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A REVIEW OF ANTIBACTERIAL POTENTIAL OF BANANG-BANANG PLANT (*Xylocarpus granatum* J.Koenig) EXTRACT

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ABSTRACT

Background: *Xylocarpus granatum* has been used traditionally by coastal communities to treat various diseases. It is known that this plant contains secondary metabolites with various pharmacological activities, including as an antibacterial. **Objective:** This review article aims to provide information regarding the potential antibacterial activity of banang-banang plants and to summarize the content of compounds that have antibacterial properties and their mechanism of action. **Methods:** The preparation of this article is through literature studies from various international journals and national journals obtained online by taking into account predetermined inclusion and exclusion criteria. Then it was selected and studied further to obtain data related to the antibacterial activity of banang-banang plants and the content of secondary metabolites that have potential as antibacterials. **Result:** The banang-banang plant, especially the leaves, roots, fruit, seeds, fruit flesh, fruit peels, stems and bark with its secondary metabolites can inhibit several bacterial species such as *Staphylococcus epidermidis, Pseudomonas aeruginosa, Escherichia coli, Vibrio alginolyticus, Staphylococcus aureus, Shigella boydii , Proteus spp., Streptococcus pyogenes, Ralstonia solanacaerum, Propionibacterium acnes, Agrobacterium tumefaciens, Aspergillus paraciticus, Bacillus subtilis, Candida albicans, Pseudomonas fluorescence, Micrococcus luteus, Saccharomyces ceresiviae, Salmonella typhi, Vibrio alginoliticus* and *Aeromonas hydrophilla*. The secondary metabolites of this plant that have potential as antibacterial are tannins, saponins, steroids, phenols, triterpenoids, flavonoids, alkaloids, terpenoids and glycosides which have their respective mechanisms of action as antibacterial agents. **Conclusion:** Secondary metabolites contained in each part of the *Xylocarpus granatum* plant are thought to have a role in its antibacterial activity.

Keywords: Antibacterial, Mechanism of action, Secondary metabolite, Xylocarpus granatum J.Koenig.

INTRODUCTION

Indonesia is a country with a large population and is inseparable from health problems. Infectious disease is a major health problem in developing countries including Indonesia [1][2]. Infection is a condition caused by microorganisms that attack human tissue[3]. Infection can be caused by several types of microorganisms, one of which is bacteria[4].

Infectious diseases caused by bacteria are usually treated with antibiotics, but along with many infectious diseases, antibiotics are often used and their use reaches 40-64%[5]. The negative impact that can be caused is the resistance of microorganisms to various

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antibiotics so that treatment becomes ineffective[6]. As for some bacteria that have been reported to be resistant to various kinds of antibiotics, for example *Staphylococcus aureus* which has a ciprofloxacin resistance rate in Asia of 37%, Methicillin Resistant *Staphylococcus aureus* (MRSA) has reached 70% in Asia and reached 23.5% in Indonesia[1].

Alternative treatments are needed that are safer and more effective, for example by utilizing natural ingredients [7], which usually have fewer side effects and are safer than prescription drugs for routine use for a longer period of time. It also tends to be more effective in individuals with chronic illnesses or long-standing health complaints[8].

One of the natural ingredients that has the potential as an antibacterial is the banang-banang plant (*Xylocarpus granatum* J.Koenig) which belongs to the *Meliaceae* family. This plant has been used traditionally by coastal communities to treat various diseases including diarrhea, dysentery and as a wound cleanser due to bacterial infections[9][10][11].

Based on literature studies, there have been several studies reporting the antibacterial activity of *Xylocarpus granatum*. This plants has secondary metabolites that have potential as antibacterials [11]. Therefore, the purpose of this study is to determine the potential antibacterial activity of banang-banang plants and to determine the content of compounds that are efficacious as antibacterials and their mechanisms of action.

METHODS

This research method is a literature review. The data presented in this studi were obtained from online literature, which was accessed through search engines such as Google Scholar and Science Direct. The keywords used in the search were antibacterial activity AND Xylocarpus granatum, antibacterial activity AND Xylocarpus granatum AND stem OR seed OR fruite OR leaf, Xylocarpus granatum AND antibakteri. Then it was further selected to obtain data related to antibacterial activity and secondary metabolites that have potential as antibacterial. The inclusion criteria in this literature review are 1). Articles that use both Indonesian and English, 2). Articles available in full text, 3). The literature that describes the antibacterial activity of Xylocarpus granatum and its secondary metabolite content which has the potential as an antibacterial while the exclusion criteria are literature in the form of articles review.

RESULTS

Based on the search results obtained 8 scientific articles. It was found that various parts of the *Xylocarpus granatum* plant containing secondary metabolites can inhibit several bacterial species which can be seen in table 1.

DISCUSSION

Antibacterial activity is related to compounds that kill bacteria or slow their growth. In general, antibacterial agents can be classified into two, namely bactericidal and bacteriostatic. Bactericidal is an agent that kills bacteria while bacteriostatic is an agent that slows down the growth of bacteria[12].

The presence of secondary metabolites is an important factor through their mechanism of action[13]. The secondary metabolites of banang-banang plants that have potential as antibacterial include tannins, saponins, steroids, phenols, triterpenoids, flavonoids, alkaloids, terpenoids and glycosides.

1. Tannin

Tannins are important phenolic compounds that reknowed for their antibacterial action.

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Table 1. Antibacterial Activity of Banang-Bananag Plant Extract (*Xylocarpus granatum* J. Koenig)

No.	Plant Parts	Extraction Method	Extraction Solvent	Inhibited Bacteria	Secondary Metabolites	References
1.	Leaf	Maceration	Methanol	*Staphylococcus epidermidis*	Tannins, saponins, steroids, phenols	[1]
2.	Root and stem	Maceration	Methanol	*Pseudomonas aeruginosa*, *Escherichia coli* and *Vibrio alginolyticus*	Triterpenoids, steroids, saponins and tannins	[18]
3.	Root, seed, fruit pulp, fruit peel and stem	Maceration	Methanol	*Escherichia coli* and *Staphylococcus aureus*	Flavonoids, tannins and saponins	[10]
4.	Bark	Soxhlet	Ethanol	*Staphylococcus epidermis*, *Staphylococcus aureus*, *Shigella boydii*, *Proteus* spp., *Escherichia coli* and *Streptococcus pyogenes*	Glycosides, saponins, tannins, flavonoids, terpenoids and alkaloids	[19]
5.	Leaf and bark	Maceration	Ethanol 96%	*Ralstonia solanacaerum* and *Propionibacterium acnes*	Flavonoids, saponins, tannins, terpenoids	[20]
6.	Seed	-	Water, methanol, ethanol, chloroform, and per-eter	*Agrobacterium tumefaciens*, *Aspergillus paraciticus*, *Bacillus subtilis*, *Candida albicans*, *Escherichia coli*, *Pseudomonas fluorescence*, *Micrococcus luteus*, *Staphylococcus aureus*, *Saccharomyces ceresiviae* and *Salmonella typhi*	Glycosides, saponins, tannins, flavonoids, terpenoids, and alkaloids	[21]
7.	Stem, fruit and leaf	Maceration	Methanol	*Vibrio alginoliticus*, *Aeromonas hydrophilla*, *Pseudomnas aeruginosa* and *Escherichia coli*	Tannins, flavonoids and saponins	[22]
8.	Leaf	Maceration	Ethyl acetate	*Staphylococcus aureus* and *Pseudomonas aeruginosa*	Saponins, flavonoids, alkaloids, tannins and terpenoids	[11]

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The mechanism as an antibacterial is preventing the availability of substrate for bacterial cells, attacking bacterial cells, and limiting the entry of iron into microorganisms[14]. In addition, tannins have antibacterial activity by reacting to cell membranes, precipitating proteins, inactivating enzymes and destroying the function of genetic material[10][15][16][17]. Tannins can also inhibit the enzymes reverse transcriptase and DNA topoisomerase so that bacterial cells cannot form[13][16][17].

2. Saponin

The mechanism of action of saponins as an antibacterial is reduce surface tension thereby increasing cell permeability and causing intracellular compounds to come out due to cell leakage[22][13]. Saponins cause intercellular compounds to diffuse through the outer membrane and cell wall. This causes the cytoplasm to leak out of the cell resulting in cell death[23].

3. Steroid

Steroids as antibacterial have a mechanism to damage the bacterial cell membrane[24]. Through the phospholipid cell membrane which is permeable to lipophilic compounds, steroids can interact and result in decreased membrane integrity and cause changes in cell membrane morphology resulting in brittle cells and lysis[25][26].

4. Phenol

Phenol has the potential as an antibacterial agent by acting as a toxin in the protoplasm, damaging and penetrating the cell wall and precipitating bacterial cell proteins[27][28]. The mechanism of action of phenolic compounds as antibacterial are 1) denaturing bacterial cell proteins so that they can stop all metabolic activity of bacterial cells, 2) Phenol can cause damage to bacterial cells, 3). inactivating important enzymes in bacterial cells, 4) changes in membrane permeability in the cytoplasm resulting in leakage of nutrients inside the cell, allowing disruption of the transport of organic ions into the cell resulting in inhibition of growth leading to cell death[25][28][29][30].

5. Triterpenoid

Triterpenoids have antibacterial properties because they can damage cell membranes[31][32]. The mechanism of triterpenoids as antibacterial is react with porins (transmembrane proteins) on the outer membrane of the bacterial cell, forming strong polymer bonds that cause damage to the porin as a way for compounds to enter and leave, this will reduce the permeability of the bacterial cell wall and can result in bacterial cells being deficient in nutrients thereby inhibiting bacterial growth or cause bacteria to die[33][34][35].

6. Flavonoid

Flavonoid compounds can act as antibiotics by interfering with the function of microorganisms[36]. The mechanism of action of flavonoids can be divided into three such as 1) inhibit nucleic acid synthesis, 2) inhibit cell membrane function and 3) inhibit energy metabolism[36][37]. In inhibiting the synthesis of nucleic acids, the A and B rings of flavonoid compounds have an important role in the interaction process, namely by accumulating nucleic acid bases so as to inhibit the formation of DNA and RNA. The interaction of these flavonoids will also cause damage to cell wall permeability[37]. In terms of inhibiting the function of the cell membrane, flavonoids form complex compounds with extracellular and dissolved proteins that can damage the bacterial cell membrane and then followed by the release of intracellular compounds[37][13][23]. Whereas inhibiting energy metabolism is by inhibiting the use of oxygen by bacteria[36], preventing the formation of energy in the

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cytoplasmic membrane and inhibiting bacterial motility which plays a role in antimicrobial activity and extracellular proteins[37].

7. Alkaloid

Alkaloids as antibacterial have a mechanism of action by interfering with the constituent components of peptidoglycan in bacterial cells so that the bacterial cell wall layer cannot form completely and results in cell death[24][30][38]. Alkaloids also interfere with peptidoglycan synthesis which causes imperfect cell formation, this causes the cell not contain peptidoglycan and the cell wall only covers the cell membrane[30]. The mechanism of action of alkaloids as an antibacterial is through inhibition of cell wall synthesis which will cause lysis of the bacterial cells so that the cells will die[39][40].

8. Terpenoid

Terpenoid compounds have chemical compounds which are natural ingredients that are used as medicine. Terpenoids are fat soluble and are found in the cytoplasm of plant cells[20]. The mechanism of terpenoids as antibacterial is that terpenoids will form polymer bonds that can damage the porin. Through damage to the porin which is the place where compounds enter and exit, it can reduce the permeability of the bacterial cell wall which will result in a lack of nutrients in the bacterial cell, so that the growth of the bacteria is inhibited or dies[20][41].

9. Glycoside

Glycosides are compounds consisting of one or more sugars (glucose) combined with non-sugar molecules (aglycones) through glycosidic bonds[42]. The content of glycoside chemical compounds can have the potential as an antibacterial by penetrating into the cell wall, causing damage to the bacterial cell wall[43][44].

CONCLUSION

Based on the literature review conducted, it can be concluded that the banang-banang plant (*Xylocarpus granatum* J.Koenig) has the potential as an antibacterial. The parts of this plant that have been studied and have potential as antibacterial are the leaves, roots, fruit, seeds, fruit flesh, fruit peel, stem and bark. For compounds that have the potential as antibacterial such as tannins, saponins, steroids, phenols, triterpenoids, flavonoids, alkaloids, terpenoids and glycosides which have their own mechanism of action as antibacterial agents.

CONFLICT OF INTEREST

There was no conflict of interest in the preparation of this article. This article is written independently without the involvement of other parties who could improperly influence this article.

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