RESEARCH PAPER

In Vitro Evaluation of Antibacterial Activity and Phytochemistry of *Aegiceras corniculatum*

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Abstract:
The present study aimed at *in vitro* antibacterial activity and phytochemistry of leaf and stem extracts of *Aegiceras corniculatum* collected from Coringa Reserve Forest, Andhra Pradesh, India. Being a mangrove plant the environmental stress induced phytometabolites that play a crucial role as shock absorbers in mitigating oxidative stress, osmotic imbalance, and environmental damage in these plants. This research revealed methanol extracts particularly from stem has highest extraction yield indicating the polar extracts are efficient to extract phytoconstituents, while qualitative phytochemistry revealed the presence of polyphenols such as flavonoids, tannins, saponins, glycosides, terpenoids, and alkaloids. Total Phenolic Content estimated, revealed stem hexane (120.68 mg GAE/g) and ethanol (98.44 mg GAE/g) fractions showing the higher phenolic content. The disc diffusion assay of plant extracts against eight pathogenic strains (with six Gram negative and two Gram positive*) - Escherichia coli, Salmonella enterica serovar Typhimurium, Shigella flexneri, Klebsiella pneumoniae, Pseudomonas aeruginosa, Vibrio parahaemolyticus, Staphylococcus aureus, and Streptococcus pyogenes demonstrated polar extracts particularly stem aqueous extracts having higher activity against gram negative pseudomonas aeruginosa* (up to 12 mm)*, E. coli and Salmonella typhi.* Overall, these findings suggest that Aegiceras corniculatum, possesses appreciable antibacterial potential likely driven by its rich phenolic and flavonoid content that may account for the observed antimicrobial activity.
Keywords: Mangroves, *Aegiceras corniculatum*, Phytochemical screening, Anti-bacterial activity
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Introduction:
Mangroves are unique intertidal habitats of tropical and subtropical coastal forests that buffer shorelines, support fisheries, alleviate sediments, and act as important blue-carbon sinks by storing large amounts of organic carbon in biomass and soils. Mangrove plants thrive in natural habitats of high stress environments of salinity, tidal flooding, high moisture and intense solar radiation which triggers the production of unusual secondary metabolites with potential therapeutic value (Sarkar et al., 2024). Consequently, they represent highly productive biomes and hotspots for bioprospecting of natural products. From time immemorial, mangrove species have been used in traditional folk medicine practices across Asia and the world, with extracts reported to exhibit antidiabetic, anti-inflammatory, anticancer, anti-ulcer, antimalarial, antiviral, antioxidant and antibacterial activities in various assays (Danduprolu & Lalitha, 2025; Sarkar et al., 2024). These medicinal properties of mangroves may be attributed to structurally diverse and synergistic interaction of these phytometabolites such as flavonoids, alkaloids, tannins, phenolics, terpenoids and saponins, making them an underexplored but promising resource for new drug discovery and functional products. Within this medicinally rich flora, *Aegiceras corniculatum* (L.) Blanco is a small evergreen tree or shrub of the family Primulaceae, known as a "river mangrove" and widely distributed across the Indo-Pacific region along tidal streams and intertidal zones of India, Bangladesh, China, Southeast Asia and Australia (Ellison 2010) and locally called Guggilam (Telugu). Ethnomedicinal records indicate that fruits, leaves and stem bark possess antidiabetic, anti-inflammatory, anticancer and hepato-protective properties and have been used to treat asthma, arthritis, and in different traditional systems. Additional reports suggest that, the bark and roots of this plant extensively used as fish poison and as remedies for rheumatism, painful arthritis and inflammatory disorders, highlighting the plant's strong medicinal properties recognized by local communities. Beyond systemic uses, leaf extracts have recently been explored as potential antibacterial effects against oral pathogenic bacteria, and used it as an ingredients in herbal mouthwash indicating the versatility of this species in oral healthcare applications (Nugraha et al., 2022).
Crude phytochemical screening on chemically rich *A. corniculatum* mangrove from different regions, isolated a wide array of secondary metabolites particularly in its leaves, bark, roots, stems and twigs. These phytometabolites include flavonoids, benzoquinones, triterpenes, polyphenolic acids, stilbenes, tannins, macrolides, saponins, alkaloids and diverse glycosides. The leaf and fruit extracts has consistently detected the presence of particularly flavonoids, tannins, phenolic compounds, saponins alkaloids and quinones (Imra et al., 2022). FTIR characterization has also confirmed the existence of functional groups such as hydroxyl,

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carbonyl, aliphatic C–H, C=C and aromatic rings, supporting the presence of polyphenols, terpenoids and other conjugated substances associated with pharmacological property. Specific active molecules such as embelin derivatives, stilbene-like resveratrol analogues, benzoquinones and steroidal saponins were identified from Bangladesh, Vietnam and Kerala coasts, some of which exhibit marked anti-inflammatory and melanoma cytotoxic effects in vitro (Sarkar et al., 2024; Vinh et al., 2020).

These investigations underscore a broad spectrum of curative activities of *A. corniculatum* extracts and isolated compounds. Various reported bioactivities of these phytochemicals were largely attributed to its phenolic constituents contributing to central analgesia, and exhibit neuroprotective effects relevant to disorders such as Parkinson's disease and amnesia (Janmanchi et al., 2017; Noshin et al., 2024; Nugraha et al., 2022). This collectively supports *A. corniculatum* as a therapeutically promising mangrove plant for the development of novel therapeutic agents against infectious, inflammatory, metabolic and neurodegenerative disorders. Despite the recognized ethnopharmacological and traditional medicinal applications, important research gaps remain, particularly from the Coringa mangroves of Andhra Pradesh. Coringa mangrove reserve forest is the second largest mangrove ecosystem in India, with approximately 124 km² after the Sundarbans and provides substantial economic benefits, including use of mangrove plants for timber, fish poison, medicines, health and food for local residents. Yet earlier assessments from this area noted that, although mangrove extracts contain many bioactive compounds, they remain largely untapped for medicinal purposes in the region of South India" and that no detailed in vitro studies on mangrove medicinal plants from the Coringa reserve forest had been conducted until very recently.

In a recent Comparative phytochemical and antibacterial study on crude extracts of leaves and stems of four mangrove species, including *A. corniculatum*, from Coringa, across six solvent systems documented total phenolic content and FTIR-based functional groups, but isolation of bioactive individual compounds, mechanism-based pharmacology or advanced applications such as anticancer or neuroprotective evaluation is not done. Furthermore, there are many ethnomedicinal surveys from Coringa mangrove species used by local people, but detailed documentation of *A. corniculatum*-specific traditional formulations, dosage, preparation methods and clinical outcomes in this landscape is scares (Madhu, 2013). There exists a clear gap between the global pharmacological application on *A. corniculatum* and the traditionally acquired knowledge and ecotypes present in Coringa. Systematic bioprospecting, chemical fingerprinting and pharmacological evaluation of *A. corniculatum* populations specifically from the Coringa mangrove—integrated with ethnobotanical data—are therefore need of the hour to validate traditional uses, discover region-specific bioactive constituents and support conservation and sustainable utilization of this pharmaceutically precious species in Andhra Pradesh to combat multi drug resistant pathogenic diseases.

MATERIAL AND METHODS

Collection of plant material

In Our present study, the fresh leaves and stem of *Aegiceras corniculatum* were collected from Coringa Reserve Forest, Kakinada, East Godavari district, Andhra Pradesh, India. Identification of the plant material was confirmed by Dr. Siddharthan S., Associate Professor, Department of Plant Sciences, School of Life Sciences, University of Hyderabad, Hyderabad, India. The herbarium was stored in the School of Life Sciences, University of Hyderabad Herbarium with, Name and Deposition number (UH Voucher No. UH1027). The collected leaves and stem were thoroughly washed under running tap water to remove the dust particles and shade dried in a well – ventilated place at room temperature for 15–20 days. The dried parts were powdered coarsely, and subjected to solvent extraction.

Solvent phytoextraction and Assessment of yield

To prepare the crude extracts, leaf and stem materials of mangrove species *Aegiceras corniculatum* around 100 g of each material was subjected to sequential Soxhlet extraction using different solvents of increasing polarity, namely hexane, ethyl acetate, chloroform, ethanol, methanol, and water at below the boiling point of the solvent. The extracts were further concentrated using rotary flash evaporator to get thick concentrated extracts. The concentrated extract was further dried at 37°C for 3 to 4 days in order to facilitate complete evaporation of the solvent. The extraction yields (g) along with the physical characteristics of the crude extracts were calculated. The extracts were stored at 4 ℃ in air- tight plastic vials for further studies.

Qualitative phytochemical analysis

Qualitative phytochemical analysis was carried out for all the extracts for the detection of major secondary metabolites by following standard methodology (Mishra et al. 2018).

Evaluation of Total Phenolic Content (TPC) by (Folin-Ciocalteau method):

Total phenolic content of the *A. corniculatum* leaf and stem extracts were evaluated by Folin–Ciocalteu (FC) method described by Senguttuvan et al. (2014) with minor modifications. 2 mL of extracts was mixed with 1 mL of FC reagent (1:10 v/v), and after 5 minutes, 1 mL of 7.5% sodium carbonate solution was added and incubated at room temperature for 2 hours in dark conditions. The absorbance of the resulting blue-colored complex was measured at 765 nm using a UV–Visible spectrophotometer against a reagent blank. The total phenolic content was estimated from the linear equation of standard curve prepared with gallic acid. The total phenolic content was expressed as mg/g of gallic acid equivalent (GAE).

Antibacterial assay:

The leaf and stem extracts of *A. corniculatum* were assessed against *Escherichia coli* (MTCC 41), *Salmonella enterica* serovar Typhimurium (MTCC 98), *Shigella flexneri* (MTCC 1457), *Klebsiella pneumoniae* (MTCC 4030), *Staphylococcus aureus* (MTCC 87), *Streptococcus pyogenes* (MTCC 442), *Pseudomonas aeruginos*a (MTCC 424), and *Vibrio parahaemolyticus* (MTCC 451) by disc diffusion method. The bacterial inoculum was standardized to approximately 1×10^7 CFU/mL using standard turbidity methods and used freshly for antimicrobial susceptibility assays. 100 µl of bacterial strains were inoculated and spread on solidified Mueller Hinton agar (MHA) media. Sterile discs of 6 mm diameter were prepared from Whatman No. 1 filter paper and impregnated with different concentrations of plant extracts (2–8 mg mL^{-1}), prepared in 5% dimethyl sulfoxide (DMSO). The impregnated discs were placed aseptically onto the surface of inoculated agar plates at equal distances to ensure uniform diffusion. Plates were incubated at 37°C for 18–24 hours under aerobic conditions. After incubation, antibacterial activity was assessed by measuring the zone of inhibition (ZOI) around each disc in millimetres using a calibrated scale.

Standard Antibiotic: Streptomycin was used as the standard antibiotic (positive control) for antibacterial activity assays.

Statistical Analysis

All experimental measurements were carried out n triplicate and are expressed as average of three analyses ± standard deviation.

Results and Discussion

Extraction Yield of *Aegiceras corniculatum*

Net weight of mangrove leaf and stem extracts yield in grams are given in Table:1. More quantity of extract was yielded with methanol followed by water of the leaves of *A. corniculatum*, whereas in stem, methanol extract yielded high quantity.

Table: 1 Net weight of *A. corniculatum* leaf and stem extracts yield in grams

Aegiceras corniculatum			
Solvent	**Plant Part**	**Net Yield in grams**	**State of extract**
Hexane	Leaf	2.94 ±0.5	Viscous
	Stem	2.22±0.6	Powder
Ethyle acetate	Leaf	1.36±0.5	Powder
	Stem	0.82±0.5	Viscous
Chloroform	Leaf	0.96±0.2	Powder
	Stem	1±0.2	Powder
Ethanol	Leaf	2.24±0.5	Powder
	Stem	1.2±0.2	Powder
Methanol	Leaf	4.38±0.5	Powder
	Stem	9.2±0.2	Powder
Water	Leaf	3.52±0.6	Powder
	Stem	1.8±0.5	Powder

The extraction yield of *A. corniculatum* varied with respect to solvent polarity and plant part. The methanolic extract demonstrated highest yield among the solvents tested, from both leaf (4.38 g) and stem (9.2 g), indicating its efficiency in extracting polar phytoconstituents. These findings are similar with Janmanchi et al. (2017), Imra et al. (2022) who demonstrated higher extractive values in polar solvents especially in methanol. Another study also documented the enhanced recovery of phytochemicals in methanol and water (Sarkar et al., 2024). Next to methanol it is aqueous extract showed high quantity in leaf, whereas non-polar solvents such as hexane, ethyl acetate and chloroform produced comparatively lower yields. The higher yields were obtained with methanol and aqueous solvents suggests that the phytoconstituents present in *A. corniculatum* are predominantly polar in nature.

Preliminary Qualitative Phytochemical Analysis of Aegiceras corniculatum

The phytochemical analysis of *A. corniculatum* revealed a broad distribution of secondary metabolites across different solvent extracts, with clear variation between leaf and stem tissues.

Table 2*: Phytochemical analysis of A. corniculatum leaves and stem extracts of different solvents*

S.No	**Phytochemical**	**Plant part**	**H**	**EA**	**C**	**E**	**M**	**Aq**
1	Tannins	Leaves	-	+	+	+	+	+
		Stem	-	-	-	-	-	-

2	Alkaloids (Mayer's)	Leaves	-	-	-	-	-	+
		Stem	-	-	-	-	-	-
3	Alkaloids (Wagner's)	Leaves	-	-	-	-	-	+
		Stem	-	-	-	-	-	+
4	saponins	Leaves	+	+	+	+	+	+
		Stem	-	+	-	+	+	+
5	Glycosides	Leaves	-	+	-	+	+	+
		Stem	-	+	+	+	+	+
6	Steroids	Leaves	+	-	-	+	+	+
		Stem	+	+	+	+	+	+
7	Terpenoids	Leaves	+	+	+	+	+	+
		Stem	+	+	+	+	+	+
8	Flavonoids (Shinoda)	Leaves	+	+	+	+	+	+
		Stem	+	+	-	-	-	-
9	Flavonoids	Leaves	-	-	+	-	+	+
		Stem	-	-	+	-	+	+
10	Anthraquinones	Leaves	-	-	-	-	-	-
		Stem	-	-	-	+	+	+
11	Reducing sugars	Leaves	-	+	-	+	-	-
		Stem	-	-	-	-	-	-
12	Carbohydrates	Leaves	-	+	+	+	+	+
		Stem	-	+	-	-	+	+

H-Hexane; EA-Ethyl acetate; C-Chloroform; E-Ethanol; M-Methanol; Aq-Water

The phytochemical composition of *A. corniculatum* leaf extracts, particularly ethyl acetate and chloroform extracts revealed the presence of flavonoids, glycosides, saponins, terpenoids and tannins. Hexane showed the presence of limited phytochemicals like flavonoids, suggesting a lower proportion of non-polar constituents. In contrast, polar solvents extracts, particularly methanol and aqueous fractions, exhibited a higher abundance of phytoconstituents, including tannins, saponins, glycosides, steroids, terpenoids, and flavonoids. Alkaloids were predominantly detected in the aqueous extract, indicating their polar nature. (Table: 2)

The phytochemical analysis of stem extract of *A. corniculatum* revealed the presence of fewer phytochemicals than in leaves. The ethyl acetate, chloroform extract showed the presence of glycosides, saponins, steroids, flavonoids and terpenoids. Ethanol and methanol extracts showed the presence of flavonoids, glycosides, saponins, terpenoids, tannins and Anthraquinones. Among these, methanolic extracts exhibited relatively higher phytochemical diversity. Overall, the findings indicate that leaf extracts are richer in phytochemicals than stem extracts, and polar solvents are more efficient in extracting bioactive constituents (Table: 2).

These findings are in align with previous studies (Sarkar et al., 2024); (Vinh et al., 2020) reporting rich phytochemical profiles especially flavonoids, benzoquinones, triterpenes, and phenolic compounds observed in leaves of *A. corniculatum*.

Quantitative Total Phenol content estimation: **(TPC)**

The crude extracts of leaf and stem of *Aegiceras corniculatum*, were tested for their total phenolic content using the Folin–Ciocalteu method.

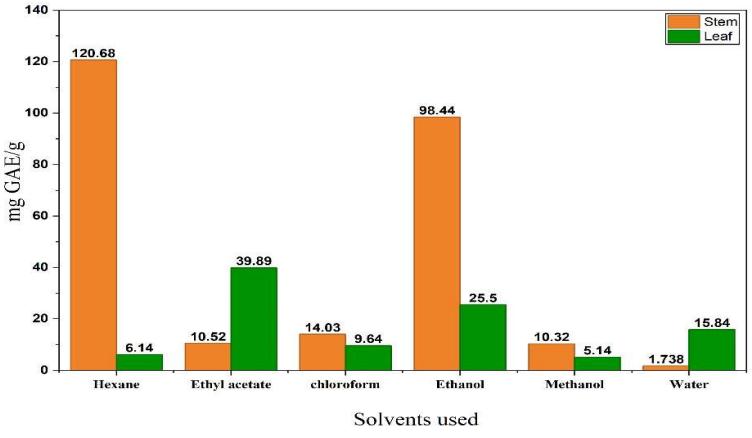

Fig 1. Total Phenol content of both leaf and stem extracts of *Aegiceras corniculatum*

The results (Fig.1) revealed that there was a wide variation in the amount of total phenolics in mangrove plant materials ranging from 1.12 to 120.68 mg GAE/g dry material (Table 3) *A. corniculatum* stem carried the highest quantity of phenolic contents compared to leaf extracts

Table 3: Total Phenolics content (mg GAE/g of Extract) of different extracts of Aegiceras corniculatum

Solvent Extract	***A. corniculatum* (Stem)**	***A. corniculatum* (Leaf)**
Hexane	120.68	6.14
Ethyl Acetate	10.52	39.89
chloroform	14.03	9.64
Ethanol	98.44	25.5
Methanol	10.32	5.14
Water	1.738	15.84

Among the fractions of *A. corniculatum*, stem hexane fraction significantly showed the highest quantity of (120.68 mg GAE/g) phenolic contents followed by the ethanol fraction (98.44 mg GAE/g), chloroform (14 mg GAE/g), methanol and ethyl acetate (10 .52mg GAE/g) (Table 3). This trend is similar with the results of Kulkarni et. al, 2019. Our TPC values obtained are higher than those reported by Janmanchi et. al, (2017), in which methanol extracts (70.86mg GAE/g extracts) exhibited higher TPC content who attributed elevated phenolic concentrations with bioactivities. TPC levels in Methanol extracts of the present study are corelating with the findings of Reddy et al, (2016).

In leaf extracts, ethyl acetate (39.89 mg GAE/g) and ethanol (25.5 mg GAE/g) showed moderate phenolic levels. These results indicate that phenolic compounds in this species are predominantly concentrated in stem tissues and can be efficiently extracted even using non-polar solvents as well as moderately polar solvents. The evaluation of total phenolic contents of *A. corniculatum* revealed that this plant possesses a huge amount of phenolics in various extracts.

Phenolic compounds are known to induce oxidative stress, disrupt membranes and cell walls and interfere with enzymatic activity in pathogens (Sarkar et al., 2024). The substantial poly phenolic content observed in the present study likely promotes the antibacterial activity of the extracts.

Antibacterial Activity of *Aegiceras corniculatum*

Table 4. Antibacterial activity of leaf extracts of Aegiceras corniculatum

***A. Corniculatum* (Leaf) Microorganism**	**Conc. mg/ml**	**Hexane**	**Ethyl acetate**	**Chloroform**	**Ethanol**	**Methanol**	**Aqueous**	**Standard**
Escherichia coli MTCC 41	2 mg	0	6 ± 0	0	6.17±0.29	6 ± 0	0	17.75
	4mg	0	6 ± 0	0	6 ± 0	7± 0	0	
	6mg	6 ± 0	6.5±0	6.5±0.29	6.5±0	7± 0	0	
	8mg	6 ± 0	6.5±0	6.17 ±0.17	6.5±0	7± 0	0	
Salmonella enterica typhimurium MTCC 98	2 mg	0	6 ± 0	0	0	0	6 ± 0	18.27
	4mg	0	6.5±0	0	0	6 ± 0	6 ± 0	
	6mg	0	9.7±0.57	0	0	6 ± 0	6 ± 0	
	8mg	0	10.7±0.57	6 ± 0	6 ± 0	6 ± 0	6 ± 0	
Shigella flexneri MTCC 1457	2 mg	0	7± 0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	27.82
	4mg	6 ± 0	6.5±0.57	6 ± 0	6 ± 0	6 ± 0	6 ± 0	
	6mg	6 ± 0	10.7±0.57	6 ± 0	6.33±0.29	6.5±0	6.5±0	
	8mg	6 ± 0	11± 0	6 ± 0	6.5±0	6.33±0.29	7± 0	
Klebsiella pneumoniae MTCC 4030	2 mg	6 ± 0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	18.27
	4mg	6 ± 0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	
	6mg	6 ± 0	6 ± 0	6 ± 0	6.5±0	6 ± 0	6 ± 0	
	8mg	6.5±0	6 ± 0	6 ± 0	6.5±0	6.5±0	6.5±0	

Pseudomonas aeruginosa MTCC 424	2 mg	0	0	0	0	0	0	23.55
	4mg	0	6 ± 0	0	7.33±0.58	6 ± 0	6 ± 0	
	6mg	0	10± 0	6 ± 0	6 ± 0	6.5±0	6.17±0.29	
	8mg	0	10± 0	6.5±0	6 ± 0	6.67±0.58	6 ± 0	
Staphylococcus aureus MTCC 87	2 mg	6 ± 0	6.9±0.173	6 ± 0	6 ± 0	6.33±0.29	6 ± 0	21.27
	4mg	6 ± 0	8± 0	6 ± 0	7.33±0.58	7± 0	8.33±0.58	
	6mg	6 ± 0	10.67±0.577	6 ± 0	7± 0	7± 0	7± 0	
	8mg	6 ± 0	12± 0	6 ± 0	7± 0	7± 0	8.33±0.58	
Vibrio parahaemolyticus MTCC 451	2 mg	0	6.667±0.577	6 ± 0	6.93±0.12	6.5±0	6 ± 0	20.36
	4mg	0	6.667±0.577	6 ± 0	7.67±0.58	7± 0	9.67±0.58	
	6mg	6 ± 0	10± 0	6 ± 0	7.67±0.58	7± 0	9.67±0.58	
	8mg	6 ± 0	12± 0	7.33±0.29	10± 0	7± 0	10± 0	
Streptococcus pyogenes MTCC 442	2 mg	6 ± 0	6.5±0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	16
	4mg	6 ± 0	6.5±0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	
	6mg	6 ± 0	6.5±0	6 ± 0	6.5±0	7± 0	6.5±0	
	8mg	6 ± 0	6.57±0.058	6 ± 0	6.83±0.29	7± 0	7± 0	

The zone of inhibition was measured in mm diameter; Zones of inhibition range 0-7mm-Lowest, 8-15mm-Moderate: ≥16mm Highest; Statistical analysis Mean ± Standard deviation.

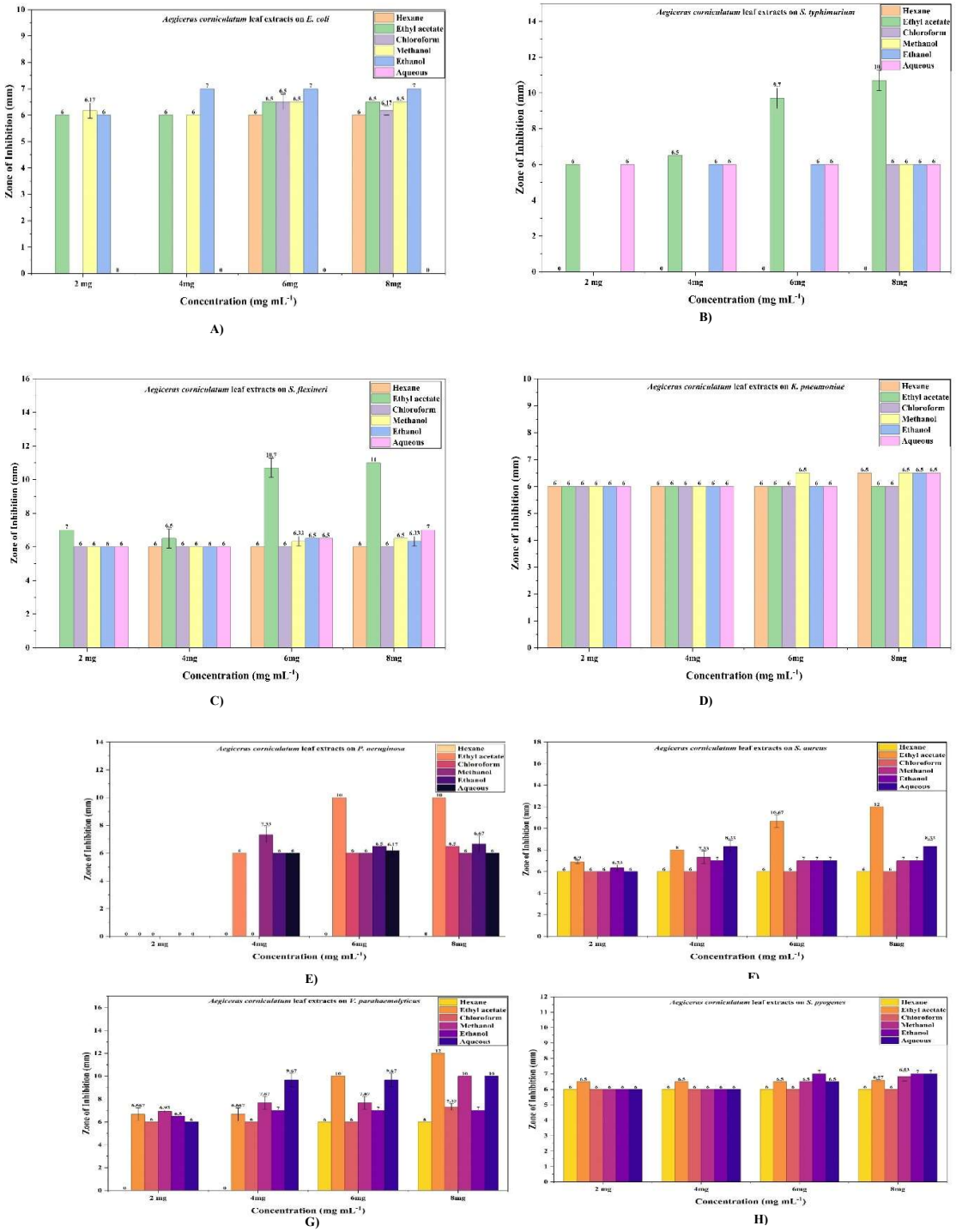

Fig 2: Antibacterial activity of leaf extracts of *Aegiceras corniculatum* against A) *E. coli* B) *S. typhi* C) *S. flexneri* D) *K. pneumoniae* E) *P. aeruginosa* F) *S. aureus* G) *V. parahaemolyticus* H) *S. pyogenes*

In the present study, antibacterial activity of leaf extracts of *A. corniculatum* exhibited increase in diameter of zone of inhibition (ZOI) in dose-dependent manner against *Salmonella typhimurium, Shigella flexneri, Pseudomonas aeruginosa, Staphylococcus aureus and Vibrio parahaemolyticus*. Ethyl acetate extract exhibited moderately wider zone of inhibition (12mm) against *Staphylococcus aureus and Vibrio parahaemolyticus* followed by 11mm diameter of ZOI by *Shigella flexneri* compared to other extracts (Table 4 and Fig. 2 A to H). Similar activities were reported in ethyl acetate and ethanol extracts of *A. corniculatum* against oral pathogens and other bacterial strains (Nugraha et al., 2022; Janmanchi et al., 2017). Aqueous extract exerted

highest inhibition (10mm) against Vibrio parahaemolyticus. However, *E. coli* is completely resistant to aqueous extract and *Salmonella typhi* and *Pseudomonas aeruginosa* are completely resistant to hexane extract. Remaining extracts exhibited lowest activity against all tested organisms. Streptomycin was used as the standard antibiotic for positive control (Table 4).

Table 5. Antibacterial activity of stem extracts of Aegiceras corniculatum

***A. Corniculatum* (Stem) Microorganism**	**Conc.in mg/ml**	**Hexane**	**Ethyl acetate**	**Chloroform**	**Ethanol**	**Methanol**	**Aqueous**	**Standard**
Escherichia coli MTCC 41	2 mg	6 ± 0	6.8±0.289	6.8±0.29	6 ± 0	6.6±0.29	6.5	17.75
	4mg	7	7	9	6.5	7	7	
	6mg	6 ± 0	6 ± 0	6 ± 0	6 ± 0	7	6 ± 0	
	8mg	6 ± 0	6.5± 0	6 ± 0	6 ± 0	10	6.33±0.29	
Salmonella enterica typhimurium MTCC 98	2 mg	6 ± 0	6 ± 0	6 ± 0	6.5± 0	6.5± 0	6 ± 0	18.27
	4mg	7.6±0.57	8± 0	8± 0	8± 0	8± 0	7± 0	
	6mg	7.5±0.5	10± 0	8± 0	8± 0	7.83±0.29	7± 0	
	8mg	7.8±0.28	11± 0	8± 0	8.1±0.29	10± 0	7.5± 0	
Shigella flexneri MTCC 1457	2 mg	0	8± 0	6 ± 0	6.6± 0	6 ± 0	6 ± 0	27.82
	4mg	6 ± 0	8± 0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	
	6mg	6 ± 0	10± 0	6.5± 0	6.83±0.29	7± 0	8.33±0.58	
	8mg	6 ± 0	11± 0	6.5± 0	7± 0	7± 0	7± 0	
Klebsiella pneumoniae MTCC 4030	2 mg	6 ± 0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	18.27
	4mg	6.5± 0	7± 0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	
	6mg	6 ± 0	6 ± 0	6 ± 0	6 ± 0	6.5± 0	6 ± 0	
	8mg	6 ± 0	6 ± 0	6 ± 0	6 ± 0	6.5± 0	6.5± 0	
Pseudomonas aeruginosa MTCC 424	2 mg	0	0	0	6 ± 0	6 ± 0	6 ± 0	23.55
	4mg	6 ± 0	6 ± 0	6 ± 0	6 ± 0	6 ± 0	6.6±0.29	
	6mg	6 ± 0	6.5	6 ± 0	6 ± 0	6.5±0.29	10.7±0.58	
	8mg	6 ± 0	10± 0	6 ± 0	6 ± 0	6.5	12	
Staphylococcus aureus MTCC 87	2 mg	6 ± 0	10± 0	6 ± 0	0	6 ± 0	6 ± 0	21.27
	4mg	6 ± 0	10± 0	6 ± 0	6 ± 0	7.6±0.58	8.3±0.58	
	6mg	6 ± 0	11± 0	6 ± 0	6 ± 0	7± 0	8.3±0.58	
	8mg	6 ± 0	11.67±0.57	6 ± 0	6 ± 0	10± 0	8.3±0.58	
Vibrio parahaemolyticus MTCC 451	2 mg	6 ± 0	7± 0	6.53	6.5± 0	6.5± 0	6 ± 0	20.36
	4mg	6 ± 0	7± 0	6.53	6.53± 0	6.83±0.29	7.67±0.58	
	6mg	6 ± 0	10± 0	6.67	6.5± 0	7± 0	7.33±0.58	
	8mg	6.5	11± 0	7± 0	7± 0	9± 0	7.67±0.58	
Streptococcus pyogenes MTCC 442	2 mg	6 ± 0	6.167±0.289	6 ± 0	6 ± 0	6.5± 0	6 ± 0	16
	4mg	7± 0	8± 0	6 ± 0	7± 0	8.3±0.58	6 ± 0	
	6mg	6 ± 0	6.5± 0	6 ± 0	6 ± 0	8.3	6 ± 0	
	8mg	6 ± 0	6.5± 0	6 ± 0	6 ± 0	10± 0	6.5± 0	

The zone of inhibition was measured in mm diameter; Zones of inhibition range 0-7mm-Lowest, 8-15mm-Moderate: ≥16mm Highest; Statistical analysis Mean ± Standard deviation.

In this study, stem Ethyl acetate extracts of *A. corniculatum* gave the zones of inhibition with increase in concentration of the extract at 2-8mg/ml against *S. typhi, S. flexneri, S. aureus and V. parahaemolyticus* (Table 5 and Fig.3 A to H). At higher concentration of extract i.e. 8mg/ml only have showed moderate activity against *P. aeruginosa*.

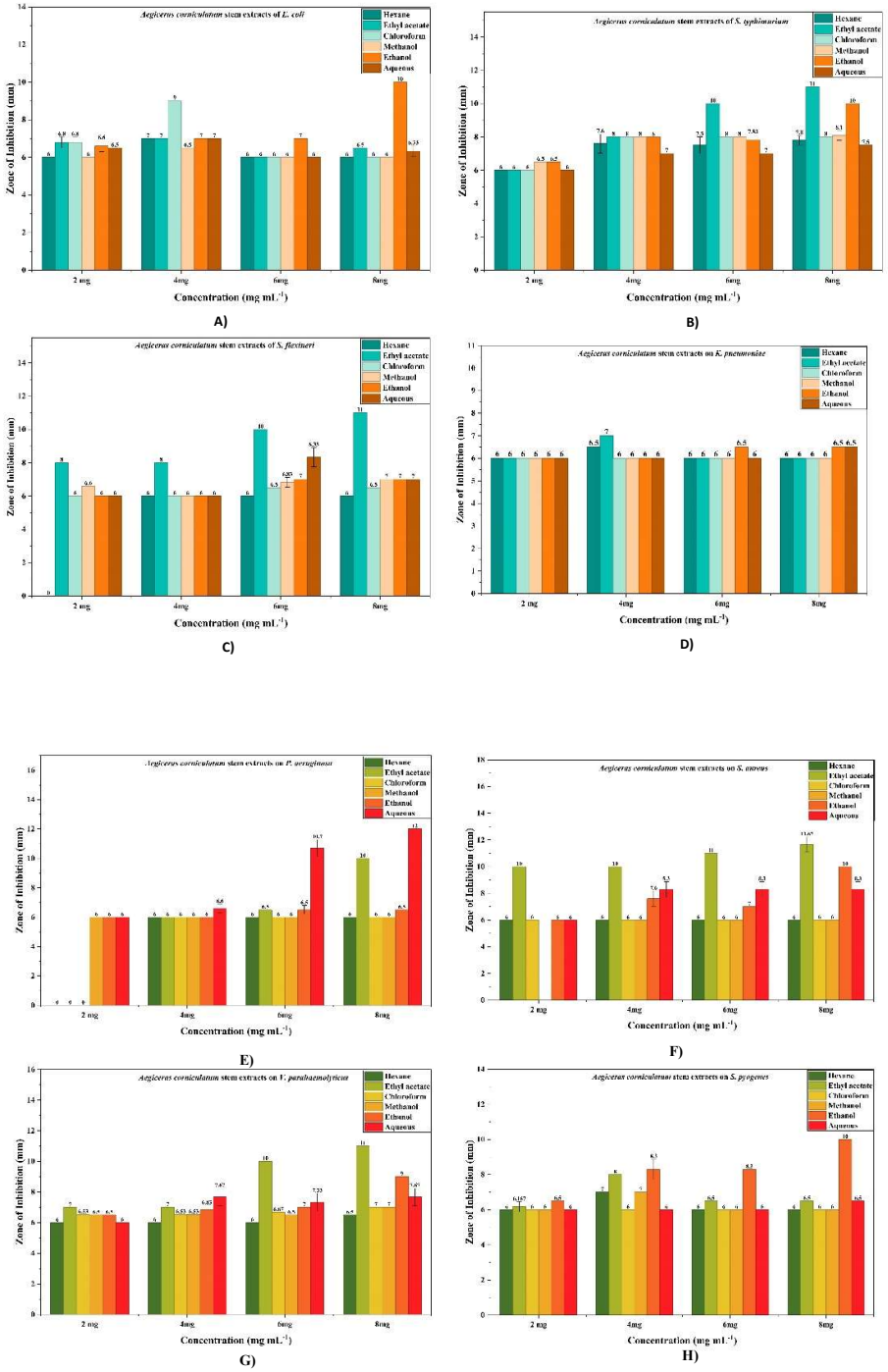

Fig 3: Antibacterial activity of stem extracts of *Aegiceras corniculatum* against A*) E. coli* B) *S. typhi* C) *S. flexneri* D) *K. pneumoniae* E) *P. aeruginosa* F) *S. aureus* G) *V. parahaemolyticus* H) *S. pyogenes*

Similar zone of inhibitions (6–10 mm) at 2-8mg/ml was obtained with methanol extract against *Salmonella typhi, S. aureus,* and *Streptococcus pyogenes*. The *Pseudomonas aeruginosa* is susceptible to aqueous extract with a zone of inhibition of 12mm. These results corroborates earlier observations that mangrove-derived secondary metabolites possess broad-spectrum antimicrobial properties (Sarkar et al., 2024); (Noshin et

al., 2024), and highlighting the therapeutic importance of this mangrove species (Janmanchi et al., 2017). However remaining extracts exhibited lowest activity against all tested organisms suggesting that antibacterial compounds in *A. corniculatum* are predominantly polar or moderately polar. Owing to outer membrane barrier in Gram negative bacteria, generally display higher resistance to antimicrobials, yet moderate inhibition was seen in this study indicates effective penetration of active phytoconstituents.

The present experimental data reveal that, the leaf ethyl acetate extracts of *A. corniculatum* possess potential antibacterial activity against *S. aureus* and *V. parahaemolyticus*, followed by *S. typhi* and *S. flexneri* with ethyl acetate. Stem extracts exhibited high sensitivity against *P. aeruginosa*. Stem methanol extract also showed similar inhibitions of 10mm against *E. coli, S. typhi, S. aureus, V. parahaemolyticus* and *S. pyogenes*.

Conclusion

Among the plant parts studied, the leaf ethyl acetate extracts of *A. corniculatum* showed greater antibacterial activities compared to remaining extracts. Phenols, steroids and flavonoids which are known to possess multiple biological activities are commonly found in this plant extracts, and it may be a valuable means to discover new healing drugs for various infectious diseases caused by MDRs to treat both acute and chronic diseases. Comparative analysis among plant parts and solvents emphasizes that differential distribution of phytochemicals and solvent polarity acutely influence the extraction efficiency of bioactive compounds and their biological activity. The non polar leaf and polar stem extracts from the selected mangroves showed highest antimicrobial activity in comparison with other solvent extracts. Hence, the study proved that *A. corniculatum* extracts can be used for development of novel bioactive molecules for therapeutic applications. Further downstream work on purifying individual compounds identified using GC-MS would provide a better understanding of the main components having antimicrobial activity.

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