Jurnal Eduhealth
Volume 15, Number 04, 2024, DOI 10.54209/eduhealth.v15i04
ESSN 2808-4608 (Online)
https://ejournal.seaninstitute.or.id/index.php/healt

The Antibacterial Activity Test Of Leaf Extract Nanoparticles Of Senggani (Melastoma Candidum D.Don) Against Cutibacterium Acnes And Staphylococcus Epidermidis Bacteria

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Article Info
Keywords:
Antibacterial Extract
Melastoma Candidum D.Don
Nanoparticles

ABSTRACT
The aim of this research is to explore and delve deeper into the reasons families request passive euthanasia, the illnesses and conditions that lead individuals to consider such actions, and how the principle of patient autonomy is applied in euthanasia practices at KH. Daud Arif Regional General Hospital, Kuala Tungkal. The research employs a qualitative approach through literature review studies. Data were collected from journals, books, and previous studies, focusing on the withdrawal of life-support measures and the ethical principle of autonomy. The collected information was analyzed to support the research. Based on the findings, decisions regarding euthanasia, particularly passive euthanasia, should ideally be made by patients when they are mentally capable. However, in critical conditions where the patient is incapacitated, the responsibility is transferred to the patient's family, who can make decisions on their behalf, including opting for passive euthanasia. While active euthanasia remains illegal in Indonesia, passive euthanasia, such as the cessation of life-support interventions, is permitted under certain legal frameworks, such as Ministry of Health Regulation No. 37 of 2014. This regulation also emphasizes the importance of therapeutic contracts between patients and healthcare providers. The reasons families or patients choose passive euthanasia at KH. Daud Arif Regional General Hospital, Kuala Tungkal, include prolonged physical suffering and a significant decline in quality of life. The illnesses or conditions considered for passive euthanasia include chronic, incurable diseases that cause ongoing suffering, such as heart disease, kidney failure, or illnesses with poor prognoses.

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INTRODUCTION

Acne is a common skin disease affecting up to 85% of the global population (Lestari et al., 2021). The prevalence of acne is 80-85% in adolescents aged 15-18 years, 12% in women aged 25 years, and 3% in women aged 35-44 years. Specifically, in adolescents, acne can affect psychological well-being related to self-esteem (Abdillah & Masykur, 2021). Currently,

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acne caused by skin microflora has been addressed using synthetic antibiotics; however, the use of synthetic antibiotics can cause side effects such as resistance (Pariury et al., 2021). One solution for treating acne is using herbs that are rich in secondary metabolites, which act as antimicrobial agents, such as phenols, flavonoids, alkaloids, terpenoids, and essential oils (Rathinavel et al., 2023). The natural antimicrobial activity obtained from medicinal plants can be used as natural antibiotics to prevent or kill acne-causing bacteria, one of which is the Senggani plant (*Melastoma candidum* D.Don). The Senggani plant is abundant in North Sumatra and is used by the local community as a wound-healing medicinal plant (Halim et al., 2021). Senggani plants contain secondary metabolites in their leaves, including tannins, alkaloids, flavonoids, and saponins (Yemima, 2018). The secondary metabolites in Senggani leaf extract suspected of having antibacterial properties are tannins and flavonoids (Halim et al., 2021)

Bacteria commonly responsible for acne include *Staphylococcus epidermidis* and *Cutibacterium* exhibit antibacterial activity against *Staphylococcus epidermidis*, with an inhibition zone of 14.76 mm at a concentration of 20%. Another study (Astuti et al., 2023) reported that Senggani leaves had an *acnes*. According to research (Suwita & Meldawati, 2022), Senggani leaves inhibition zone of 14.39 mm at a 20% concentration, while research by (Ridho, 2021) found that Senggani leaves had an inhibition zone of 10.7 mm against *Cutibacterium acnes*, which is categorized as strong. When formulated at higher doses, this extract may make the formulation less appealing due to the extract's intense color (Saryanti et al., 2019). Therefore, innovation is needed to strengthen the antibacterial activity of Senggani leaf extract at lower doses.

Nanoparticles are particles with dimensions ranging from 1-1000 nm (Ayumi et al., 2018). At the nano size, the surface contact area of the particles becomes larger, increasing the amount and solubility of the active compound, thus enhancing the antibacterial activity (Natasya, 2018). Nanoparticles are widely used in drug delivery systems because they offer benefits such as preventing skin dehydration, enhancing absorption effects, and improving the penetration of active ingredients (Saryanti et al., 2019). Nanoparticles can be an innovation to enhance efficacy at lower doses. Based on the above description, the researchers are interested in testing the antibacterial activity of Senggani leaf extract nanoparticles (*Melastoma candidum* D.Don) against *Cutibacterium acnes* and *Staphylococcus epidermidis*. This study aims to determine whether Senggani leaf extract nanoparticles exhibit antibacterial activity against *Cutibacterium acnes* and *Staphylococcus epidermidis* and to assess whether there are differences in antibacterial activity between Senggani leaf extract nanoparticles and ethanol leaf extract against these bacteria.

METHODS

This research was conducted using a laboratory experimental approach. The study included the collection of Senggani leaf samples, extraction using the maceration method, phytochemical screening, and the preparation of Senggani leaf extract nanoparticles. The antibacterial activity of Senggani leaf extract was tested at concentrations of 25%, 50%, 75%,

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and 100%, while the nanoparticles were tested at concentrations of 2.5%, 5%, 7.5%, and 10% against *Staphylococcus epidermidis* and *Cutibacterium acnes* using the agar diffusion method.

The independent variables in this study were the ethanol extract and Senggani leaf ethanol extract nanoparticles, while the dependent variables included nanoparticle characteristics and antibacterial activity. The parameters measured in this study were sample collection, simplisia characterization, ethanol extract preparation, phytochemical screening, ethanol extract nanoparticle preparation, nanoparticle size validation, and the measurement of the inhibition zone diameters for bacterial growth of *Staphylococcus epidermidis* and *Cutibacterium acnes*.

The research was carried out in the Research Laboratory of the Faculty of Pharmacy, Universitas Muslim Nusantara Al-Washliyah Medan, from January 2023 to May 2024. The materials used included Senggani leaves, aquadest, 96% alcohol, hydrochloric acid, sulfuric acid, benzene, ferric chloride, lead (III) chloride, mercuric chloride, bismuth nitrate, ethyl acetate, n-hexane, isopropanol, chloroform, magnesium powder, sodium hydroxide, nitric acid, ferrous chloride, aquades, chitosan, Na TPP, clindamycin, DMSO, Na CMC, MHA media, NA, and bacteria.

The equipment used in this study included beakers, measuring flasks, test tubes, test tube racks, aluminum foil, sterile gauze, thread, Petri dishes, autoclaves, blenders, incubators, calipers, inoculating loops, ovens, vortex mixers, mason jars, analytical balances, dropper pipettes, graduated cylinders, Bunsen burners, Vernier calipers, furnaces, hotplates, microscopes, pycnometers, LAF (Laminar Air Flow) system, viscometers, Petri dishes, tweezers, spatulas, Erlenmeyer flasks, paper discs, magnetic stirrers, particle size analyzers (PSA), and Scanning Electron Microscopy (SEM).

The plant samples used in this study were Senggani leaves (*Melastoma candidum* D.Don), which were obtained from Tapanuli Tengah District. The purposive sampling method was applied, selecting the plant without comparing it to similar plants from other regions. Data on the inhibition zone diameters of the ethanol extract and ethanol extract nanoparticles of Senggani leaves were analyzed using a One-way ANOVA to compare the inhibition zones between the two treatments.

RESULTS AND DISCUSSION

Plant Identification Results

Based on the identification results conducted at the Herbarium Medanese Laboratory (MEDA), Biotechnology Street, Universitas Sumatera Utara, the sample obtained was identified as Senggani Leaf (*Melastoma candidum* D.Don) from the family Melastomaceae.

Simplisia Characterization Results

Macroscopic Examination of Senggani Leaf

The macroscopic examination was carried out by directly observing the physical condition of the Senggani leaves (*Melastoma candidum* D.Don) used in this study. The results of the macroscopic examination of the Senggani leaves are as follows:

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Table 1. Macroscopic Examination Results of Senggani Leaf Simplisia

No.	Parameter	Result
1	Shape	The leaf is round and pointed, with a surface covered with fine hairs. The edges are smooth, and the leaf length is 11-15 cm.
2	Color	Green
3	Taste	Bitter
4	Smell	Distinctive

Microscopic Examination of Senggani Leaf Simplisia

The microscopic examination of the powder simplisia aimed to identify characteristic fragments in the Senggani leaf. The microscopic analysis revealed the presence of glandular hairs, vascular bundles, and parasitic stomata.

Yield Determination

A total of 700 grams of Senggani leaf powder was subjected to maceration extraction, resulting in 81.625 grams of thick extract, corresponding to a yield of 11.660%.

Simplisia Characterization Examination

Characterization is an initial step to control the quality of simplisia to obtain uniform raw materials, ensuring the pharmacological effects of the plant (Departemen Kesehatan Republik Indonesia, 2000). The parameters used to guarantee the quality of simplisia include moisture content determination, total ash content, acid-insoluble ash content, water-soluble extract content, and ethanol-soluble extract content. The results of the simplisia characterization are presented in Table 2.

Table 2. Simplisia Characterization Results

No.	Parameter	Result	MMI 1989 Requirements (%)
1	Moisture Content	4.6%	<10%
2	Total Ash Content	7.25%	<15%
3	Acid-Insoluble Ash Content	0.43%	<1%
4	Water-Soluble Extract Content	58%	>7%
5	Ethanol-Soluble Extract Content	19%	>3%

The determination of moisture content measures the amount of water in the dried and powdered simplisia. The goal is to set a minimal limit for the moisture content range in the simplisia powder (Departemen Kesehatan Republik Indonesia, 2000). According to the standard parameters, the moisture content of simplisia should not exceed 10%. The result of the moisture content determination for Senggani leaf was 4.6%. This indicates that the Senggani leaf meets the required standards. The determination of total ash content is a parameter where simplisia is heated at a high temperature to destroy and evaporate organic compounds, leaving only mineral and inorganic elements. According to the applicable parameters, the total ash content of simplisia should not exceed <15%. The result for Senggani leaf simplisia was 7.25%, indicating that the Senggani leaf meets the required standard. Next, 25 mL of hydrochloric acid was added to the total ash obtained, and the acid-insoluble ash was collected by filtering through filter paper, rinsed with hot water, and then incinerated until constant weight, followed by weighing. The required standard for acid-

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insoluble ash content is <1%. The result for Senggani leaf simplisia was 0.43%, which meets the required standard (Departemen Kesehatan Republik Indonesia, 2000).

The determination of water-soluble and ethanol-soluble extract content aims to provide insight into the compounds or contents of Senggani leaf simplisia that can be extracted by water and ethanol solvents. For water-soluble extract content, 5 grams of Senggani leaf simplisia was weighed and then subjected to maceration for 24 hours with 100 mL of chloroform water. The maceration process was done in a stoppered flask, shaking for the first 6 hours and leaving it for 18 hours, followed by filtration. 20 mL of the filtrate was evaporated until dry in a dish. The residue was heated at 105°C until constant weight, and the extract content was calculated as a percentage (Departemen Kesehatan Republik Indonesia, 2000). According to the applicable parameters, the water-soluble extract content should exceed 7%. The result for Senggani leaf simplisia was 58%, indicating that it meets the standard.

For the determination of ethanol-soluble extract content, 5 grams of simplisia was weighed, and 100 mL of 96% ethanol was added. The mixture was macerated for 24 hours in a stoppered flask. 20 mL of the filtrate was then taken and evaporated or heated at 105°C until constant weight (Departemen Kesehatan Republik Indonesia, 2000). Based on the applicable standards, the ethanol-soluble extract content should be greater than 3%. The result for Senggani leaf simplisia was 19%, indicating that it meets the standard for ethanol-soluble extract content.

Results of Ethanol Extract

The Senggani leaves (Melastoma candidum D.Don) used in this study were obtained from the Sibolga region, North Sumatra. The collected leaves underwent wet sorting to separate the samples from any contaminants. A total of 8 kg of fresh leaves were washed and then dried. After the drying process, a dry sorting was performed to remove any remaining impurities from the sample to be used. The sample was then blended into a powder and sieved to obtain a fine powder. A total of 2.5 kg of powdered sample was obtained. The powdered simplisia was weighed at 500 grams and then placed into a maceration vessel. 3750 ml of 96% ethanol was added, and the mixture was sealed and allowed to macerate for 5 days with occasional stirring. Afterward, the mixture was filtered and pressed, and the residue was rinsed with 1250 ml of 96% ethanol and allowed to stand for another 2 days, then filtered again to obtain a liquid extract. The liquid extract was concentrated using a rotary evaporator until a thick extract was obtained. The yield of the concentrated extract from the maceration process was 81.625 grams, with a dark brown color.

Phytochemical Screening Results

Phytochemical screening was conducted to detect active compounds present in the plant qualitatively, enabling the identification of bioactive secondary metabolites such as alkaloids, flavonoids, tannins, saponins, steroids/triterpenoids, and glycosides. The results of the phytochemical screening of the Senggani leaf maceration extract are shown in Table 3 below.

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Table 3. Phytochemical Screening Results of Maceration Extract

No.	Compound Group	Maceration Extract
1	Alkaloids	
	- Mayer	-
	- Dragendorff	+
	- Bouchardat	+
2	Flavonoids	+
3	Saponins	+
4	Tannins	+
5	Steroids	+
6	Glycosides	+

Explanation:

- : Does not contain secondary metabolites

+: Contains secondary metabolites

Based on the table, the phytochemical screening of the Senggani leaf maceration extract shows the presence of secondary metabolites, including alkaloids, flavonoids, saponins, tannins, steroids, and glycosides. The presence of alkaloids was indicated by a white precipitate in the Mayer reagent, but no white precipitate was observed in the Senggani leaf maceration extract, indicating a negative result for alkaloids in this test. However, the Dragendorff reagent produced a red or orange precipitate, suggesting that the Senggani leaves contain alkaloids. The Bouchardat reagent also resulted in a brown precipitate, confirming that the Senggani leaf extract positively contains alkaloids. Alkaloids are considered positive if two out of the three reagents produce precipitates or color changes, meaning that the Senggani leaf maceration extract is positive for alkaloids. For flavonoid testing, a positive result is indicated by the formation of a blackish-red, yellow, or orange color. The flavonoid test on the Senggani maceration extract showed a positive result with yellow and brownish-black colors.

The saponin test showed a positive result, indicated by the formation of stable foam that lasted for 10 minutes and did not disappear after adding HCl. For tannin testing, a positive result is indicated by the formation of a dark green color after the addition of 1% FeCl3. The Senggani maceration extract exhibited this color change, indicating the presence of tannins. The steroid test is considered positive if a blue to green color forms in the sample. The Senggani leaf extract exhibited a green color, confirming the presence of steroids. Glycosides were detected using the reflux method. Both the simplisia powder and the ethanol extract of Senggani leaves tested positive for glycosides. This was indicated by the formation of a purple ring at the boundary between two liquid layers, confirming the presence of glycosides.

Results of Senggani Leaf Extract Nanoparticles

The production of Senggani leaf extract nanoparticles was carried out using the ionic gelation method. This method is based on the electrostatic interaction between the amine groups of chitosan and the negatively charged polyanion groups such as sodium

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tripolyphosphate (Na-TPP). Nanoparticles produced via ionic gelation have several advantages, including an easy reaction process, no need for heating, and the potential to prevent the degradation of active compounds. In this study, nanoparticles were created by reacting a mixture of chitosan, Senggani leaf extract, and sodium tripolyphosphate (Na-TPP). The chitosan solution used was 0.2%, and Na-TPP was 0.1%, with a ratio of 1:10 between the weight of chitosan and TPP. Increasing the chitosan to TPP ratio results in nanoparticles with smaller sizes, providing the best absorption efficiency and a compact nanoparticle structure (Kumowal et al., 2019).

The process of mixing chitosan with Senggani leaf extract and Na-TPP was carried out step by step. A 50 ml solution of Senggani extract, previously dissolved in ethanol and distilled water, was added to 1000 ml of a 0.1% chitosan solution, followed by 100 ml of Na-TPP solution and 350 ml of distilled water. The mixture was stirred using a homogenizer at 12,500 rpm for 2.5 hours. Once all components were thoroughly mixed, sonication was performed for 1 hour. The chitosan and Na-TPP Senggani leaf nanoparticle colloid was separated by centrifugation at 3000 rpm for 15 minutes. The solid nanoparticle extract was then placed in a petri dish and left to dry at room temperature. After drying, it was ground into a fine powder, yielding 5 grams of the final product. Nanoparticles are particles with a size range of 10-1000 nm, and particle size is one of the factors that affect drug effectiveness. In this study, a Particle Size Analyzer (PSA) was used to determine particle size. The PSA test result for Senggani leaf nanoparticle extract showed a size of 283.55 nm which is considered a good result as it falls within the nanoparticle size range of less than 1000 nm. Scanning Electron Microscopy (SEM) is a material characterization technique widely used to observe the surface morphology of particles down to sizes as small as 1 nm (Ismail et al., 2020). Below is the SEM image showing the particle characterization.

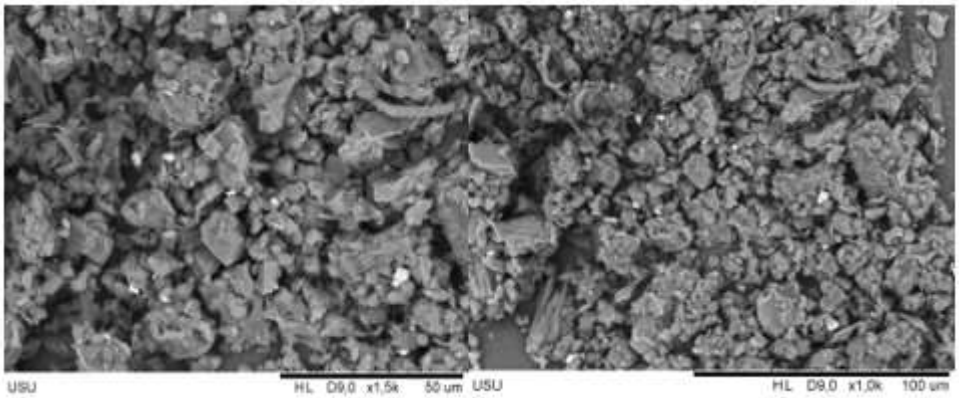

Figure 1. Morphological Image of Particles Using SEM

Antibacterial Activity Test Results

In this study, the extracts used were from two extraction methods: maceration extract and nanoparticle extract from senggani leaves. The results from these two extractions showed different antibacterial activities. The negative control used was DMSO, as it does not have antibacterial effects. DMSO can dissolve both polar and non-polar compounds and is soluble in various organic solvents. The positive control used was clindamycin because this

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antibiotic is broad-spectrum and bacteriostatic, working by inhibiting protein synthesis through the enhancement of 50S ribosomal units. The inhibition zone category can be determined using the David and Stout category. The average inhibition zone results from the antibacterial test on the ethanol extract of senggani leaves can be seen in table 4 below:

Table 4. Antibacterial Activity Test Results

Bacteria	Sample	Concentration (%)	P1 (mm)	P2 (mm)	P3 (mm)	Average ± Standard Deviation	David and Stout Category	Sig
S. Epidermidis	Ethanol Extract of Senggani Leaf	25	12.5	13.7	12.7	12.96 ± 0.64	Strong	0.001
		50	13.9	14.1	14.35	14.11 ± 0.22	Strong	
		75	14.2	15.4	15.7	15.1 ± 0.79	Strong	
		100	16.15	16.6	16.45	16.4 ± 0.23	Strong	
	Nanoparticle Extract of Senggani	2.5	10.2	10.1	10.35	10.21 ± 0.12	Moderate	
		5	11.3	11.5	11.65	11.48 ± 0.17	Strong	
		7.5	13.1	13.05	13.55	13.23 ± 0.27	Strong	
		10	14.0	13.95	13.95	13.96 ± 0.028	Strong	
	Positive Control (clindamycin)	30	27.0	26.8	26.9	26.9 ± 0.1	Very Strong	
	Negative Control (DMSO)	-	-	-	-	-	-	
C. acnes	Ethanol Extract of Senggani Leaf	25	12.5	12.2	11.85	12.18 ± 0.32	Strong	0.001
		50	13.2	13.7	14.1	13.66 ± 0.45	Strong	
		75	15.1	14.35	15.2	14.88 ± 0.46	Strong	
		100	15.95	15.85	16.15	15.98 ± 0.15	Strong	
	Nanoparticle Extract of Senggani	2.5	9.65	9.5	9.6	9.58 ± 0.076	Moderate	
		5	10.65	10.85	10.8	10.76 ± 0.10	Moderate	

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Bacteria	Sample	Concentration (%)	P1 (mm)	P2 (mm)	P3 (mm)	Average ± Standard Deviation	David and Stout Category	Sig
		7.5	11.6	11.4	11.65	11.55 ± 0.13	Strong	
		10	12.6	12.45	12.45	12.5 ± 0.086	Strong	
	Positive Control (clindamycin)	30	26.55	23.2	26.7	25.48 ± 1.97	Very Strong	
	Negative Control (DMSO)	-	-	-	-	-	-	

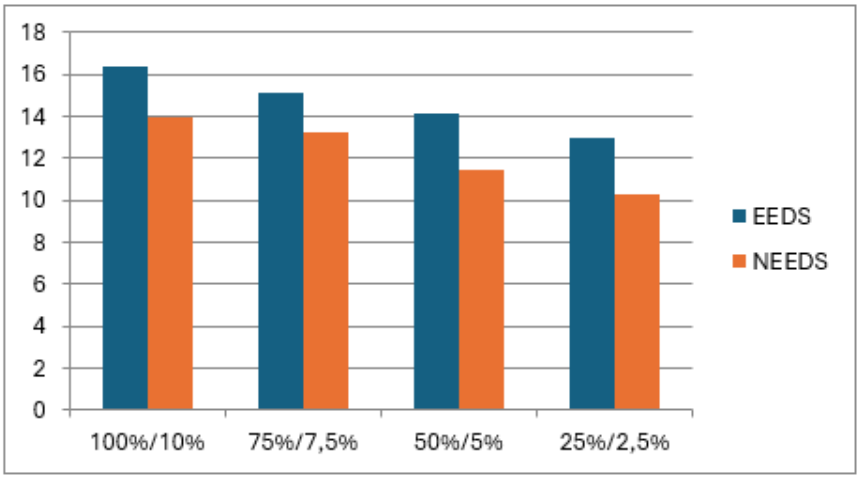

Figure 2. Graph of Antibacterial Test Results on Staphylococcus Epidermidis

Explanation:
EEDS: Ethanol Extract of Senggani Leaf
NEEDS: Nanoparticle Ethanol Extract of Senggani Leaf

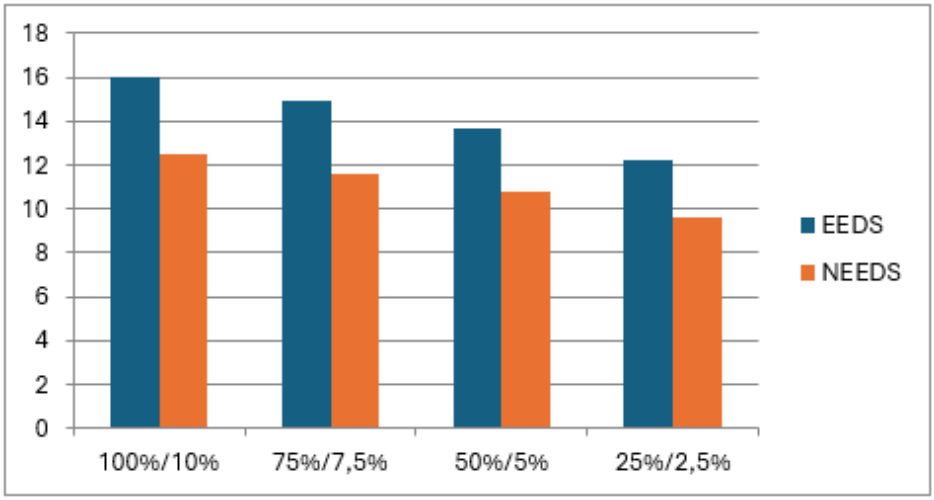

Figure 3. Graph of Antibacterial Test Results on Cutibacterium Acnes

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Based on the test results in the table, both maceration and nanoparticle extracts of senggani leaves show antibacterial activity against the gram-positive bacteria Staphylococcus epidermidis and Cutibacterium acnes. In Table 4, it can be observed that the ethanol extract of senggani leaves at concentrations of 25%, 50%, 75%, and 100%, and the nanoparticle extract at concentrations of 2.5%, 5%, 7.5%, and 10%, each show inhibition zones against Staphylococcus epidermidis: at 25% concentration, 12.96 mm; at 50%, 14.11 mm; at 75%, 15.1 mm; and at 100%, 16.4 mm. The average inhibition zone obtained from the nanoparticle extract of senggani leaves at 2.5% concentration was 10.21 mm, at 5% was 11.48 mm, at 7.5% was 13.23 mm, and at 10% was 13.96 mm. The positive control used, clindamycin, formed an inhibition zone of 26.9 mm, categorized as very strong. The negative control, DMSO, showed no inhibition.

For Cutibacterium acnes, the inhibition zone diameters from the ethanol extract of senggani leaves were 12.18 mm at 25%, 13.66 mm at 50%, 14.88 mm at 75%, and 15 mm at 100%. The average inhibition zone diameter obtained from the nanoparticle extract at 2.5% concentration was 9.58 mm, at 5% was 10.76 mm, at 7.5% was 11.55 mm, and at 10% was 12.5 mm. The positive control, clindamycin, formed an inhibition zone of 26.9 mm, categorized as very strong. The negative control, DMSO, showed no inhibition zone.

Based on the results above, the largest inhibition was observed at the 100% concentration and the lowest at 2.5%, indicating that the inhibition increased as the concentration of the extract increased. This shows that both ethanol extract and nanoparticle extract of senggani leaves have antibacterial activity against Staphylococcus epidermidis and Cutibacterium acnes. The inhibition zones formed are due to the secondary metabolites in the senggani leaf extract, such as saponins, flavonoids, tannins, and steroids, which have antibacterial properties (Halim et al., 2021).

The inhibition effects obtained from both ethanol extract and nanoparticle extract of senggani leaves were similar, despite the different concentrations of 1:10. The larger inhibition zone formed by nanoparticles is due to the smaller particle size, which allows easier diffusion into bacterial cells, leading to greater damage. Another factor influencing the inhibition effect of the nanoparticle extract is the presence of chitosan solution, which has antibacterial properties. There are two possible mechanisms of chitosan as an antibacterial agent: one is that chitosan adheres to the bacterial cell surface, forming a polymer membrane that prevents nutrients from entering the cell, leading to cell death; the second is that low molecular weight chitosan can enter the cell and interact with electronegative substances within the cell, disrupting bacterial activity (Kumowal et al., 2019).

Based on the results of the normality test, the data obtained for the bacteria *Staphylococcus epidermidis* and *Cutibacterium acnes* showed probability (p) values for each concentration that were greater than 0.05, indicating that the data followed a normal distribution. Therefore, the data can proceed to the homogeneity test. The homogeneity test aims to determine whether the data in each treatment group are homogeneous. If the p-value is > 0.05, the data are considered homogeneous, and if $p < 0.05$, the data are considered non-homogeneous, preventing the use of the One Way ANOVA test. The results from the test

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showed that the p-values for the inhibition zones from both nanoparticle extracts and leaf extracts of *Senggani* against both bacteria were above 0.05, allowing for the continuation to the One Way ANOVA test.

The One Way ANOVA test results for the inhibition zones from both nanoparticle extracts and leaf extracts of *Senggani* against both bacteria revealed a p-value < 0.01, indicating a significant difference. To examine the differences between each concentration, a Post Hoc test was performed. The results of the Post Hoc test on *Staphylococcus epidermidis* revealed significant differences between several concentrations. However, for the 25% concentration of *Senggani* leaf extract, the p-value = 0.446 compared to the 7.5% concentration of nanoparticle *Senggani* extract, showing no significant difference in the inhibition zones formed by these two concentrations. Additionally, the 50% concentration of *Senggani* leaf extract had a p-value = 0.321 compared to the 10% concentration of nanoparticle *Senggani* extract, indicating no significant difference in the inhibition zones formed by these two concentrations. For *Cutibacterium acnes*, significant differences were observed for each concentration. However, only at the 25% concentration of *Senggani* leaf extract was the p-value = 0.172 compared to the 10% nanoparticle *Senggani* extract, indicating no significant difference in the inhibition zones formed by these two concentrations.

This study explores the antibacterial potential of the ethanol extract of *Senggani* leaves (Melastoma candidum D.Don), sourced from Sibolga, North Sumatra. The extraction process was carried out using the maceration method with 96% ethanol, resulting in a viscous extract with a dark brownish color. The findings indicate that *Senggani* leaves contain active compounds with antibacterial potential, which will be further investigated through phytochemical screening. The phytochemical screening revealed the presence of several bioactive compounds, including flavonoids, saponins, tannins, steroids, and glycosides. The presence of flavonoids was indicated by a yellow and brownish-black color, while saponins showed a positive result with the formation of stable foam. A positive result for tannins was shown by a greenish-black color after the addition of FeCl3, and the presence of steroid compounds was indicated by a color change to green. These results support the claim that *Senggani* leaves are rich in secondary metabolites, which are known to have biological activities, including antibacterial activity.

The preparation of *Senggani* leaf extract nanoparticles using the ionic gelation method provides an advantage in maintaining the stability of active compounds. The size of the nanoparticles obtained (283.55 nm) indicates that they are within the expected size range, between 10-1000 nm, which is the ideal size for enhancing bioavailability and therapeutic efficiency. Characterization using Scanning Electron Microscopy (SEM) also showed appropriate morphology, supporting the potential application of this extract in the pharmaceutical field. In antibacterial activity testing, both the maceration extract and nanoparticles showed significant differences in inhibition against *Staphylococcus epidermidis* and *Cutibacterium acnes*. One Way ANOVA tests revealed significant differences at various concentrations of the extract and nanoparticles. However, certain concentrations, such as the

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25% *Senggani* leaf extract and 10% nanoparticle concentrations, did not show significant differences, suggesting that certain concentrations may have equivalent effectiveness.

The results of this analysis indicate that *Senggani* leaf extract has the potential to be an effective antibacterial source, both in macerated extract form and as nanoparticles. This study also opens up opportunities for further development in utilizing *Senggani* leaves as a natural material in medicine, especially for combating infections caused by the tested bacteria. Therefore, this research provides new insights into the potential of *Senggani* leaf extract and highlights the need for further studies to understand its mechanisms of action and applications in healthcare.

CONCLUSION

Based on the results of the research and discussion above, it can be concluded that: The ethanol extract of senggani leaves (Melastoma candidum D.Don) can be formulated into nanoparticles with a particle size of 283.55 nm. The nanoparticle extract of senggani leaves exhibits antibacterial activity against *Staphylococcus epidermidis* and *Cutibacterium acnes*. The inhibition zone increases with higher concentrations, indicating that the nanoparticle ethanol extract of senggani leaves has antibacterial effects. There is a difference in antibacterial activity between the ethanol extract of senggani leaves and the nanoparticle extract of senggani leaves against *Staphylococcus epidermidis* and *Cutibacterium acnes*. The inhibition zone formed by the nanoparticle extract of senggani leaves at a 10% concentration is greater than the inhibition zone formed by the ethanol extract of senggani leaves at a 25% concentration and is almost the same as the inhibition zone formed at a 50% concentration, suggesting that the nanoparticle extract of senggani leaves has stronger antibacterial activity than the ethanol extract of senggani leaves.

ACKNOWLEDGEMENT

On this valuable occasion, the author would like to express deep gratitude to my father, M. Jamil, and my late mother, Rasnawati, as well as my younger sibling, Daffa Andika. Their support and affection have been the main driving force for the author in completing this thesis. The author is also deeply grateful to Mr. Apt. Muhammad Amin Nasution, S.Farm., M.Farm, as the supervisor, who has provided guidance, feedback, suggestions, and motivation with great patience. The author also extends thanks to the examiners who have given valuable suggestions for the improvement of this research. Further, the author would like to express gratitude to Dr. H. Firmansyah, M.Si, the Rector of Universitas Muslim Nusantara Al Washliyah Medan, and to the Deans, Vice Deans, and Heads of Study Programs in the Faculty of Pharmacy, who have provided support and guidance throughout the author's education. The author also appreciates the dedication of the Faculty of Pharmacy teaching staff, who have educated and mentored the author to reach this point. The author acknowledges that this thesis is far from perfect and humbly welcomes constructive criticism and suggestions. Finally, the author would like to express gratitude to all parties who have contributed,

although they cannot be mentioned one by one. May the results of this work be beneficial for the development of knowledge.

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