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THE POTENTIAL OF FRANGIPANI FLOWER EXTRACT (*Plumeria alba* L.) AS AN ANTIBACTERIAL: A LITERATURE REVIEW

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ABSTRACT

Background: Bacteria develop naturally in the human body to aid in protecting the individual. Antibiotic resistance is quickly increasing and is becoming a global health concern. In this situation, the risk of synthetic antibiotic resistance against bacterial infections makes it critical to find alternative medications that are safe, easy to obtain, and better than synthetic antibiotic alternatives. The frangipani plant is one of the medicinal plants used in traditional medicine as an antibacterial. The frangipani plant possesses antibacterial properties comparable to broad-spectrum medicines against uro-gastro pathogens. **Objective:** The purpose of this study was to determine the activity of the frangipani flower as an antibacterial. **Methods:** studying literature from various databases, websites, national journals, and relevant international journals to identify frangipani flowers with antibacterial activity. **Results:** Results showed that frangipani flowers have antibacterial activity against gram-positive and gram-negative bacteria because frangipani flowers contain various antibacterial chemical components, such as terpenoids, saponins, phenols, flavonoids, tannins, and essential oils. **Conclusion:** Frangipani flowers have the potential to an antibacterial against gram-positive and gram-negative bacteria.
Keywords: Frangipani flower, Antibacterial, Bacteria

INTRODUCTION

Bacteria are a group of prokaryotic (single-celled) microorganisms that grow in colonies and lack a nuclear envelope, allowing them to live in any environment[1]. Bacteria develop naturally in the human body to aid in the protection of the individual. There are, however, a number of bacteria that are harmful to humans. Bacteria are frequently referred to as germs due to their ability to infect and cause disease. Bacteria reproduce quickly due to simple cell division and may take nutrients from their surroundings[2].

Antibiotic resistance is quickly increasing and is becoming a global health concern. Antibiotic resistance poses a risk to hospitals and the general public since it can result in treatment failure, healthcare-associated infections (HAI), and increased morbidity and death from multiresistant bacterial infections. According to epidemiological studies on nosocomial bacteria in the ICU, gram-negative bacteria cause around 75 percent of infections, whereas gram-positive bacteria cause about 25% of infections[3].

In this situation, the risk of synthetic antibiotic resistance against bacterial infections makes it critical to find alternative medications that are safe, easy to obtain, and better than synthetic antibiotic alternatives. Microbes, animals, and plants can all produce antibacterial chemicals[4]. The frangipani plant is one of the medicinal plants used in traditional medicine as an antibacterial. The frangipani plant (*Plumeria alba* L.) is a traditional plant with a variety of properties, including laxative and anti-itch properties in the leaves, anti-inflammatory properties in the fruit and bark[5], and antibacterial and antifungal properties in the flowers[6].

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The frangipani plant possesses antibacterial properties comparable to broad-spectrum medicines against uro-gastro pathogens, particularly Escherichia coli, a common bacteria with pathogenic strains that is resistant to synthetic medications. This plant has the potential to be used as a source of natural anti-toxin drugs as well as a new antibacterial component[7]. According to several studies, Antibacterial compounds have been found in numerous sections of the frangipani plant, including the flowers, leaves, and sap. Based on the preceding description, additional research searches in the form of review articles are required to address the part of the frangipani plant, particularly the frangipani flower, which has antibacterial activity against both gram-positive and gram-negative bacteria.

METHODS

The literature review method was used to write this review paper. The data for this article came from Google Scholar, Researchgate, Sciencedirect, and Elsevier, all of which were accessed online from international journals. The keywords were "Antibacterial of Plumeria alba " or "Antibacterial activity of Plumeria alba against Gram-positive and Gram-negative bacteria." The reference journals that were used were those that were published during the recent ten years. Relevant reference journals were gathered for additional research and given as article reviews. There are a total of 23 journals that were used.

RESULTS

1. **Antibacterial activity on *Staphylococcus aureus* and *Salmonella typhi* in a frangipani flower extract**

The activity test of frangipani flower extract using chloroform as a solvent for the growth of gram-positive bacteria (*Staphylococcus aureus*) and gram-negative bacteria (*Salmonella typhi*) was characterized by the formation of a clear zone around the well. This activity test employed an amoxicillin antibiotic as a positive control and DMSO (dimethylsulfoxide) as a negative control. According to the findings, a 30 µl extract of the 10% chloroform fraction in frangipani flowers produced an average inhibitory zone diameter of 20.89 mm for *Staphylococcus aureus* and 27.69 mm for *Salmonella typhi*[8].

2. **Antibacterial activity *on Bacillus subtilitis, Bacillus cereus,* and *Shigella fexneri* on frangipani flower extract**

The activity of frangipani flower extract on the development of *Bacillus subtilis*, *Bacillus cereus*, and *Shigella fexneri* in a petroleum ether solvent was determined by a clear area with no microbiological growth. Positive control in the form of chloramphenicol antibiotics and negative control in the form of DMSO (dimethylsulfoxide) were utilized in this activity test. The results revealed that 20 µl of petroleum ether extract in frangipani flowers and in an average inhibition zone diameter of 17.4 mm for *Bacillus subtilis*, 15.2 mm for *Bacillus cereus*, and 23.7 mm for *Shigella fexneri*[9].

3. **Antibacterial activity test on *Escherichia coli* on a frangipani flower extract**

The activity of frangipani flower extract was examined using a silver nitrate solvent mixed with FFE, referred to as frangipani silver nanoparticles, and tested on *Escherichia coli* using the disc diffusion method. A positive control, streptomycin, was used in this activity test. The results showed that 20 µl of frangipani silver nanoparticles produced an average inhibitory zone diameter of 18 mm in *Escherichia coli*[10].

4. **Antibacterial activity test on *Streptococcus pneumoniae* and *Proteus mirabilis* on a frangipani flower extract**

The activity test of frangipani flower extract with silver nitrate ($AgNO_3$) as a solvent resulted in frangipani silver nanoparticles, which were tested by well diffusion method on *Streptococcus pneumoniae* and *Proteus mirabilis*. Positive

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control in the form of gentamicin and negative control in the form of DMSO (dimethylsulfoxide) was used in this activity test. The results showed that 0.2 mL of frangipani silver nanoparticles caused an inhibition zone of 5 mm in *Streptococcus pneumoniae* and a 3 mm inhibitory zone in *Proteus mirabilis*[11].

DISCUSSION

Bacteria is a type of prokaryotic creature that lacks a nuclear envelope[12]. Gram-positive bacteria and gram-negative bacteria are the two types of bacteria. Gram-positive bacteria and gram-negative bacteria exhibit different hues, indicating that the two types of bacteria have different cell wall structures. Gram-positive bacteria have a purple tint, and gram-negative bacteria have a red color[13]. Gram-positive bacteria can keep the primary crystal violet paint because their cell walls are thick with peptidoglycan. Gram-negative bacteria can't keep their main paint color because their cell walls have a layer of lipoprotein that dissolves when they're washed with ethanol[14].

Antibiotics are chemical substances produced by fungi or bacteria that have the ability to kill or limit the growth of pathogenic microorganisms while having a low toxicity for humans. The derivatives of these semi-synthetic substances also belong to the group of antibiotics, as well as synthetic compounds with antibacterial properties[15]. Antibiotics work by killing bacteria cells (bactericidal) and slowing bacterial growth (bacteriostatic), one of which is by suppressing bacterial cell wall formation, causing the cell wall to become brittle and causing cell lysis[16].

According to table 1, frangipani flowers are bactericidal against both gram-positive and gram-negative bacteria. Because frangipani flowers contain various antibacterial chemical components, such as terpenoids, saponins, phenols, flavonoids, tannins, and essential oils, they can inhibit both gram-positive and gram-negative bacteria[8][17].

The antimicrobial activity of terpenoid chemicals found in frangipani flowers includes monoterpenoids linalool, diterpenoids, phytol, and triterpenoid saponins. Terpenoid chemicals work as antibacterials by causing damage to the bacterial cell membrane[8]. This terpenoid molecule will react with the porin (transmembrane protein) on the bacterial cell wall's outer membrane, establishing a strong polymeric link and causing the porin to be destroyed. Damage to the porin allows chemicals to enter the bacterial cell membrane, reducing its permeability and causing the bacterial cell to run out of nutrients, causing the cell membrane to lyse or the bacterial cell's cytoplasm to coagulate[18]. Terpenoid chemicals work as antibacterials by causing damage to the bacterial cell membrane[8]. This terpenoid molecule will react with the porin (transmembrane protein) on the bacterial cell wall's outer membrane, establishing a strong polymeric link and causing the porin to be destroyed. Damage to the porin allows chemicals to enter the bacterial cell membrane, reducing its permeability and causing the bacterial cell to run out of nutrients, causing the cell membrane to lyse or the bacterial cell's cytoplasm to coagulate[18].

Saponins can act as an antibiotic by reducing the surface tension of the bacterial cell wall, disrupting cell permeability. Saponins work as antibacterials by causing proteins and enzymes to seep from bacterial cells, and when saponins connect with bacterial cells, the bacteria will die[8].

The antibacterial activity of phenolic chemicals found in frangipani flowers is due to their ability to denaturize cell proteins[8]. By poisoning protoplasm, penetrating the cell wall, and precipitating bacterial cell proteins, phenolic chemicals inactivate key enzymes de bacterial cells, causing cell leakage and inhibiting bacterial growth[4].

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Table 1. Compilation of literature related to the antibiotic potency of Frangipani Flower

Test bacteria	Positive	Negative	Plant Parts	Inhibition Zone Diameter (mm)	Authors
Staphylococcus aureus	✓		Flower	20,89	Rupiniasih et al., 2019
Salmonella typhi		✓	Flower	27,69	Rupiniasih et al., 2019
Bacillus subtilitis	✓		Flower	17,4	Sibi et al., 2014
Bacillus cereus	✓		Flower	15,2	Sibi et al., 2014
Escherichia coli		✓	Flower	18	Mata et al., 2015
Proteus mirabilis		✓	Flower	3	Patil and hooli., 2013
Streptococcus pneumoniae	✓		Flower	5	Patil and hooli., 2013
Shigella fexneri		✓	Flower	23,7	Sibi et al., 2014

Furthermore, this substance acts as a powerful antioxidant by reducing the permeability of bacterial cell walls, microsomes, and lysosomes, allowing them to impede bacterial development[17].

Flavonoid chemicals found in frangipani flowers have antimicrobial properties. Flavonoids are phenolic chemicals that serve as coagulants for proteins[19]. Flavonoids work as antibacterials by building complex molecules with extracellular proteins, causing the integrity of the bacterial cell membrane to be disrupted. It operates by denaturing bacterial cell proteins and irreversibly destroying the cell membrane[18].

Tannin compounds have antibacterial characteristics because they contain astringent chemicals that can disrupt the function of cell walls and membranes[8]. Tannin chemicals work by forming complex molecules with proteins via hydrogen bonds, causing proteins to be denatured and bacterial metabolism to be disturbed[4].

The essential oil contained in frangipani flowers has antibacterial activity due to the presence of terpenes or alcohol as active substances. Increased ion permeability and leakage of key intracellular component molecules, as well as harm to the bacterial enzyme system, are caused by the presence of this essential oil concentration[18][17].

The size of the inhibitory zone created in an extract determines its antibacterial strength. Antibacterial potency is divided into four categories: very strong, strong, medium, and weak. If the diameter of the resulting inhibition is greater than 20 mm, the extract is said to have a very strong category of inhibition. If the diameter of the resulting inhibition runs from 10 mm to 20 mm, the extract is said to have a strong inhibitory power. If the inhibitory potency of the extract is between 5 and 10 mm, it is said to have a moderate diameter of inhibition. If the diameter of the resulting inhibition is less than 5 mm, the extract is said to have a weak diameter of inhibitory power[8].

According to the antibacterial strength classification, frangipani flower extract inhibited the growth of Staphylococcus aureus, Salmonella typhi, and Shigella fexneri bacteria in the very strong group. Bacillus subtilitis, Bacillus cereus, and Escherichia coli are all susceptible to the frangipani flower extract, which has the ability to limit the growth of bacteria in the strong category. Streptococcus pneumoniae bacteria can be inhibited by frangipani flower extract, which has the ability to suppress the growth of medium category bacteria. The frangipani flower extract, which can inhibit Proteus mirabilis, is rated as weak in terms of bacterial growth inhibition.

CONCLUSION

Based on the results of the review, it can be concluded that frangipani flowers have the potential as an antibacterial against

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gram-positive and gram-negative bacteria. This is because the frangipani flowers contain chemical compounds that are antibacterial, namely terpenoids, saponins, phenols, flavonoids, tannins, and essential oils that have antibacterial activity.

CONFLICT OF INTEREST

No conflict of interest in this paper. This paper was written independently without being affiliated with another party.

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