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Review: Antibacterial Activity of *Syzygium polyanthum*

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Abstract
Syzygium polyanthum is a species of the *Myrtaceae* family, used as traditional medicine by various ethnic groups, especially in Southeast Asia. Based on the studies, it has antibacterial activity. This article aims to review the studies about the antibacterial activity of *S.polyanthum*. Literature studies were used in the article review for 20 last years (2010-2020) from trusted online databases (ScienceDirect, NCBI, Researchgate, Google Scholar, and other publishers and trusted journals. The results showed that *S.polyanthum* had a significant effect in inhibiting the growth of bacteria likes *Escherichia coli*, *Streptococcus mutans*, *Staphylococcus aureus*, and *Salmonella*. It can be a conclusion that *S.polyanthum* has the potential to develop as antibacterial therapy.
Keywords: antibacterial, *Syzygium polyanthum*, traditional medicine

1. Introduction
Syzygium polyanthum is a species of the *Myrtaceae* family, used as a spice in cooking and medicine, especially in Southeast Asia, Malaysia, and Indonesia [1]. *S. polyanthum* has synonyms *Eugenia polyantha* Wight, *Euginia nitida* Duthie, *Euginia balsamea* Ridley [2]. *S. polyanthum* is also used as a traditional medicine to treat diabetes mellitus, gastric disorders, hemorrhoids, diarrhea, hypertension, and reduce cholesterol levels [3]. A study about the pharmacological activity of *S.polyanthum* showed that it has pharmacology. *S. polyanthum* has antihypertensive, antidiabetic, antioxidant, anti-inflammatory, immunomodulatory, antibacterial, and anticancer activities [4].

Phytochemical analysis showed that *S. polyanthum* contained flavonoids, alkaloids, terpenoids, tannins, and saponins [5]. The pharmacological activity of *S polyanthum* is related to its secondary metabolites. *S. polyanthum* extract dissolved in a water solvent tested on male mice could reduce the average blood pressure. TerpeNoid compounds, phenolics (*e.g., eugenol*), tannins, and flavonoids are responsible for the antihypertensive effect. Eugenol has vasorelaxants so that it can lower blood pressure [6]. *S.polyanthum* extract could reduce blood glucose levels. It was equivalent to glibenclamide which was used as a positive control [7]. *S.polyanthum* extract can inhibit free radicals. At a concentration of 50 ppm, *S.polyanthum* extract could inhibit 82% of free radicals [8]. *S.polyanthum* extract can inhibit *Methicillin-Resistant Staphylococcus aureus* (MRSA) bacteria growth. Its ability was equivalent to ampicillin [9]. Using the disk diffusion method showed that *S. polyanthum* extract had good activity as an antibacterial, especially for *Salmonella thypii* and *Bacillus cereus* [8]. Some studies showed that these compounds have antibacterial activity [10]. This article aims to review studies on the antibacterial activity of *S .polyanthum.*

2. Data Collection
In compiling review articles, the technique was used by literature studies to finding sources or literature from primary articles in the last 20 years (2010-2020). Also, in making this review article, data were searched using

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the keywords "antibacterial" and "*Syzygium polyanthum*" from trusted websites such as ScienceDirect, NCBI, Researchgate, Google Scholar, and others published and trusted journals.

3. Result and Discussion

Table 1 was showed the results of review studies about the antibacterial activity of *S.polyanthum*. The ethaNolic extract of *S.polyanthum* leaves was used to test the antibacterial activity using the disk diffusion test method and determine the MIC and MBC value. Bacteria used *Escherichia coli*, *Klebsiella pneumonia*, *Listeria monocytogenes*, *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Staphylococcus aureus*, *Salmonella typhimurium*, *Vibrio cholerae*, *Vibrio parahaemolyticus*. By the disk diffusion test method, the zone of inhibition is obtained *Escherichia coli* 7.00 ± 0.28, *Klebsiella pneumonia* 9.33 ± 0.50, *Listeria monocytogenes* 9.67 ± 0.58, *Pseudomonas aeruginosa* 7.00 ± 0.32, *Proteus mirabilis* 6.67 ± 0.40, *Staphylococcus aureus* 9.33 ± 0.52, *Salmonella typhimurium* 6.67 ± 0.50, *Vibrio cholerae* 8.33 ± 0.30, *Vibrio parahaemolyticus* 6.67 ± 0.50. Determination of the MIC value of *Escherichia coli* 1.25, *Klebsiella pneumonia* 1.25, *Listeria monocytogenes* 0.63, *Pseudomonas aeruginosa* 1.25, *Proteus mirabilis* 1.25, *Staphylococcus aureus* 0.63, *Salmonella typhimurium* 1.25, *Vibrio cholerae* 1.25, *Vibrio parahaemolyticus* 1.25. Determination of MBC value against *Escherichia coli* 2.50, *Klebsiella pneumonia* 2.50, *Listeria monocytogenes* 0.63, *Pseudomonas aeruginosa* 2.50, *Proteus mirabilis* 2.50, *Staphylococcus aureus* 1.25, *Salmonella typhimurium* 1.25, *Vibrio cholerae* 1.25, *Vibrio parahaemolyticus* 1.25 [11].

Table 1: Antibacterial activity of *S.polyanthum*

No	Sample	Part of Plants	Method	Bacteria	Results	Ref.
1.	Ethanolic extract	Leaves	Disc diffusion method and determination of MIC and MBC value	*Escherichia coli*, *Klebsiella pneumonia*, *Listeria monocytegenes*, *Pseudomonas aerugiNosa*, *Proteus mirabilis*, *Staphylococcus aureus*, *Salmonella typhimurium*, *Vibrio cholerae*, *Vibrio parahaemolyticus*	Inhibits *Escherichia coli*, *Klebsiella pneumonia*, *Listeria monocytogenes*, *Pseudomonas aerugiNosa*, *Proteus mirabilis*, *Staphylococcus aureus*, *Salmonella typhimurium*, *Vibrio cholerae*, *Vibrio parahaemolyticus*	[11]
2.	*S. polyanthum* chitosan nanoparticles 1%	Leaves	Disc diffusion method *Kirby-Bauer*	*Streptococcus mutans*	Inhibits *Streptococcus mutans*	[12]
3.	Methanol extract, aqueous fraction, ethyl acetate fraction, n-hexane fraction	Leaves	Broth dilution method	*S.aureus* and *E.coli*	Methanol extract and its fraction of *S.polyanthum* leaves have potential antibacterial. MethaNol extract induces the highest antibacterial against *S.aureus* and *E.coli*	[13]

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4.	Extracts red leaves n-hexane, ethyl acetate, ethaNol fraction	Leaves	Agar diffusion method	*S.aureus* and *E. coli*	The highest antibacterial activity against *S.aureus* was found in the ethyl acetate fraction. The highest antibacterial activity against *E.coli* was found in the total extract.	[14]
5.	Methanol extract	Bark	Agar diffusion method	*E.coli*	The extract significantly inhibited the growth of *E. coli*	[15]
6.	*S.polyanthum* Tannins and flavonoids	Leaves	Disc Diffusion method Kirby-Bauer	*E. coli*	Inhibits the growth of *E.coli*	[16]
7.	Methanol, ethyl acetate dichloromethane, ethanolic, and hexane	Leaves	Colorimetric Ellman and GCMS	*S.aureus*	The ethanolic extract of the leaves has antibacterial activity against *S.aureus* with MBC values in the range of 10%–20% w/v	[17]

Chitosan nanoparticles 1% extract *S.polyanthum* concentration of 100%, 75%, and 50% inhibit bacterial growth *S.mutans* with the zone of inhibition was 13.45 ± 0.2881, 12.67 ± 0.2733, and 11.52 ± 0.4070 mm [12]. Ampicillin as positive control showed antibacterial activities against *S.aureus* and *E.coli* with IC_{50} values of 37.82 µg/mL and 10.28 µg/mL, respectively. Methanol extract showed antibacterial activities against *S.aureus* and *E.coli* with IC_{50} values of 23.16 µg/mL and 35.01 µg/mL, respectively. The n-hexane fraction had the highest antibacterial activity against *S.aureus* and *E.coli* with an IC_{50} value of 49.25 µg/mL and 27.54 µg/mL, respectively, compared with aqueous and ethyl acetate fractions. The results showed the antibacterial activity of methanol extract of *S.polyanthum* leaves and its fractions [13].

Antibacterial activity test using agar diffusion method showed that ethyl acetate fraction had the highest inhibition against *S.aureus*, whereas total extract had the highest inhibition against *E.coli* with MIC values of 0.5%. These results showed that *Syzygium myrtifolium* extract potential as an antibacterial agent [14]. Extract concentrations of 40%, 60%, and 80% have antibacterial activity with an average diameter of the inhibitory zone was 16.2, 8.5, and 16.3 mm, while the positive control 27.3 mm and negative control 0 mm. The statistical analysis results showed significant differences in the effects of various concentrations of methaNol extract. *S. polyanthum* stem bark against *E.coli* growth. The study concludes that the methanol extract of *S. polyanthum*'s stem bark has antibacterial activity against *E.coli* [15].

The inhibition was obtained based on the drag zones formed around the disc paper using the sliding term. The experiment was repeated three times with the positive control (*ciprofloxacin*) and negative control (*aquadest*). The zone inhibition of 25%, 50%, and 75% concentrations was 14 mm, 16 mg, and 20 mm. While on the positive control was 31 mm. The results of the inhibitory test of extract *S.polyanthum* against *E.coli* were smaller than positive control [16]. *S.polyanthum* had shown that boiled water of *S.polyanthum* at a concentration of 60% could reduce plaque index by 43.1±4.02% when the decoction was rinsed by a group of patients with fixed orthodontic appliances. These patients achieved a mean hygiene category (31%–50%),

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where the effect was comparable to chlorhexidine (42.1±4.3%) as the gold standard of antimicrobial agents [17].

The antibacterial activity of *S. polyanthum* was related to its phytochemical content, such as flavonoids, tannins, alkaloids, phenols, saponins, steroids, and triterpenoids. Flavonoids are secondary metabolites that can inhibit bacterial growth [18]. The activity of flavonoids in inhibiting bacterial growth is by causing damage to cell membranes and inhibiting the synthesis of bacterial cell macromolecules [19].

Tannin compounds can inhibit bacterial growth. The activity of tannins in inhibiting antibacterial growth is related to their ability to bind to bacterial cell walls, inhibiting growth and protease activity. *E.coli* is a short rod-shaped gram-negative bacterium, facultatively anaerobic, grows well on *MacConkey* with round and convex colonies. Lactose fermenting and some strains of *E.coli* are hemolyzing blood. *E.coli* generally causes diarrhea worldwide. *E.coli* was classified according to the characteristic properties of its virulence, and each group causes disease by different mechanisms. *E.coli* that often cause diarrhea was classified into 5, namely: *Enteropathogenic E. coli* (EPEC), *Enterotoxigenic E. coli* (ETEC), *Enterohemorrhagic E. coli* (EHEC), *Enteroinvasive E. coli* (EIEC), *Enteroaggregative E. coli(*EAEC) [20].

The ability of alkaloids to inhibit bacterial growth was related to their ability to interact with DNA, thereby inhibiting DNA synthesis and reverse transcriptase. Also, by releasing lipoteichoic acid adhesins from the cell surface, thereby interfering with membrane permeability. Saponin compounds can inhibit bacteria. The activity of saponins in inhibiting bacterial growth reduces the efficiency of glucose utilization in microorganisms, affects growth and proliferation, reduces the activity of critical enzymes in physiological metabolism, suppresses protein synthesis, and then causes cell death.

4. Conclusion

Based on the studies, it concludes that *S.polyanthum* has the potential to develop in antibacterial therapy.

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A Brief Author Biography

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