Comparison of Antibacterial Effectiveness Tests Between Aloe Vera Gel (Aloe Vera L.) And Pure Kaliandra Honey (Calliandra Calothyrsus) On The Growth of Staphylococcus Aureus

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Abstract.
Background: Aloe vera (Aloe vera L) and honey (Calliandra calothyrsus) have many benefits, especially in Indonesia, aloe vera and honey are also often used as drugs for various diseases because of their content which has many health benefits. Objective: This study aims to determine the comparison between aloe vera (Aloe vera L) and honey (Calliandra calothyrsus) as an inhibitor of the growth of Staphylococcus aureus bacteria.Method: This study uses true experimental design in microbiological test with post test only control group design. With the treatment of aloe vera gel (Aloe vera L) and kaliandra honey (Calliandra calothyrsus) and ciprofloxacin antibiotics as a positive control and aquades as a negative control against Staphylococcus aureus bacteria to see antibacterial effectiveness using diffusion methods in thelaboratory.Results: The most effective variable was kaliandra honey (Calliandra calothyrsus) with concentrations of 50%, 75% and 100% with p values of 0.03, 0.01, and 0.03 respectively when compared to using aloe vera gel (Aloe vera L) with concentrations of 25%, 50%, 75% and 100% which obtained the results could not at all inhibit the growth of Staphylococcus aureus bacteria. Conclusions and Suggestions: This research can be used as a theoretical basis, so that people can choose a more appropriate ingredient, namely kaliandra honey (Calliandra calothyrsus) rather than using aloe vera gel (Aloe vera L) to be used as herbal medicine by people who experience Staphylococcus aureus bacterial infections. Other researchers are also advised to be able to use other variables or other types of aloe vera (Aloe vera L) and honey from the nectar of other flowers to conduct similar studies.

Keywords: *Aloe Vera (Aloe vera L); Calliandra Honey (Calliandra calothyrsus) and Staphylococcus aureus.*

I. INTRODUCTION

Indonesia is categorized as a tropical country because it has 2 different seasons, this makes Indonesia able to grow various types of plants. Plants that grow can be used for several purposes, one of which is to treat diseases (Darnita & Toyib, 2020). Among the various plants, one variety or type of plant that is often used for medicinal purposes since centuries ago is aloe vera (Aloe vera) as a group of Lliliaceae plants.(Suryati et al., 2018).This plant can be used or utilized as a medicine because it contains antibacterial components and bioactive content. The content of these compounds is antroquinone, campesterol, sisterol, and lupeol(Rahardjo et al., 2017).The content of these active compounds makes aloe vera (Aloe vera L) able to inhibit the growth of bacteria, for example Escherichia coli and Staphylococcus aureus (Utami & Denanti, 2018). Other ingredients that are easily found in Indonesia and can also be used as medicine, one of which is honey. Honey is a sweet flavor produced by nature as a food ingredient for living things, especially humans. Honey also has several types of compound components, such as phenolic acids, flavonoids, quercetin, and antioxidants(Hidayatullah et al., 2022). Honey is also said to have antibacterial properties against Staphylococcus aureus bacteria.(Ma'ruf et al., 2018; Puji et al., 2022).

Microorganisms that can cause infectious diseases in humans include Staphylococcus aureus. Staphylococcus aureus is categorized as a coccus-shaped bacteria with gram-positive properties. Staphylococcus aureus is often a pathogen that causes infectious diseases that occur in an individual, for example, infections that occur on the skin (Surah Maida & Lestar, 2019). One of the skin diseases caused by Staphylococcus aureus bacteria is pyoderma. Pyoderma can be caused by Streptococcus β-hemolyticus and Staphylococcus aureus or both. (Volume JN, 2018). According to the World Health Organization (WHO), in 2018 skin diseases affected almost 900 million people in the world. The prevalence of pyoderma in Indonesia in adults is 1.4% and 0.2% in children, especially those under 10 years of age.Based on the description of the research problem that has been explained above, the researcher feels motivated to

participate in conducting similar research, namely in finding the most effective natural ingredients to be used as antibacterial ingredients for Staphylococcus aureus. The researcher chose aloe vera gel (Aloe vera L) and calliandra honey (Calliandra calothyrsus). The researcher is also interested in comparing the antibacterial effectiveness of aloe vera gel (Aloe vera L) and honey, especially calliandra honey (Calliandra calothyrsus) to inhibit or reduce the growth of Staphylococcus aureus bacteria and to reduce the level of antibiotic resistance in the community.

II. METHODS

The design or method of this study used true experimental in microbiological tests with a post test only control group design. With the treatment of giving aloe vera gel (Aloe vera L) and calliandra honey (Calliandra calothyrsus) and using positive control with ciprofloxacin antibiotics and using negative control with distilled water against Staphylococcus aureus bacteria to see the effectiveness of antibacterial using the diffusion method in the laboratory. The population and sample size in this study were Staphylococcus aureus bacteria from the Microbiology Laboratory of the Pamitran Building, Padjajaran University. The independent variables applied in this study were calliandra honey (Calliandra calothyrsus) and aloe vera gel (Aloe vera L) using 25%, 50%, 75%, and 100% concentrations, as well as through positive control using antibiotics, namely ciprofloxacin and negative control with distilled water. The dependent variable Staphylococcus aureus bacteria became the dependent variable in this study.

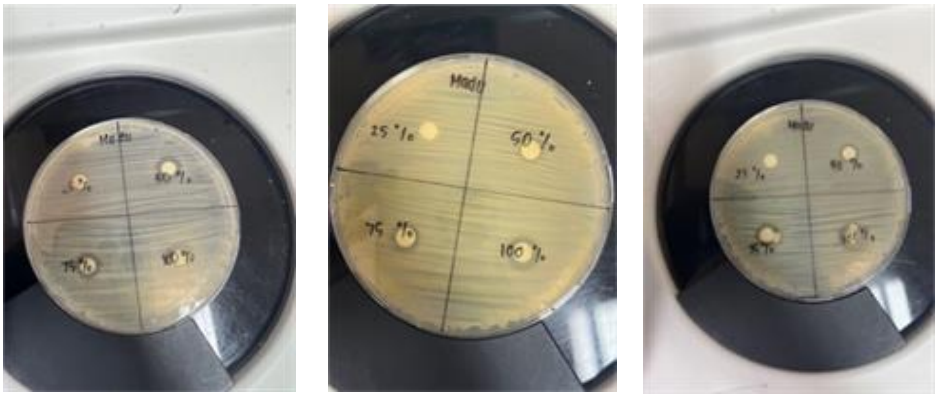
The sampling technique was carried out purposively, so using the purposive sampling technique or given deliberate treatment which was carried out by taking bacterial isolates that were inserted into the agar media. The selection of aloe vera (Aloe vera L) was taken in North Bekasi, West Java. Honey was taken from pure calliandra honey (Calliandra calothyrsus) obtained in Tahura or Taman Hutan Raya, Bandung which comes from calliandra flower nectar with apis cerana bees, because the apis cerana bee type is the most commonly found bee in Asia (Suhandy et al., 2020). The two samples were then taken to be processed at the Microbiology Laboratory of the Pamitran Building, Padjajaran University. The research location was conducted at the Microbiology Laboratory of the Pamitran Building, Padjajaran University. Meanwhile, the research time was carried out during the testing process and the preparation of Scientific Papers from February to November 2023.

III. RESULTS AND DISCUSSION

Description of the Inhibition Zone Results of Calliandra Honey (Calliandra calothyrsus) on the Growth of Staphylococcus aureus

Table 1. Description of the Inhibition Zone Results of Calliandra Honey (Calliandra calothyrsus) on the Growth of Staphylococcus aureus

Honey	*Mean*	*Std. Deviation*	*Min (mm)*	*Max (mm)*
Concentration 25%	0	0	0	0
Concentration 50%	8.13	0.77	7.68	9.02
Concentration 75%	8.84	0.47	8.29	9.14
100% Concentration	10.84	0.96	10.02	11.90



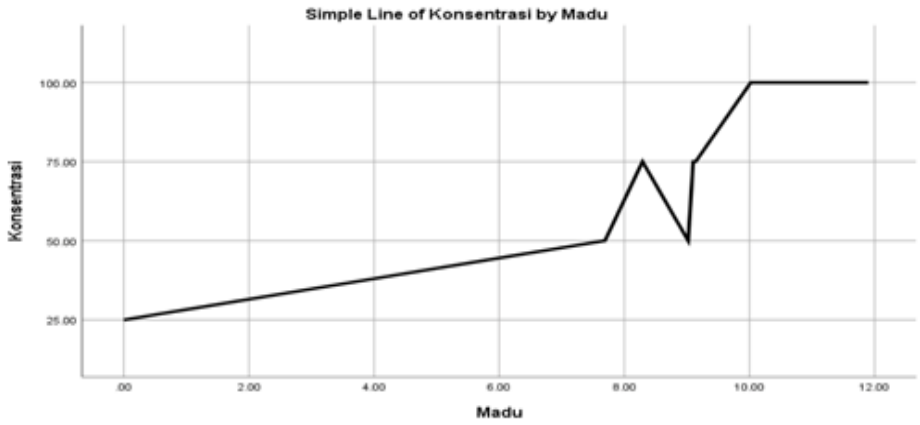


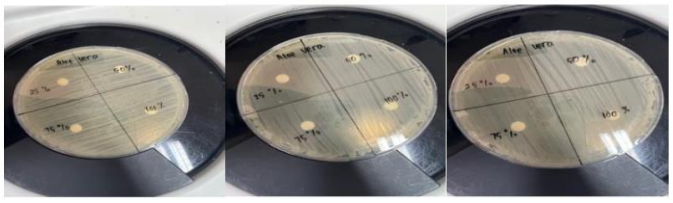
Fig 1. Chart of Calliandra Honey Concentration (Calliandra calothyrsus)

Based on the table above, it shows the results of the univariate analysis data test on the results of the honey inhibition zone.calliandra (Calliandra calothyrsus)in inhibiting the growth of Staphylococcus aureus bacteria. Honeycalliandra (Calliandra calothyrsus)The most effective results were obtained with a concentration of 100%, the average large results of the inhibition zone diameter test were 10.84 mm with the smallest inhibition zone being 10.02 mm, which is included in the category of moderate inhibition zone according to Davis and Stout (1971) and the largest inhibition zone being 11.90 mm, which is included in the category of strong inhibition zone according to Davis and Stout (1971), the second position was occupied by honeycalliandra (Calliandra calothyrsus)75% concentration with an average result of the inhibition zone diameter of 8.44 mm, with the smallest inhibition zone diameter of 8.29 mm and the largest inhibition zone of 9.14 mm, which is included in the medium inhibition zone category, followed by honeycalliandra (Calliandra calothyrsus)50% concentration is in third place with an average result of the inhibition zone diameter of 8.13 mm, with the smallest inhibition zone diameter of 7.68 mm and the largest inhibition zone of 9.02 mm, which is included in the moderate inhibition zone category and a concentration of 25% which does not inhibit the growth of Staphylococcus aureus at all (Davis & Stout, 1971).

1. Description of the Results of the Aloe Vera Gel Inhibition Zone (Aloe Vera L) on the Growth of Staphylococcus aureus

Table 2. Description of the Results of the Aloe Vera Gel Inhibition Zone (Aloe Vera L) on the Growth of Staphylococcus aureus

Gel Lidah Buaya	*Mean*	*Std. Deviation*	*Min (mm)*	*Max (mm)*
Konsetrasi 25%	0	0	0	0
Konsetrasi 50%	0	0	0	0
Konsetrasi 75%	0	0	0	0
Konsetrasi 100%	0	0	0	0



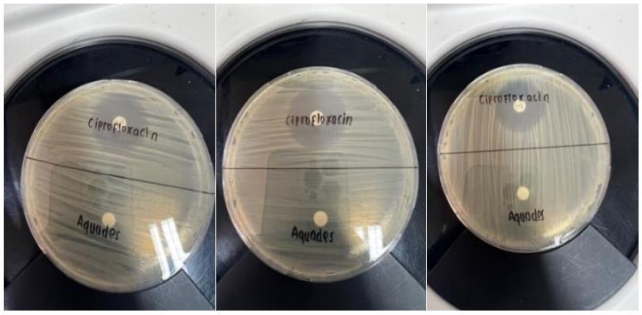
Based on the results of the univariate analysis data test on the description of the inhibition zone results of aloe vera gel (Aloe vera L) inhibited the growth of Staphylococcus aureus, all concentrations of aloe vera gel (Aloe vera L) used as a test in this study did not inhibit the growth of Staphylococcus aureus, namely included in the category of weak inhibition zone according to Davis and Stout (1971) and when compared with the results of the diameter of the Staphylococcus aureus growth inhibition zone with calliandra honey (Calliandra calothyrsus) it can be seen that calliandra honey (Calliandra calothyrsus) is

more effective and efficient in reducing the growth of Staphylococcus aureus.

2. Overview of the Control Group Inhibition Zone Results of Ciprofloxacin on the Growth of Staphylococcus aureus

Table 3. Description of the Control Group Inhibition Zone Results of Ciprofloxacin on the Growth of Staphylococcus aureus

	Mean	*Std. Deviation*	*Min (mm)*	*Max (mm)*
Ciprofloxacin	25.27	1.08	24.17	26.33



Based on the table above shows the results of the univariate analysis data test of the positive control of the antibiotic ciprofloxacin in reducing the inhibition zone of Staphylococcus aureus growth. The average obtained from the results of the ciprofloxacin inhibition zone was 25.27 mm with the largest inhibition zone of 26.33 mm and the smallest inhibition zone of 24.17 mm, which is included in the category of a very strong inhibition zone according to Davis and Stout (1971). Comparing the results of the ciprofloxacin inhibition zone with calliandra honey (Calliandra calothyrsus) and aloe vera gel (Aloe vera L), this is proven based on the results of the inhibition zone obtained from calliandra honey (Calliandra calothyrsus) which is closer to the results of the ciprofloxacin inhibition zone, so calliandra honey (Calliandra calothyrsus) can be said to be more effective in inhibiting Staphylococcus bacteria when compared to using aloe vera gel (Aloe vera L).

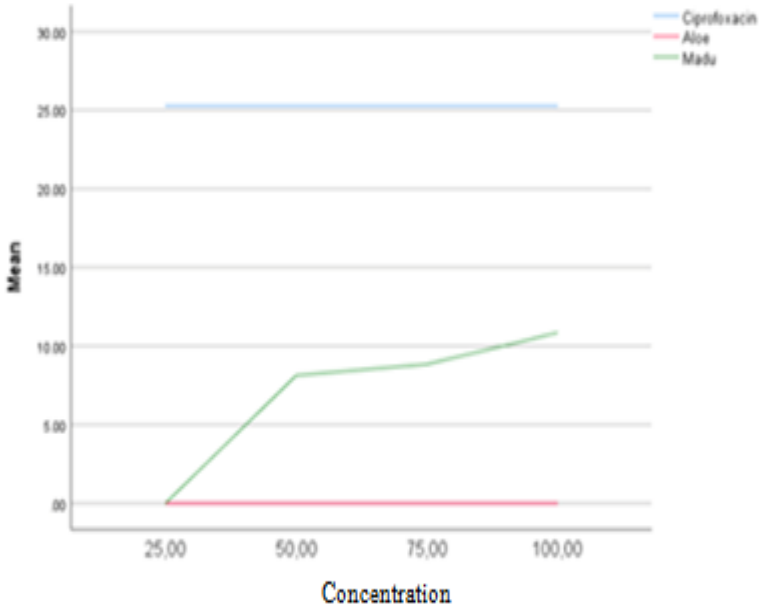


Fig 2. Comparative Graph of Inhibition Zones

Comparison of Antibacterial Effectiveness Test between Aloe Vera Gel (Aloe vera L) and Mayou Kaliandra (Calliandra calothyrsus) against the Growth of Staphylococcus aureus

Table 4. Comparison of Antibacterial Effectiveness Test between Aloe Vera Gel (Aloe vera L) and Kaliandra Honey (Calliandra calothyrsus) against the Growth of Staphylococcus aureus.

Variabel bebas	Konsentrasi	Rata-Rata Zona Hambat (mm)	*P-Value*
Madu Kaliandra (*Calliandra calothyrsus)*	25%	0	1.000
	50%	8,13	.003
	75%	8,84	.001
	100%	10,84	.003
Gel aloe vera (*Aloe vera* L)	25%	0	1.000
	50%	0	1.000
	75%	0	1.000
	100%	0	1.000
Kontrol positif (antibiotik ciprofloxacin)	100%	25.27	.001
Kontrol negatif (aquades)	100%	0	1.000

The table above shows the results of bivariate data analysis using the Unpaired T Test or One Sample T Test, there is a significant difference between each sample at different concentrations (P value <0.05). So from the results of the research that has been done, it can be concluded that calliandra honey (Calliandra calothyrsus) with a concentration of 50%, 75% and 100% has an antibacterial effect on Staphylococcus aureus and aloe vera gel (Aloe vera L) concentration of 25%, 50%, 75% and 100% does not have an antibacterial effect on Staphylococcus aureus due to the value (P> 0.05).

A. Discussion

The results of the univariate and bivariate data analysis from this experiment can be It is concluded that the antibacterial effectiveness of calliandra honey (Calliandra calothyrsus) is greater than aloe vera gel (Aloe vera L) when viewed from the P value <0.05 obtained by calliandra honey (Calliandra calothyrsus) with concentrations of 50%, 75% and 100%. This statement was obtained from the average diameter of the inhibition zone between the two ingredients in each test group of treatment against Staphylococcus aureus bacteria.

1. Antibacterial Effectiveness of Calliandra Honey (Calliandra calothyrsus) Against Staphylococcus Aureus

The findings obtained from the research that has been carried out explain that kaliandra honey (*Calliandra calothyrsus)*able to stop the growth of Staphylococcus aureus bacteria, this is evidenced by the formation of an inhibition zone in the area around the disc. The largest inhibition zone diameter is produced by a concentration of 100%. This statement is in line with the research of Nazimuddin and Maulida (2020) which states that honey has antibacterial content that can inhibit the growth of bacteria as evidenced by the average size of the inhibition zone test on Staphylococcus aureus bacteria at concentration variations of 25%, 50%, 75%, and 100% and using natural honey of 27, 29.4, 32.1, and 36.2 mm. (Putri N, 2020). This can occur due to the acidity levels, phytochemicals, and osmotic pressure contained in kaliandra honey (*Calliandra calothyrsus)*.The high acidity level in honey can stop bacterial activity in terms of growth, causing the bacteria to be unable to survive. The flavonoid composition in calliandra honey (Calliandra calothyrsus) can also interfere with metabolism, inhibiting enzyme activity in Staphylococcus aureus bacteria and damaging cell wall permeability.

The collection of phenols and flavonoid compounds can inactive bacteria, so bacterial growth can be inhibited. Osmotic pressure caused by the high sugar content in calliandra honey (Calliandra calothyrsus) can also cause severe dehydration so that Staphylococcus aureus bacteria are easily lysed. (Izzulhaq JA, 2023). Flavonoids inhibit bacterial growth by being lipophilic to damage microbial membranes and inhibiting bacterial DNA transcription and replication. Phenol can damage the peptidoglycan of bacterial cell walls and damage the hydrophobic bonds in the cell walls, so that the contents of the cells can come out. Inflammation

can also cause the release of ROS (reactive oxygen) to signal inflammatory mediators and provide local oxidative stress and tissue injury, this can also be inhibited by the beta ring content and -OH groups of flavonoids. (Mulyani Y, 2021)

2. Antibacterial Effectiveness of Aloe Vera Gel (Aloe vera L.) against Staphylococcus Aureus

Based on the results of the aloe vera gel effectiveness test (*Aloe Vera*L) as an antibacterial in stopping the growth rate of Staphylococcus aureus bacteria, the results obtained with the lowest to highest concentration variations did not produce an inhibition zone at all. Information obtained from the study shows that aloe vera gel (Aloe vera L) cannot inhibit the growth of Staphylococcus aureus bacteria, this is not in accordance with the findings of previous research by Dewi and Marniza (2019), in the study aloe vera gel (Aloe vera L) was able to reduce the growth of gram-positive bacteria, especially Staphylococcus aureus with a concentration of 30% and produced an inhibition zone diameter of 4.75 mm. (Dewi R, 2019). The absence of inhibition zones formed in aloe vera gel (Aloe vera L) occurs due to the selection of types, growing places, washing, cutting methods, storage methods, and storage times of aloe vera gel (Aloe vera L), as well as research methods and types of bacteria grown during the study. The type of aloe vera gel (Aloe vera L) used can affect biological variations and the amount of antibacterial content in aloe vera gel (Aloe vera L).

A good place to grow is at a cold air temperature, while researchers took aloe vera gel (Aloe vera L) grown in Bekasi, West Java with a fairly hot temperature and can also be influenced by the use of fertilizers, lighting, watering, and other factors that can have an effect. (Dewi R, 2019). The reason researchers used aloe vera gel (Aloe vera L) taken from Bekasi, namely because of cost limitations and also easy to obtain from the area where researchers live. The process of washing aloe vera gel (Aloe vera L) also affects the results of the inhibition zone diameter which can cause a lack of available antibacterial content due to the use of water to remove dirt and other foreign materials. (Suryati N, 2018).The cutting process that is too small can also change the composition of the active compound content in aloe vera gel (Aloe vera L) so it is feared that the evaporation process can occur. So if the amount of antibacterial substances in an aloe vera gel (Aloe vera L) is low, the main active compound will also be low so that it cannot damage the cell membrane and interfere with the physiology of bacterial cells, especially Staphylococcus aureus bacteria. This statement strengthens the theory that causes the absence of an inhibition zone by all studies conducted with aloe vera gel on Staphylococcus aureus bacteria. (Suryati N, 2018).

IV. CONCLUSION

From the research data that has been conducted to compare the level of antibacterial effectiveness using calliandra honey (Calliandra calothyrsus) and aloe vera gel (Aloe vera L) on the growth of Staphylococcus aureus, it is concluded as follows: The average inhibition zone of calliandra honey (Calliandra calothyrsus) at a concentration of 25% is 0 mm, a concentration of 50% is 8.13, a concentration of 75% is 8.84 mm and a concentration of 100% is 10.84 mm. The average inhibition zone of aloe vera gel (Aloe vera L) with a concentration of 25%, 50%, 75% and 100% is 0 mm. The most effective variable is calliandra honey (Calliandra calothyrsus) with a concentration of 50%, 75% and 100% with a p value of 0.03, 0.01, and 0.03 respectively.

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