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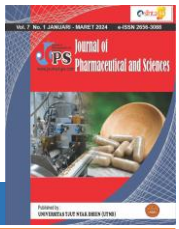

# Potention Antimicrobial of Infusa Extract from Pedada Leave (*Sonneratia caseolaris* L) Mandeh, West Sumatera

# Potensi Antimikroba Ekstrak Infus Daun Pedada (Sonneratia caseolaris L) Mandeh, Sumatera Barat

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## Abstract

The increasing emergence of antibiotic-resistant bacteria poses a serious global health threat, highlighting the need for alternative antimicrobial sources derived from natural products. Pedada mangrove (*Sonneratia caseolaris* L.), widely distributed in the coastal area of Mandeh, West Sumatra, has been traditionally used as a medicinal plant. This study aimed to evaluate the antimicrobial potential of leaf infusion extracts of *Sonneratia caseolaris* and to determine the effect of heating time variation on antimicrobial activity. Leaf infusion extracts were prepared using boiling water with heating durations of 10, 15, and 30 minutes. Antimicrobial activity was assessed against *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans* using the disc diffusion method. The results showed that all infusion extracts exhibited antimicrobial activity with varying inhibition levels. The optimal heating time was 10 minutes, resulting in inhibition zone diameters of 10.5 mm against *E. coli*, 10 mm against *S. aureus*, and 10 mm against *C. albicans*. These findings indicate that *Sonneratia caseolaris* leaf infusion extract has potential as a natural antimicrobial agent, with shorter heating time being more effective in preserving antimicrobial activity.

***Keywords*: Extract, Infusion, Sonneratia, Antimicrobial, West Sumatra.**

## Abstrak

Meningkatnya resistensi antibiotik merupakan ancaman serius bagi kesehatan global dan mendorong pencarian sumber antimikroba alternatif dari bahan alam. Mangrove pedada (*Sonneratia caseolaris* L.) yang banyak ditemukan di kawasan pesisir Mandeh, Sumatera Barat, secara tradisional dimanfaatkan sebagai tanaman obat. Penelitian ini bertujuan untuk mengevaluasi potensi antimikroba ekstrak infus daun *Sonneratia caseolaris* serta pengaruh variasi waktu pemanasan terhadap aktivitasnya. Ekstrak infus daun dibuat menggunakan pelarut air mendidih dengan variasi waktu pemanasan 10, 15, dan 30 menit. Aktivitas antimikroba diuji terhadap *Escherichia coli*, *Staphylococcus aureus*, dan *Candida albicans* menggunakan metode difusi cakram. Hasil penelitian menunjukkan bahwa seluruh ekstrak infus memiliki aktivitas antimikroba dengan tingkat daya hambat yang bervariasi. Waktu pemanasan 10 menit menghasilkan aktivitas antimikroba tertinggi dengan diameter zona hambat masing-masing sebesar 10,5 mm terhadap *E. coli*, 10 mm terhadap *S. aureus*, dan 10 mm terhadap *C. albicans*. Hasil ini menunjukkan bahwa ekstrak infus daun *Sonneratia caseolaris* berpotensi sebagai sumber antimikroba alami, dengan waktu pemanasan optimal selama 10 menit.

***Kata Kunci*: Ekstrak, Infus, Sonneratia, Antimikroba, Sumatera Barat.**

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## Introduction

The trend of antibiotic-resistant bacteria is a serious problem and a global threat to health. MRSA is a bacteria that has become resistant to the antibiotic meticillin. *S. aureus* is a normal human flora located on the skin and mucous membranes that can also be found in the environment. *S. aureus* is the causative agent of many infections such as skin and soft tissue infections (boils, impetigo, oliculitis, cellulitis, etc.), bacteremia, lung infections, meningitis and urinary tract infections. To overcome this problem, exploration of antimicrobial compounds derived from natural materials has begun to attract interest [1]. One source of plant habitat that produces antimicrobial compounds is mangrove habitat. Indonesia has the largest mangrove habitat in the world and contributes to 25.79% of the global mangrove ecosystem [2].

Mangrove plants are currently receiving attention, especially in tropical areas such as Indonesia. Indonesia is a country with very high mangrove diversity, with 202 types of mangroves growing on the coast [3]. One of the mangrove plants that has antimicrobial activity is *Sonneratia* sp. Sonneratia has unique characteristics where it can live in environmental conditions with high or low salinity, and can withstand waves and sea currents. With the unique and extreme habitat characteristics of Sonneratia, it produces secondary metabolite compounds that are also unique. The community in Mamuya Village, North Maluku, uses young fruit parts, bark, and roots for treating mangir, increasing appetite, lusiang (muscle pain, back pain, bone pain, rheumatism), malaria, restoring stamina, appendicitis, and liver [4].

In addition, coastal communities also utilize Sonneratia plants as a medicine for skin wound infections and scabies caused by *Staphylococcus aureus* bacteria, as a medicine for diarrhea caused by the diarrhea-causing bacteria *Eschercia coli* [5] as a medicine for canker sores caused by the fungus *Candida albicans* [6]. The content of secondary metabolite bioactive compounds from the *Sonneratia spp*. mangrove plant is phenol, flavonoid, alkaloid, tannin, steroid and triterpenoid so that it has an antimicrobial function [7-12]. The extract of *Sonneratia alba* mangrove leaf infusion from Mandao has antibacterial activity against pathogenic bacteria *E. coli* and *S. aureus* [13,14].

One of the coastal areas in West Sumatra is the Mandeh area. The Mandeh area is one of the coastal areas where many Sonneratia mangrove plants are found. The topographic conditions of the West Sumatra mangrove habitat are quite extreme due to sea waves, tectonic vibrations originating from the sea, tidal areas and fluctuating environmental temperatures, resulting in unique secondary metabolite content of Sonneratia, both in terms of antimicrobial activity. The secondary metabolite content of each habitat area will produce different concentrations of secondary metabolites. Factors that influence the production of secondary metabolites are environmental conditions. One of the factors that influences the production of secondary metabolites is temperature and $CO_2$, the higher the temperature and $CO_2$ levels, the higher the production of secondary metabolites produced [15]. This study examines the potential antimicrobial activity of *Sonneratia caseolaris* leaf infusion extract from the coastal area of West Sumatra. These findings can be produced in the form of basic information data from the potential of local coastal resources from Mandeh, West Sumatra, which can overcome infectious diseases caused by pathogenic microbes.



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## Experimental Section

### Materials and Apparatus

Nutrient Agar (NA) (Merk) medium, Potato Dextrose Agar (PDA) (Merk) medium, sodium chloride (NaCl), distilled water, 70% ethanol (Brataco), spiritus (Brataco), test microorganisms (*Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922 and *Candida albicans*), Whatman filter paper, blank paper discs (Oxoid), and antibiotic discs (Oxoid).

Brown glass maceration bottles, Duran glass bottles, cool box, grinder, oven (Memmert), rotary vacuum evaporator (Buchi), incubator (Lab Tech), Petri dishes (Normax), Erlenmeyer flasks (Pyrex), glass beakers (Pyrex), measuring cylinders (Pyrex), test tubes (Pyrex), test tube racks, glass funnels (Normax), droppers, glass stirring rods, Bunsen burner, spatula, analytical balance (Shimadzu), and hot plate (Thermo Scientific).

### Leaf Sampling of *Sonneratia caseolaris*

Healthy leaves of *Sonneratia caseolaris* were collected and placed into labeled plastic sample bags. The labeled samples were then stored in a cool box to preserve sample integrity prior to further processing.

### Drying and Preparation of *Sonneratia caseolaris* leaf simplicia

Healthy *Sonneratia caseolaris* leaves were collected from the Mandeh area, West Sumatra, Indonesia, and thoroughly cleaned to remove adhering dirt and debris. The leaf samples were air-dried at room temperature (28 °C) until a constant weight was achieved and subsequently ground using a mechanical grinder to obtain simplicia powder. The resulting powder was analyzed for moisture content using the oven-drying method and for ash content using a muffle furnace. The prepared simplicia powder was then used for the subsequent extraction process.

### Preparation of *Sonneratia caseolaris* Leaf Infusion

The leaf infusion of *Sonneratia caseolaris* was prepared using an aqueous infusion method. A total of 100 g of dried *Sonneratia caseolaris* leaf simplicia was accurately weighed and extracted with distilled water at a material-to-solvent ratio of 1:10 (w/v), corresponding to 100 g of plant material in 1,000 mL of water. The water was heated to boiling (approximately 100 °C). Once boiling was reached, the leaf material was added, and the infusion process was carried out. The heating treatments were conducted separately for each extraction time, namely 10, 15, and 30 minutes, using the same amount of plant material and solvent volume in each batch to ensure consistency of extraction conditions. During the infusion process, the temperature was maintained near the boiling point.

After heating, the infusion was allowed to cool to room temperature and then filtered through filter paper to remove plant residues. The resulting filtrate was designated as the *Sonneratia caseolaris* leaf infusion extract and was used directly for subsequent antimicrobial activity assays.

### Antimicrobial Activity Assay (Diffusion Method)

The antimicrobial activity assay was conducted according to the method described by Murray et al., [16] with minor modifications. The pathogenic microorganisms used in this study included *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans*. Each test microorganism was suspended in physiological saline, and 100 µL of the suspension with a concentration of $10^8$ CFU/mL for bacterial strains and $10^5$ CFU/mL for the fungal strain was used for inoculation. The microbial suspensions were evenly spread onto Nutrient Agar (NA) for bacterial cultures and Potato Dextrose Agar (PDA) for fungal cultures using the *spread plate* method. *Sonneratia caseolaris* infusion extracts obtained from different boiling time variations were applied at a volume of 10 µL onto sterile paper discs, which were then placed on the surface of the inoculated agar media. Streptomycin (10 µg) was used as a positive control for antibacterial assays, while ketoconazole served as the positive control for antifungal assays. All treatments were performed in triplicate and incubated at 37 °C for 24 h. Antimicrobial activity was evaluated by measuring the diameter of the inhibition zones formed around the paper discs [5, 10]. The diameter of the inhibition zone was classified as weak (5 mm), moderate (5–10 mm), strong (10–20 mm), and very strong (20–30 mm) [17].



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## Results and Discussion

### Infusion Extraction of *Sonneratia caseolaris* L Leaf Samples

Infusion extraction of *Sonneratia caseolaris* L. leaf samples was performed using distilled water as a polar solvent. Infusion is a conventional extraction method commonly applied in the preparation of herbal remedies, in which plant simplicia are extracted using hot water. In this study, the use of distilled water facilitated the extraction of polar bioactive compounds from mangrove leaves.

### Antimicrobial Activity Assay (Diffusion Method)

The antimicrobial activity of the infusion extract of *Sonneratia caseolaris* L. leaves demonstrated inhibitory effects against pathogenic microorganisms, including *Escherichia coli*, methicillin-resistant *Staphylococcus aureus* and *Candida albicans*. The results are presented in Table 1.

Table 1. Measurement of Antimicrobial Activity of *Sonneratia caseolaris* L. Leaf Infusion Extract.

| Bakteri Uji | Variasi suhu | Verage± SD | Category |
|---|---|---|---|
| *E. coli* ATCC 25922 | 10 | 10,33±0,289 | Moderate |
| | 15 | 8,33±0,578 | |
| | 30 | 8,33±0,578 | |
| *S. aureus* ATCC 25923 | 10 | 10±0 | Moderate |
| | 15 | 9±1 | |
| | 30 | 8±0 | |
| *C. albicans* | 10 | 9±1 | Moderate |
| | 15 | 8,33±0,578 | |
| | 30 | 7±1 | |
| Control (+) Streptomucyn | | 15±0 | Strong |
| Control (-) aquadest steril | | 6±0 | No. activity |

Table 1 demonstrates that heating duration during the infusion process significantly influenced the antimicrobial activity of *Sonneratia caseolaris* leaf extract. The infusion heated for 10 minutes exhibited the strongest antimicrobial activity against *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans*, with inhibition zone diameters of 10.5 mm, 10 mm, and 10 mm, respectively. In contrast, extending the heating time to 15 and 30 minutes reduced the inhibition zones to 8–9 mm, indicating moderate activity. This decline suggests that prolonged heating may reduce the effectiveness of antimicrobial constituents present in the extract. The reduction in activity is likely associated with the thermal degradation of heat-sensitive bioactive compounds. Phenolic and flavonoid compounds, widely recognized as key contributors to antimicrobial and antioxidant activities in plants, are generally thermolabile and susceptible to structural damage under excessive heat. Degradation processes such as oxidation and hydrolysis can lower their effective concentration in extracts, resulting in diminished biological activity [18]. This interpretation is consistent with reports showing that increased heating duration and intensity in plant and food extracts often lead to reduced phenolic content and associated bioactivities [19]. Therefore, the 10-minute heating time observed in this study likely represents an optimal balance between extraction efficiency and preservation of thermolabile antimicrobial compounds. The antimicrobial activity observed in this study is also consistent with previous reports on mangrove plants, which are known to contain diverse secondary metabolites such as flavonoids, tannins, phenolics, saponins, and alkaloids that contribute to antimicrobial effects [20]. Several studies on *Sonneratia* species have demonstrated broad-spectrum antimicrobial activity against both Gram-positive and Gram-negative bacteria, including *E. coli* and *S. aureus*, as well as pathogenic fungi such as *C. albicans* [21]. Because aqueous extraction primarily isolates polar compounds, the observed inhibition zones are likely associated with phenolic and flavonoid constituents effectively extracted in the infusion process [22].

Based on the inhibition observed against both Gram-positive and Gram-negative bacteria, the infusion extract of young *S. caseolaris* leaves can be classified as having broad-spectrum antibacterial activity. According to established criteria, inhibition zones of 6–10 mm indicate moderate activity, while 11–20 mm indicate strong activity. The inhibition zones recorded in this study, ranging from moderate to strong, confirm the antibacterial potential of the infusion extract [23]. This activity is likely related to the presence of secondary metabolites reported in *Sonneratia* species, including alkaloids, flavonoids, tannins, saponins, and phenolics,



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which have also been identified in the infusion extract of *Sonneratia alba* roots through phytochemical screening [24]. Overall, these findings highlight that control of heating duration is a critical factor in preserving the antimicrobial potency of plant extracts, as excessive heating may reduce activity through degradation of bioactive compounds. This has practical implications for the development of plant-based antimicrobial formulations as well as for traditional herbal infusion practices, where shorter and controlled heating durations may help maximize therapeutic efficacy.

## Conclusions

The infusion extract of *Sonneratia caseolaris* L. leaves demonstrated antimicrobial activity against *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans*. Variation in heating time during the infusion process significantly affected antimicrobial effectiveness, with a 10-minute heating time producing the strongest inhibition, while longer heating durations resulted in moderate activity. The reduced antimicrobial activity observed at extended heating times is likely associated with the thermal degradation of heat-sensitive polar bioactive compounds. The ability of the aqueous infusion extract to inhibit both Gram-positive and Gram-negative bacteria indicates broad-spectrum antimicrobial potential. These findings suggest that a short heating duration is optimal for preserving antimicrobial constituents in *Sonneratia caseolaris* leaf infusions and highlight the potential of mangrove leaves as a natural source of antimicrobial agents. Further studies focusing on phytochemical identification and mechanism of action are recommended to support future applications.

## Conflict of Interest

The authors declare that there are no financial or non-financial conflicts of interest that could have influenced the conduct of the research, the analysis and interpretation of the data, or the preparation of this manuscript.

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