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Antibacterial Activity Of Jatropha Curcas Sap Against Staphylococcus Aureus

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ABSTRACT

Jatropha curcas is a plant that has long been known by the community as a border or hedge plant, a source of medicine, and a producer of oil for lamps. The sap plant contains various chemical compounds, including flavonoids, tannins, saponins, and jatrophine, which also show antibacterial and antifungal activity. One of the common bacteria in the human body is Staphylococcus aureus, which is associated with pyogenic infections, especially those that attack the skin. Staphylococcus aureus is one of the most common infectious agents, which enters the skin through hair follicles, sweat glands, or small wounds. The purpose of this study was to investigate the effect of Jatropha curcas L. on the growth of Staphylococcus aureus bacteria. This study was designed as a true experimental study, which aims to determine the symptoms or effects resulting from certain treatments. Preparation of Jatropha curcas L. sap with a concentration of 25% v/v. Required 025 ml of Jatropha curcas L. sap with a concentration of 100% v/v and 0.75 ml of sterile distilled water. Preparation of Jatropha curcas L. sap with a concentration of 50% v/v. Required 0.5 ml of Jatropha curcas L. sap with a concentration of 100% w/v and 0.5 ml of sterile distilled water. Preparation of Jatropha curcas L. sap with a concentration of 75% v/v. Required 0.75 ml of Jatropha curcas L. sap with a concentration of 100% w/v and 0.25 ml of sterile distilled water. The results showed that the 25% concentration of J. curcas sap had an inhibition zone of 21.75 mm, the 50% concentration had an inhibition zone of 22.63 mm, the 75% concentration had an inhibition zone diameter of 24.13 mm, and the 100% concentration had an inhibition zone diameter of 24.75 mm. The conclusion showed that the higher the concentration of Jatropha curcas sap, the larger the diameter of the inhibition zone, this indicates a significant effect on the growth of Staphylococcus aureus bacteria.

Keywords: *Antibacterial, Jatropha curcas Sap, Staphylococcus aureus*

1. INTRODUCTION

The increasing cases of antibiotic resistance pose a significant threat to global public health. The growing prevalence of bacteria that have developed resistance to several types of antibiotics makes the common infections more complex to treat. Among the resistant bacteria, Methicillin-resistant *Staphylococcus aureus* (MRSA) is of significant concern since it contributed to the morbidity and mortality in hospital and community. There is an urgent need to explore new antimicrobial agents from plants for treatments of the diseases caused by resistant bacteria.

Plants have been used as medicinal resources in traditional practice to treat diseases. Secondary metabolites contain in the plants exhibit potential antimicrobial agents that can inhibit or kill microorganisms (Rampadarath et al., 2016). Jatropha curcas, a plant that has been used as traditional medicine in various cultures. Different parts of the plant, including the leaves, seeds, roots, bark, and sap have been employed in traditional remedies to address a wide range of ailments. The sap has been used to treat skin infections, wounds, and even as a disinfectant. This traditional application hints that the sap could contain an antibacterial substance, particularly against skin infections against *Staphylococcus aureus*.

J. curcas is a species of Euphorbiaceae family that originated from Mexico and have distribution worldwide (Rachana et al., 2012). Every part of the plant employed to treat a wide array of ailments (Abdelgadir & Van Staden, 2013). The leaves have been traditionally utilized to treat various conditions including coughs, fevers, jaundice, rheumatic pains, and malaria (Patil et al., 2013). The seeds and leaves extract have ability to molluscidal and insecticidal (Afzal et al., 2012; E. Omoregie & Folashade, 2013). The seed oil widespread use in treating various skin ailments such as eczema, herpes, itches, boils, and parasitic skin infections, as well as in soothing pain associated with rheumatism and promoting hair growth (Patil et al., 2013). The root extract also helps to check bleeding from gums (Thomas et al., 2008). The bark juice is applied externally to treat burns, scabies, eczema, and ringworm (Patil et al., 2013). The latex or sap, a milky secretion from the plant, has been directly applied to wounds, ulcers, skin infections, and mouth infections, and it is also used as a styptic to help stop bleeding (Patil et al., 2013; Prasad, 2012).

The methanolic leaves extract of *Jatropha curcas* shows antibacterial activity against 13 bacterial species including E. coli, Pseudomonas aeruginosa and Staphylococcus aureus (Akinpelu et al., 2009). The consistent use of the sap or latex for skin infections and wound healing suggests the presence of pharmacologically active compounds with potential antibacterial effects. Given that skin infections are frequently caused by bacteria such as *Staphylococcus aureus*, this historical application hints at a traditional recognition of the plant's ability to combat such pathogens. This study aims to analyze the antibacterial potential of *J. curcas* sap against S. aureus.

2. METHOD

This study employs an experimental research design aimed at identifying symptoms or effects resulting from specific treatments (Notoadmodjo, 2002).

The research was conducted at Research and Consultancy Center – Sebha University, where pure cultures of Staphylococcus aureus were sourced.

The sap from *Jatropha curcas* was collected from plants located in West Lombok, Nusa Tenggara Barat. The sap was extracted by tilting and breaking the base of the leaves that connect to the stem, allowing the sap to drain into a sample bottle. Care was taken during this process to avoid any contamination. The Jatropha sap was prepared under sterile conditions and divided into four distinct concentrations: 25%, 50%, 75%, and 100%. The concentrations were achieved using the following dilution formula:

$V1 \times C1 = V2 \times C2$

With

V1: volume of 100% v/v jatropha sap to be diluted

V2: volume of jatropha sap to prepare

C1: concentration of 100% v/v jatropha sap to be diluted

C2: concentration of jatropha sap to prepare

The culture media

Muller Hinton Agar (MHA) was utilized as the culture media. To prepare the media, 3.4 grams of MHA Oxoid were diluted in 100 mL of distilled water and then heated on a hot plate. The mixture was sterilized using an autoclave at 121°C for 15 minutes. After sterilization, the media was allowed to cool to 50°C before being poured into sterile plates with a thickness of 4 mm. The plates were then incubated overnight to ensure complete sterilization.

Antibacterial Test

The suspension of *Staphylococcus aureus* culture was adjusted to 0,5 McFarland standard. The entire surface of the Mueller-Hinton agar (MHA) medium was inoculated with the *Staphylococcus aureus* suspension. A sterile cotton swab was dipped into the bacterial suspension and gently rolled over the surface of the MHA medium, followed by a 5-15 minute incubation period. Utilizing a sterile blue tip, wells were then created in the medium. A total of 50 µl of *Jatropha curcas* sap, prepared at various concentrations, was added to each well. The plate was incubated for 24 hours at 37 °C. Antibacterial activity was assessed by measuring the zones of inhibition formed post-incubation. Ciprofloxacin served as the positive control, while aquadest was used as the negative control in this study.

To evaluate the antibacterial activity of *Jatropha curcas* sap against Staphylococcus aureus, a one-way ANOVA statistical test was conducted at a 95% confidence level, followed by the Tukey HSD test.

3. RESULTS AND DISCUSSION

Based on the sensitivity test of *Jatropha curcas* sap against the growth of Stahylococcus aureus with the well diffusion method the following results were obtained:

Table 1. Diameter of the inhibition zone of *Jatropha curcas* against the growth of Staphylococcus aureus bacteria

***J. curcas* sap concentration**	**Replication**				**Total Diameter**	**Average Diameter**
	1	2	3	4		
25%	22	24	21	20	87	21,75
50%	22	25	22,5	21	90,5	22,63
75%	24	25	24	23,5	96,5	24,13
100%	25	25	25	24	99	24,75
Control (+)	32	35	32	33	132	33
Control (-)	0	0	0	0	0	0

Table 1 shows that the concentration of the jatropha sap solution with a concentration of 25% exhibits an inhibition zone of 21.75 mm. When the concentration increases to 50%, the inhibition zone rises to 22.63 mm. A 75% concentration yields an inhibition zone of 24.13 mm, and the highest inhibition zone of 24.75 mm is observed at a 100% concentration.

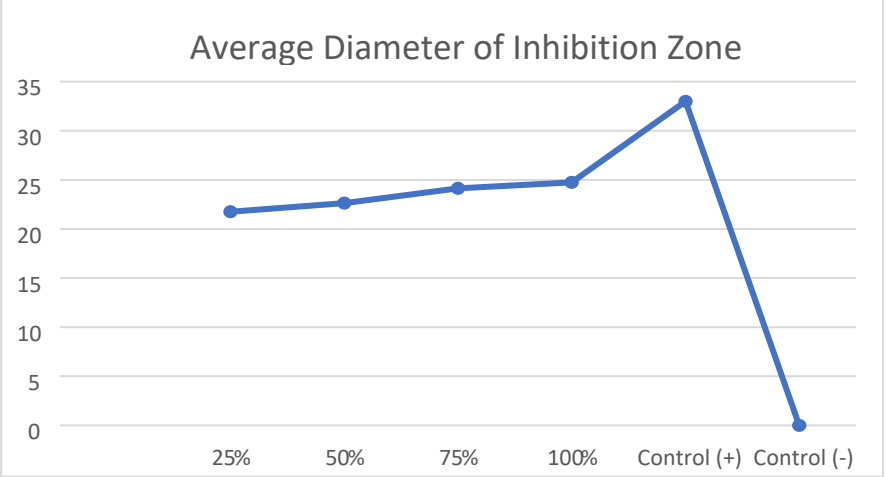

Figure 1. The effect of concentrated solutions of *Jatropha curcas* L. sap on the growth of *Staphylococcus aureus* bacteria.

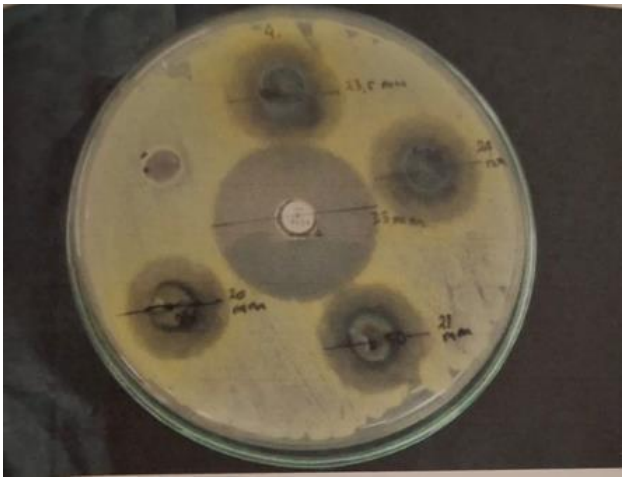

Figure 2. The inhibition zone formed on the MHA media

The graph illustrating the effect of varying concentrations of *jatropha curcas* sap solution on the growth of Staphylococcus aureus reveals that higher concentrations of the sap result in larger diameters of the inhibition zones. The results from the ANOVA test indicated a statistically significant antibacterial activity ($\alpha < 0.05$) of *jatropha curcas* sap against Staphylococcus aureus. However, the sap demonstrated a lower level of effectiveness when compared to the commercial antibiotic Ciprofloxacin, which served as the positive control.

From the results of measuring the diameter of the inhibition zone with various concentrations of castor oil solution in inhibiting the growth of Staphylococcus aureus bacteria and the results of the One Way Anova statistical test which obtained a significance value of 0.00 <a 0.05 and in further tests with the Tukey HSD test to determine whether there was a difference between treatments showed that the higher the concentration of the castor oil solution, the greater the diameter of the inhibition zone formed, meaning that there is a significant effect of the *Jatropha curcas* sap solution concentration on the growth of Staphylococcus aureus bacteria.

This findings is consistent with the previous study by (Arekemase et al., 2011; Abubakar et al., 2016; Adeiza et al., 2024) that found the antibacterial activity of *J. curcas* sap against several microorganism. The sap of *Jatropha curcas* contains several secondary metabolites including alkaloids, terpenoids, saponins, tannins, glycoside, and steroid (E. H. Omoregie & Folashade, 2013; Abubakar et al., 2016; Adeiza et al., 2024). The phytochemical contains in the sap of *Jatropha curcas* have known to have various medicinal usage.

Saponins are recognized as a component of the plant's defense mechanisms against pathogens. They are thought to exert antibacterial effects by enhancing the permeability of bacterial cell membranes, which can disrupt their structure and lead to the leakage of vital cellular components (Alina et al., 2023). Alkaloids demonstrate antibacterial activity through a variety of mechanisms, including the inhibition of bacterial cell wall synthesis, alterations in cell membrane permeability, suppression of bacterial metabolism, and interference with nucleic acid and protein synthesis (Yan et al., 2021). Tannins have the capability to disrupt the integrity of the *S. aureus* cell membrane and bind to bacterial proteins, potentially inhibiting essential enzymes. Additionally, they can prevent biofilm formation and disrupt the synthesis of peptidoglycan in the cell wall (Akiyama, 2001; Payne et al., 2013; Villanueva et al., 2023).

4. CONCLUSION

The use of *Jatropha curcas* sap has a notable effect on the growth of Staphylococcus aureus. The largest inhibition zone diameter is observed at a concentration of 100%, indicating that as the concentration of *jatropha curcas* sap increases, its antibacterial activity also intensifies.

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