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Study of Antimicrobial Activity of the Rubiaceae Family: A Review

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Abstract:
The Rubiaceae tribe is one of the largest tribes in the plant kingdom which has around 13.150 species of plants, shrubs, and trees with 611 genera, the largest in the tropics on earth. The components of chemical compounds in this tribal plant that function as antibacterials are flavonoids, saponins, tannins, and alkaloids. In compiling this review article, the technique used is to use literature studies by finding sources in the form of primary data or the form of official books, national journals, and international journals. Search data using online media with the keywords Antimicrobial, Rubiaceae. Search for the main references used in this article through trusted websites such as Pubmed, Google Scholar. Based on the results of the literature data that has been done, it can be concluded that the zone of inhibition of both have an inhibition zone of > 30 mm which is categorized as a very strong antibacterial activity.

Keywords: Antimikroba, Rubiaceae.

1. Introduction

The Rubiaceae tribe is one of the largest tribes in the plant kingdom which has around 13,150 species of plants, shrubs, and trees with 611 genera, the largest in the tropics on earth (1). The components of chemical compounds in this tribal plant that function as antibacterials are flavonoids, saponins, tannins, and alkaloids (2).

The alkaloid content in the leaves, seeds, fruit, flowers, and stems of plants can inhibit the work of enzymes in synthesizing bacterial proteins so that bacterial metabolism is disrupted (3).

The mechanism of action of flavonoids is to inhibit cell membrane function and bacterial energy metabolism (4). Phenol compounds can denature proteins and damage bacterial cell membranes (4). Meanwhile, saponin compounds can damage the nucleic acids (DNA and RNA) of bacteria. Tannin activity can inactivate adhesion so that bacteria cannot attach to host epithelial cells (5).

Based on this, the authors are interested in conducting a review of the antimicrobial activity test of the Rubiaceae family. The method used in this review is a literature study.

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2. Data Accumulation

In compiling this review article, the technique used is to use literature studies by finding sources in the form of primary data or the form of official books, national journals, and international journals. Search data using online media with the keywords Antimicrobial, Rubiaceae. Search for the main references used in this review article through trusted websites such as Pubmed, Google Scholar and other journals that can be trusted.

3. Result

Table 3.1 Antimicrobial Activity Of The Rubiaceae Family

No	Plant	Part Plant	Ingredient Test	Method	Test Bacteria	Concentration	Obstacles Zone(mm)	Ref
1	*Borreria exilis*	Leaf	N-Hexane Extract	*Agar Disc Diffusion*	*Bacillus sublitis*	500 µg/disc 800 µg/disc 1000 µg/disc	11.50 11.70 14.51	(6)
					Staphyloccus aureus	500 µg/disc 800 µg/disc 1000 µg/disc	11.75 13 14.83	
2	*Borreria laevicaulis*	Leaf	N-Hexane Extract	*Agar Disc Diffusion*	*Aspergillus niger*	500 µg/disc 800 µg/disc 1000 µg/disc	12.35 13.00 15.63	(6)
					Salmonella typhi	500 µg/disc 800 µg/disc 1000 µg/disc	11.35 12.20 14.40	
					Candida albicans	500 µg/disc 800 µg/disc 1000 µg/disc	19.15 23.21 25.65	
					Bacillus sublitis	500 µg/disc 800 µg/disc 1000 µg/disc	9.60 13.10 15.63	
					Staphylococcus aureus	500 µg/disc 800 µg/disc 1000 µg/disc	15.13 18.64 22.15	

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No	Plant	Part Plant	Ingredient Test	Method	Test Bacteria	Concentration	Obstacles Zone(mm)	Ref
3	*Coffea canephora L.*	Leaf	Ethanol Fraction	*Agar Disc Diffusion*	*Staphylococcus aureus*	5% 10% 15%	6.70 8.14 9.29	(7)
					Escherichia coli	5% 10% 15%	0 14.8 15.27	
			Water Fraction		*Staphylococcus aureus*	5% 10% 15%	11.45 13 12.51	
					Escherichia coli	5% 10% 15%	10.06 11.71 11.15	
			Ethyl Acetate Fraction		*Staphylococcus aureus*	5% 10% 15%	14.58 15.86 18.58	
					Escherichia coli	5% 10% 15%	13.12 12.08 17.28	
			N-Hexane Extract		*Staphylococcus aureus*	5% 10% 15%	12.4 11.15 13.52	
					Escherichia coli	5% 10% 15%	10.7 12.07 13.31	
4	*Canthium dicocum*	Leaf	Ethanol Extract	*Agar Well Diffusion*	*Escherichia coli*	25µg/mL 50 µg/mL 100 µg/mL	10 13 19	(8)
					Staphylococcus aureus	25µg/mL 50 µg/mL 100 µg/mL	11 12 14	

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No	Plant	Part Plant	Ingredient Test	Method	Test Bacteria	Concentration	Obstacles Zone(mm)	Ref
			Pet. Eter Extract		*Escherichia coli*	25µg/mL 50 µg/mL 100 µg/mL	9 11 15	
					Staphylococcus aureus	25µg/mL 50 µg/mL 100 µg/mL	4 6 8	
			Ethyl Acetate Fraction		*Escherichia coli* *Staphylococcus aureus*	25µg/mL 50 µg/mL 100 µg/mL 25µg/mL 50 µg/mL 100 µg/mL	5 8 10 0 5 9	
5	*Crossopteryx febrifuga*	Root	Methanol Extract	*Agar Disc Diffusion*	*Pseudomonas*	50 µg/mL 100 µg/mL 200 µg/mL	0 14 19	(10)
					Streptococcus aureus.	50 µg/mL 100 µg/mL 200 µg/mL	9 17 23	
					Escherichia coli	50 µg/mL 100 µg/mL 200 µg/mL	7 15 19	
					Aspergilus fumigatus	400 µg/mL 500 µg/mL	8 12	
6	*Gardenia augusta*	Leaf	Ethanol Extract	*Kyrbir-bauner (metode cakram)*	*Escherichia coli*	20% 40% 60%	10.67 12.9 13.2	(5)
					Salmonella Choleraesuis	20% 40% 60%	8.43 10.7 11.73	
					Staphylococcus	20%	10.8	

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No	Plant	Part Plant	Ingredient Test	Method	Test Bacteria	Concentration	Obstacles Zone(mm)	Ref
					aureus	40% 60%	11.93 13.16	
7	*Morinda lucida*	Leaf	Ethanol Extract	*Kyrbir-Bauer (metode cakram)*	*Escherichia coli*	25% 50% 75%	7.3 7.2 7.5	(11)
					Salminella sp	25% 50% 75%	6.2 7.1 6.6	
8	*Mitragyna speciosa*	Leaf	Methanol Extract	*Agar well diffusion*	*Salmonella typhi*	100 mg/mL	29	(12)
					Bacillus subtilis	100 mg/mL	30	
9	*Nauclea lotifola*	Leaf	Water Extract	*Diffusion punch hole*	*Pseudomonas aeruginosa*	50% 100% 150% 200%	20 22 22 23	(13)
					Staphylococcus aureus	50% 100% 150% 200%	12 15 17 18	
		Root	Water Extract		*Pseudomonas aeruginosa*	50% 100% 150% 200%	0 10 14 18	
					Staphylococcus aureus	50% 100% 150% 200%	10 13 15 16	

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No	Plant	Part Plant	Ingredient Test	Method	Test Bacteria	Concentration	Obstacles Zone(mm)	Ref
10	*Paederia foetida L.*	Leaf	Chloroform Fraction	*Agar well diffusion*	*Escherichia coli*	300 µg/disc	14	(14)
					Bacillus cereus	300 µg/disc	10	
					Pseudomonas aeruginosa	300 µg/disc	9	
					Shingella boydii	300 µg/disc	13	
					Staphylococcus aureus	300 µg/disc	-	
					Vibrio mimicus	300 µg/disc	12	
					Candida albicans	300 µg/disc	8	
					Sacharomyces cerenvacae	300 µg/disc	-	
			N-Hexane Extract		*Escherichia coli*	300 µg/disc	16	
					Bacillus cereus	300 µg/disc	12	
					Pseudomonas aeruginosa	300 µg/disc	10	
					Shingella boydii	300 µg/disc	-	
					Staphylococcus aureus	300 µg/disc	14	
					Vibrio mimicus	300 µg/disc	16	
					Candida albicans	300 µg/disc	8	

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No	Plant	Part Plant	Ingredient Test	Method	Test Bacteria	Concentration	Obstacles Zone(mm)	Ref
					Sacharomyces cerenvacae	300 µg/disc	7	
			Ethyl Acetate Fraction		*Escherichia coli*	300 µg/disc	13	
					Bacillus cereus	300 µg/disc	-	
					Pseudomonas aeruginosa	300 µg/disc	-	
					Shingella boydii	300 µg/disc	11	
					Staphylococcus aureus	300 µg/disc	11	
					Vibrio mimicus	300 µg/disc	18	
11	*Galium incanum*		Essential Oil	*Agar well diffusion*	*Escherichia coli*	15mg/mL	9.8±0.6	(16)
					Pseudomonas syringae	15mg/mL	4.3±0.4	
					Salmonella typhmurim	15mg/mL	7.1±0.5	
					Staphylococcus aureus	15 mg/mL	7±0.5	
					Streptococcus mutans	15mg/mL	8.9±06	

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No	Plant	Part Plant	Ingredient Test	Method	Test Bacteria	Concentration	Obstacles Zone(mm)	Ref
12	*Galium dieckii*		Essential Oil	*Agar well diffusion*	*Escherichia coli*	15mg/mL	9.3±0.7	(16)
					Pseudomonas syringae	15mg/mL	7.9±0.5	
					Salmonella typhmurim	15mg/mL	8.2±0.6	
					Staphylococcus aureus	15 mg/mL	9.1±0.7	
					Streptococcus mutans	15mg/mL	9.8±0.7	
13	*Galium aladagh ense*		Essential Oil	*Agar well diffusion*	*Escherichia coli*	15mg/mL	11.5±0.8	(16)
					Pseudomonas syringae	15mg/mL	10.2±0.6	
					Salmonella typhi	15mg/mL	11.3±0.7	
					Staphylococcus aureus	15 mg/mL	10±0.6	
					Streptococcus mutans	15mg/mL	12.3±0. 9	

The following are the results of a review of the antimicrobial activity of the Rubiaceae family including plant species, plant parts used, methods used, test bacteria used, concentrations used, the resulting inhibition zones and references from reviewed journals.

4. Discussion

4.1. *Borreria exilis*

N-Hexane extract from *Borreria Exilis* leaves has antimicrobial activity against *Bacillus Sublitis* and *Staphylococcus aureus* bacteria. Tests were carried out using the *Agar disc diffusion method* and its antibacterial effect used different concentrations of 500 µg/disc, 800 µg/disc, and 1000 µg/disc. The results showed that the highest inhibition zone was produced in *Staphylococcus aureus*, namely a concentration of 1000 µg/disc with an

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inhibition zone of 14.83 mm. *Bacillus Sublitis* bacteria at a concentration of 1000µg/disc with an inhibition zone of 14.51 mm (6).

4.2. *Borreria laevicaulus*

The N-hexane extract from Borreria laevicaulus leaves had antimicrobial activity against the bacteria Aspergillus niger, Salmonella thypi, Candida albicans, Bacillus subtilis, Shapylococcus aureus with concentrations of 500 µg/disc, 800 µg/disc, and 1000 µg/disc, respectively. The results showed that the highest inhibition zone was produced on Candida albicans bacteria, namely a concentration of 1000 µg/disc with an inhibition zone of 25.65 mm. Aspergillus niger bacteria at a concentration of 1000 µg/disc with a zone of inhibition of 15.63 mm. Bacillus subtilis bacteria at a concentration of 1000 µg/disc with a zone of inhibition of 16.60 mm. Staphylococcus aureus bacteria at a concentration of 1000 µg/disc with a zone of inhibition of 22.15 mm. Salmonella thypi bacteria at a concentration of 1000 µg/disc with a zone of inhibition of 14.40 mm (6).

4.3. *Coffea canepora L.*

In testing the antimicrobial activity of *Coffea canepora L.* leaves from the ethanol, water, ethyl acetate, and N-hexane fractions using the *disc diffusion method*. Based on this research, the bacteria tested were *Staphylococcus aureus* and *Escherichia coli* with respective concentrations of 5, 10, 15%. In the *Staphylococcus aureus* test from the ethanol fraction, the zone of inhibition was 6.70; 8,14 ; 9.29 mm with concentrations of 5, 10, and 15% respectively. In the *Staphylococcus aureus* test from the ice fraction, the zone of inhibition was 11.45; 13 ; 12 ; 51 mm with concentrations of 5, 10 and 15% respectively. In the *Staphylocuccos aureus* test from the ethyl acetate fraction, the zone of inhibition was 14.58; 15.86 ; 18.58 mm with a concentration of 5, 10, and 15% respectively. In the *Staphylocuccos aureus* test from N-Hexane, the zone of inhibition was 12.47; 11.15 ; 13.52 mm with concentrations of 5, 10, and 15% respectively. In the *Escherichia coli* bacteria test from the ethanol fraction, the zone of inhibition was 0; 14.8 ; 15.27 mm concentration of 5, 10, and 15% respectively. In the *Escherichia coli* bacteria test from the water fraction, the zone of inhibition was 10.06; 11.71 ; 101.15 mm with concentrations of 5, 10, and 15% respectively. In the *Escherichia coli* bacteria test from the ethyl acetate fraction, the zone of inhibition was 13.12; 12.08 ; 17.28 mm with concentrations of 5, 10, and 15% respectively. In the *Escherichia coli* bacteria test from N-Hexane, the zone of inhibition was 10.7; 12.07 ; 13.31 mm with concentrations of 5 , 10, and 15% respectively. *Escherichia coli* bacteria obtained zone of inhibition, namely 0; 14.8 ; 15.27 mm concentrations of 5, 10 and 15% respectively. In *Escherichia coli*, from the water fraction, the inhibition zone was 10.06; 11.71 ; 101.15 mm with concentrations of 5, 10, and 15%. In the *Eschechia coli* bacteria test from the ethyl acetate fraction, the zone of inhibition was 13.12; 12.08 ; 17.28 mm with concentrations of 5, 10, and 15%. In the *Escherichia coli* test of N-Hexane, the zone of inhibition was 10.7; 12.07 ; 13.31 mm with concentrations of 5, 10, and 15% (7).

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4.4. *Canthium dicocum*

Antimicrobial activity of ethanol extract, petroleum ether, and ethyl acetate from *Canthium dicocum* leaves using the disc diffusion method. In the *Escherichia coli* and *Staphylococcus aureus* bacteria tests from ethanol extract, the zones of inhibition were 10, 13, 19 mm and 11, 12, 14 mm respectively with the same concentrations of 25, 50 and 100 µg/ml. In the *Escherichia coli* and *staphylococcus aureus* bacteria tests from petroleum ether extract, the zones of inhibition were 9, 11, 15 mm and 4, 6, 8 mm, respectively, with the same concentrations of 25, 50 and 100 µg/ml. In the *Escherichia coli* and *Staphylococcus aureus* bacteria tests from ethyl acetate extract, the zones of inhibition were 5, 8, 10 mm 0, 5, 9 mm respectively with the same concentrations of 25, 50 and 100 µg/ml (8).

4.5. *Crossopteryx febrifuga*

Antimicrobial activity test of methanol extract from the roots of *Crossopteryx febrifuga*. Based on this study, it was found that the antimicrobial activity of the zone of inhibition with the test bacteria *Pseudomonas vulgaris* was 0, 14, 19 mm with respective concentrations of 50, 100, 200 µg/ml, *Staphylococcus aureus* namely 9, 17, 23 mm with respective concentrations of 50, 100 and 200 µg/ml, *Escherichia coli* namely 9, 17, 23 mm with respective concentrations of 50, 100 and 200 µg/ml (10).

4.6. *Gardenia augusta*

In testing the antimicrobial activity of the ethanol extract of *Gardenia augusta* leaves using the *Kyrbi-Bauer* method. Based on this research, it was found that the antimicrobial activity of the zone of inhibition with the *Escherichia coli* test bacteria was 10.67; 12.9 ; 13.2 mm with respective concentrations of 20, 40 and 60%, *Salmonella enteric*, namely 8.43 ; 10.7; 11.73 mm with respective concentrations of 20, 40 and 60%, *Staphylococcus aureus*, namely 10.8; 11.93 ; 13.16 mm with a concentration of 20, 40, 60% (5).

4.7. *Morinda lucida L.*

Antimicrobial activity of the ethanol extract of *Morinda lucida L.* leaves using the *Kyrby-Bauer* method. Based on this research, it was found that the antimicrobial activity of the zone of inhibition with *Escherichia coli* bacteria was 7.3; 7,2 ; 7.5 mm with respective concentrations of 25, 50, 75%, *Salmonella sp*, namely 6.2; 7,1 ; 6.6 mm with respective concentrations of 25, 50, 75 (11).

4.8. *Mitragyna speciosa*

Antimicrobial activity of the ethanol extract of *Mitragyna speciosa* leaves using *Disc diffusion*. Based on this study, it was found that the antimicrobial activity of the zone of inhibition with the test bacteria *Salmonella thypi* was 29 mm with a concentration of 100 mg/ml, *Bacillus subtilis* was 630 mm with a concentration of 100 mg/mL (12).

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4.9. *Nauclea latifola*

Antimicrobial activity of aqueous extracts from the leaves and roots of *Nauclea latifola* using the *Diffussion Punch Hole* method. Based on this study, it was found that the antimicrobial activity of the zone of inhibition of the leaves with the test bacteria *Pseudomonas auruginosa* was 20, 22, 22, 23 mm with concentrations of 50, 100, 150 and 200% respectively, *Staphylococcus aureus* namely 12, 15, 17, 18 mm with respective concentrations of 50, 100, 150, and 200% and the antimicrobial activity of the zone of inhibition of the roots with the test bacteria *Pseudomonas auruginosa*, namely 0, 10, 14, 18 mm with concentrations of 50, 100, 150, 200%, respectively. *Staphylococcus aureus*, namely 10, 13, 15 16 mm with respective concentrations of 50, 100, 150, 200% (13).

4.10. *Paederia foetida L.*

Antimicrobial activity of the chloroform (FK) fraction, the hexane (FH) fraction, and the ethyl acetate (FEA) fraction from *Paederia foetida L*. leaves using the *Disc diffusion* method. Based on this research, it was found that the antimicrobial activity of the zone of inhibition with the *Escherichia coli* test bacteria was 16 (FH) ; 14 (FK) ; 13 (FEA) with a concentration of 300 µg/disc, *Bacillus cereus* 12 (FH) ; 10 (FK) ; mm with a concentration of 300 µg/disc, *Pseudomonas auruginosa*, namely 10 (FH) ; 19 (FK) mm with a concentration of 300 µg/disc, *Shigella boydii* namely 10 (FH) ; 11 (FEA) mm with a concentration of 300 µg/disc, *Staphylococcus aureus* namely 14 (FH) ; 11 (FEA) mm with a concentration of 300 µg/disc, *vibrio parahemolyticus* namely 16 (FH) with a concentration of 300 µg/disc (14).

4.11. *Gallium incanum*

Antimicrobial activity of *Gallium incanum* essential oil using the *Disc diffusion method*. Based on this research, it was found that the antimicrobial activity of the zone of inhibition with the *Escherichia coli* test bacteria was 9.8 ± 0.6. *Pseudomonas syringe* bacteria, namely 4.3 ± 0.4 with a concentration of 15 mg/mL. *Salmonella thypi* bacteria, namely 7.1 ± 0.5 with a concentration of 15 mg/mL. Bacteria *Steplococcus aureus* 7 ± 0.5 with a concentration of 15 mg/mL. *Streptococcus mutans* bacteria, namely 8.9 ± 0.6 mm with a concentration of 15 mg/mL (16).

4.12. *Gallium* Dieckii

Antimicrobial activity of *Gallium dieckii* essential oil using the *Disc diffusion* method. Based on this research, it was found that the antimicrobial activity of the zone of inhibition with the *Escherichia coli* test bacteria was 9.3 ± 0.7. *Pseudomonas syringe* bacteria, namely 7.9 ± 0.5 with a concentration of 15 mg/mL. *Salmonella thypi* bacteria, namely 8.2 ± 0.6 with a concentration of 15 mg/mL. *Steplococcus aureus* bacteria 9.1 ± 0.7 with a concentration of 15 mg/mL. *Streptococcus mutans* bacteria, namely 9.8 ± 0.7 mm with a concentration of 15 mg/mL (16).

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4.13. Aladaghense

Antimicrobial activity of *Gallium aladaghense* essential oil using the *Disc diffusion* method. Based on this research, it was found that the antimicrobial activity of the zone of inhibition with the *Escherichia coli* test bacteria was 11.5 ± 0.8. *Pseudomonas syringe* bacteria, namely 10.2 ± 0.6 with a concentration of 15 mg/mL. *Salmonella thypi* bacteria, namely 11.3 ± 0.7 with a concentration of 15 mg/mL. Bacteria *Steplococcus aureus* 10 ± 0.6 with a concentration of 15 mg/mL. *Streptococcus mutans* bacteria, namely 12.3 ± 0.9 mm with a concentration of 15 mg/mL (16).

5. Conclusion

The data from the antibacterial activity test results in the table shows that the highest inhibition zone was found in Mitragyna Speciosa plants for bacteria, namely Bacillus subtilis with a value of 30 mm. Based on this, it can be concluded that the inhibition power of the Rubiaccae tribe against Gram-negative bacteria is higher than that of Gram-positive bacteria. This could be due to differences in the structure of the bacterial cell wall (17).

In addition, the higher the concentration of the extract used, the greater the area of the inhibition zone of the extract against the test bacteria (18).

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