3	*Aspergillus* sp	Bacteriostatic	Bacteriostatic

According to Situmorang et al. (2021); Heirina et al. (2020), endophytic fungi in *A. marina* and *S. alba* mangroves can inhibit the growth of pathogenic bacteria. Host plants also influence the ability of endophytic fungi to inhibit the growth of pathogenic bacteria because plants generally pass on the metabolites they contain to endophytes so that endophytes can produce abilities that are the same or similar to their host plants (Rozirwan et al., 2020). The results of the antagonism activity test showed that endophytic fungi could inhibit the growth of *Vibrio* sp and *E. coli*. Endophytic fungi with antagonistic properties can control pathogenic bacteria through bacteriostatic, bactericidal, and antibiotic mechanisms (Fontana et al., 2021).

Measure of the antimicrobial index of endophytic fungi

The inhibition of endophytic fungi against *Vibrio* sp and *E. coli* was analyzed based on the growth diameter of *Vibrio* sp and *E. coli* on antagonist test media and control media, which was calculated using the formula. If the diameter of *Vibrio* sp and *E. coli* on the antagonist test medium was smaller, the endophytic fungi were inhibited against *Vibrio* sp and *E. coli*, and vice versa. The antimicrobial index of endophytic fungi was determined by calculating the percentage growth inhibition (PGI). Data on the antimicrobial index of the endophytic fungi were obtained on the ninth day of observation. The antimicrobial indices of endophytic fungi are shown in Table 6.

Table 6. Endophytic fungi antimicrobial index

Mangrove	Isolate	Endophytic fungi	Inhibition (%)		Antimicrobial index	
			Vibrio sp	*E. coli*	*Vibrio* sp.	*E. coli*
A.marina	DSA 2	*Rosellinia* sp	85.23	75.99	high	high
	DSA 3	*Pythium* sp	13.32	22.48	low	low
	BSA 2	*Hansfordia* sp	12.00	73.41	low	high
S. alba	DAM 3	*Aspergillus* sp	86.07	86.88	high	high
	BAM 1	*Hansfordia* sp	87.87	24.94	high	low
	BAM 2	*Pythium* sp	11.88	87.70	low	high
	BAM 3	*Aspergillus* sp	13.44	74.70	low	high

Based on the data in Table 6, the inhibition percentages of *Vibrio* sp and *E. coli* by endophytic fungi varied between 11.88–87.70%. This shows that each isolate has a different ability to inhibit the growth of *Vibrio* sp and *E. coli*. Most of the diameters of *Vibrio* sp and *E. coli* on the test plate antagonism activity were lower than those of *Vibrio* sp and *E. coli* on control plates. Endophytic fungi have antagonistic potential against *Vibrio* sp and *E. coli*. This shows that the two isolates compete for life to get space and nutrients.

CONCLUSION

Based on research, it can be concluded that there are 12 endophytic fungi isolated from mangroves *A. marina* and *S. alba*, namely two genera Rosellinia, two genera Pythium, four genera Hansfordia and four genera Aspergillus. Based on the test results that have been carried out, all genera found in this research were able to inhibit the growth of *E. coli* bacteria with inhibition of 75.99% (*Rosellinia* sp), 87.70% (*Pythium* sp), 73.42% (*Hansfordia* sp) and 86.88% (*Aspergillus* sp). However, only three genera were able to inhibit the growth of

Vibrio sp, with inhibition of 85.23% (*Rosellinia* sp), 87.87% (*Hansfordia* sp), and 86.07% (*Aspergillus* sp). Differences in the inhibition of endophytic fungi against *Vibrio* sp and *E. coli* may be because these isolates belong to the same genus, but in different species.

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