

Urinary Tract Infection and Medicinal Importance of *Anacardium Occidentale*

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ABSTRACT

Urinary tract infections (UTIs) are common infectious diseases affecting the urinary system, with a higher incidence in women and children. They are mainly caused by pathogenic microorganisms such as *Escherichia coli*, *Klebsiella spp.*, *Proteus spp.*, and *Staphylococcus spp.* The growing problem of antimicrobial resistance has increased interest in medicinal plants as alternative or supportive therapies. *Anacardium occidentale* L. (cashew) is a traditionally important medicinal plant known for its wide range of therapeutic properties. Different parts of the plant, including leaves, bark, nuts, and shells, contain bioactive compounds such as anacardic acids, flavonoids, tannins, and phenolic compounds. These constituents possess antimicrobial, anti-inflammatory, antioxidant, and wound-healing activities. Scientific studies have reported that extracts of *A. occidentale* show inhibitory effects against several uropathogenic bacteria, indicating its potential usefulness in the management of urinary tract infections. This abstract emphasizes the causes and significance of UTIs and highlights the medicinal importance of *Anacardium occidentale* as a natural source for developing effective plant-based therapies.

Keywords: Urinary tract infection, *Anacardium occidentale*, uropathogens, medicinal plants, antimicrobial activity, phytochemicals.

I. INTRODUCTION

Urinary tract infection (UTI) is a common infectious disease affecting the urinary system, which includes the kidneys, ureters, bladder, and urethra. UTIs can occur in any part of the urinary tract but are most frequently observed in the lower urinary tract, particularly the bladder and urethra. The condition is primarily caused by bacterial pathogens, with

Escherichia coli being the most common causative organism. Other bacteria such as *Klebsiella spp.*, *Enterococcus spp.*, and *Staphylococcus spp.* are also known to cause UTIs. Common symptoms include pain during urination, frequent and urgent urination, cloudy or foul-smelling urine, and the presence of blood in urine. UTIs are more prevalent in women due to their shorter urethra, which facilitates bacterial entry into the bladder. If untreated, UTIs may

progress to serious complications such as kidney infections; therefore, timely medical intervention is essential (Komala et al., 2013). It has been reported that up to 7% of girls and 2% of boys experience a symptomatic, culture-confirmed UTI by six years of age.

Medicinal plants, also known as herbal medicines or phytotherapy, have been used for centuries across various cultures for disease prevention and health promotion. These plants are rich sources of bioactive compounds and form the basis of many modern pharmaceuticals. The Ayurvedic system of medicine, practiced in India since ancient times, extensively utilizes medicinal plants for therapeutic purposes. In recent decades, Ayurvedic and other herbal remedies have gained global popularity due to their perceived safety and effectiveness (Yogini et al., 2016). Since the Vedic period, medicinal herbs have been employed to treat a wide range of diseases and epidemics. Many plants exhibit additional properties such as anti-inflammatory, antioxidant, antiparasitic, anti-insecticidal, and anti-haemolytic activities. According to the World Health Organization (WHO), approximately 80% of the global population relies on traditional medicine for primary healthcare needs (Bamola et al., 2017).

Plants contain diverse secondary metabolites including tannins, terpenoids, alkaloids, flavonoids, and phenolic compounds, many of which have demonstrated medicinal properties in vitro. Pharmacological studies have validated medicinal plants as valuable sources of bioactive compounds (Biswas et al., 2002).

Anacardium occidentale (cashew) is a medicinally important plant belonging to the family Anacardiaceae. Taxonomically, it is classified under Kingdom Plantae, Phylum Tracheophyta, Class Magnoliopsida, Order Sapindales, Genus *Anacardium*, and Species *occidentale*. Cashew leaves are elliptical to lanceolate, glossy, dark green, and arranged alternately along the branches. Ecologically, the leaves provide shelter for small organisms and

contribute to soil nutrient cycling upon decomposition. Leaves mature within 20–25 days, and flowering may occur at any time, with individual flowers comprising five yellowish-green sepals and five white to reddish petals (Zarqa et al., 2021).

The evergreen cashew tree grows rapidly into a large, multi-branched tree reaching up to 15 meters in height. It is native to northeastern Brazil and tropical America but is widely cultivated in countries such as India, Vietnam, Brazil, Tanzania, and Mozambique. Cashew trees thrive in warm, humid climates with annual rainfall exceeding 1000 mm and can grow up to 1000 meters above sea level (Christopher et al., 2024). Various parts of the cashew plant, including leaves, seeds, and bark, are rich in nutrients and are used in traditional medicine to treat ailments such as cough, diarrhea, stomach ache, allergies, and skin infections (Nkemakolam et al., 2023).

Plants like *A. occidentale* contain phytochemicals such as alkaloids, flavonoids, saponins, terpenes, and tannins, which contribute to their medicinal properties (Yadav et al., 2011). In the present study, qualitative phytochemical analysis and chemical characterization of *Anacardium occidentale* Leaf extracts were carried out using gas chromatography–mass spectrometry (GC–MS). The antibacterial activity of the extract against UTI pathogens was evaluated using the agar well diffusion method.

II. MATERIALS AND METHODS

1) Collection of Plant Material

Fresh leaves of *Anacardium occidentale* were collected from Chittur, Palakkad district, Kerala, India. The collected plant material was washed thoroughly under running tap water followed by rinsing with distilled water to remove dust and contaminants. The leaves were shade-dried at room temperature for 5–10 days until a constant weight was obtained. The dried leaves were then powdered using a mechanical grinder and stored in airtight containers for further analysis.

2) Preparation of Leaf Extract

Twenty grams of dried leaf powder were weighed and transferred into conical flasks containing 200 mL of 70% ethanol. The mixture was kept on a rotary shaker at 200 rpm for 48 hours at room temperature to facilitate extraction. After incubation, the extract was filtered using Whatman No.1 filter paper. A portion (10 mL) of the filtrate was stored in a screw-capped bottle for phytochemical screening, while the remaining extract was concentrated, dried, and stored in Eppendorf tubes at 4°C for further studies.

3) Phytochemical Screening

Qualitative phytochemical analysis of the ethanolic leaf extract was carried out following standard procedures described by Harborne to detect the presence of various secondary metabolites such as alkaloids, flavonoids, terpenoids, saponins, phenols, tannins, glycosides, and reducing sugars.

Alkaloids (Wagner's test): One milliliter of extract was treated with Wagner's reagent. Formation of a brown or reddish precipitate indicated the presence of alkaloids. **Flavonoids (Alkaline reagent test):** One milliliter of extract was treated with 10% sodium hydroxide solution, producing a yellow colour which turned colourless upon addition of dilute hydrochloric acid, confirming the presence of flavonoids. **Terpenoids (Salkowski test):** Two milliliters of chloroform and a few drops of concentrated sulphuric acid were added to the extract. Formation of a reddish-brown ring indicated the presence of terpenoids. **Saponins (Foam test):** The extract was shaken vigorously with distilled water; formation of stable foam confirmed saponins. **Phenols (Ferric chloride test):** Addition of 5% ferric chloride solution to the extract resulted in dark green or bluish-black coloration indicating phenols. **Tannins:** Addition of ferric chloride solution produced blue, black, or brownish-green colour indicating tannins. **Glycosides:** Formation of red colour upon addition of concentrated sulphuric acid indicated the presence of glycosides. **Reducing sugars (Fehling's test):** Filtrate

was boiled with Fehling's solution A and B; formation of orange or red precipitate confirmed reducing sugars.

4) Collection of Clinical Samples

Urine samples were collected from a clinical laboratory in Kanjikode, Palakkad district, using sterile containers. The samples were immediately transported to the Department of Microbiology, Sree Narayana Guru College, and processed without delay. The samples were streaked onto Nutrient agar and MacConkey agar plates and incubated at 37°C for 24 hours to isolate bacterial pathogens.

5) Identification and Characterization of Bacterial Isolates

Gram Staining

Bacterial smears were prepared on clean glass slides and heat-fixed. The smears were stained with crystal violet for 1 minute, followed by Gram's iodine for 1–2 minutes. Decolorization was done using 95% ethyl alcohol, and the slides were counterstained with safranin for 30 seconds. The slides were washed, air-dried, and examined under a light microscope.

Biochemical Characterization:

The bacterial isolates were characterized using standard biochemical tests to confirm their identity. These tests included Indole, Methyl Red, Voges–Proskauer, Citrate utilization, Triple Sugar Iron, Urease, Catalase, and Oxidase tests. The results were interpreted based on standard microbiological procedures.

6) GC–MS Analysis

The chemical constituents of *Anacardium occidentale* leaf extract were analyzed using Gas Chromatography–Mass Spectrometry (GC–MS) with a QP2010 Ultra system. The column oven temperature was maintained at 100°C, injection temperature at 250°C, and split injection mode was used. Linear velocity flow control was applied with a column flow rate of 1 mL/min and total flow of 24 mL/min. The pressure was maintained at 73 kPa, and purge flow at 3 mL/min.

7) Antibacterial Activity

The antibacterial activity of the leaf extract was evaluated using the agar well diffusion method. Bacterial strains were inoculated into nutrient broth and incubated at 37°C for 18–24 hours. Mueller–Hinton agar plates were swabbed evenly with bacterial suspensions. Wells were aseptically bored into the agar, and varying concentrations of the extract (20 μ L, 40 μ L, 60 μ L, and 80 μ L) were added. The plates were incubated at 37°C for 24 hours, and the zones of inhibition were measured to assess antibacterial efficacy.

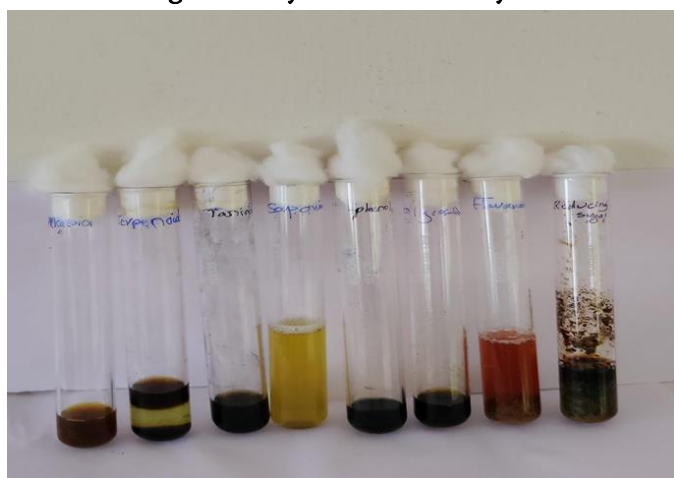
III.RESULTS

The results of phytochemical analysis were shown on figure 1 and table 1

Table: 1

S No	Constituents Results	Constituents Results
1	Alkaloids	+
2	Flavonoids	-
3	Terpenoids	+
4	Saponins	+
5	Tannins	+
6	Tannins	+
7	Glycosides	+
8	Reducing sugar	+

Figure 1 Phytochemical analysis



Identification of bacteria from clinical sample

The bacterial samples were streaked on selective media, which is shown in figure 2

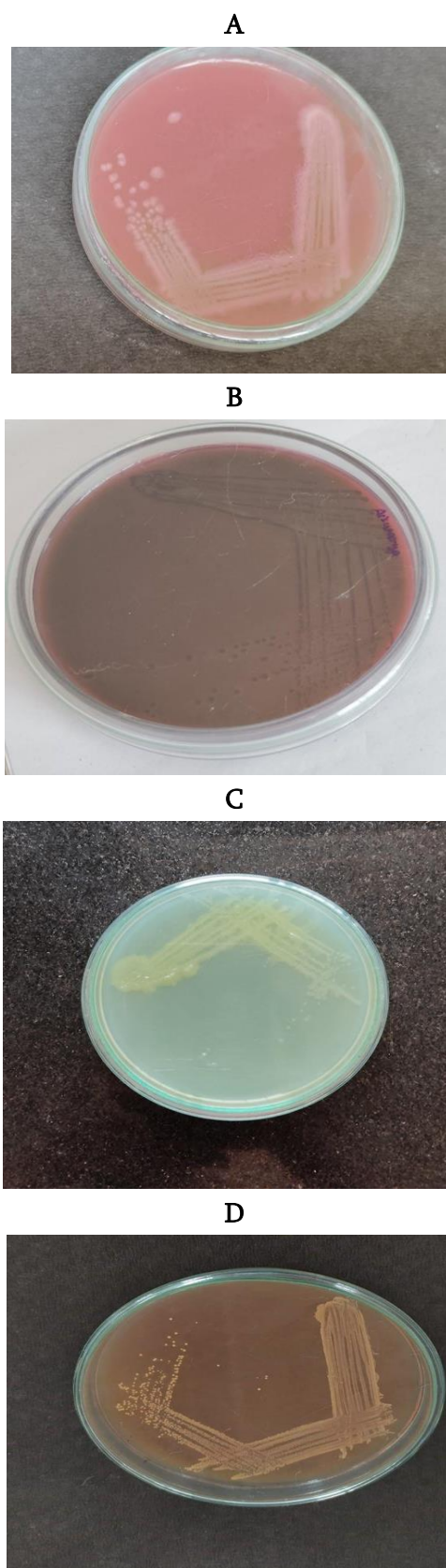


Fig : 2 A and B *E coli* , C- *Staphylococcus sp*, D - *Pseudomonas sp*

Table: 2 Gram staining Results

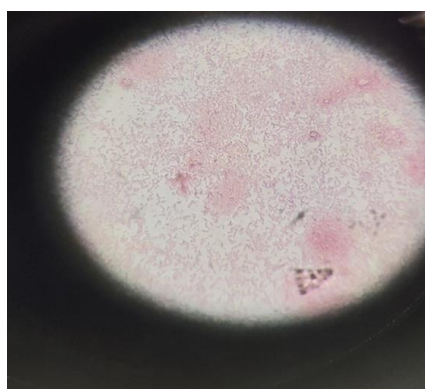
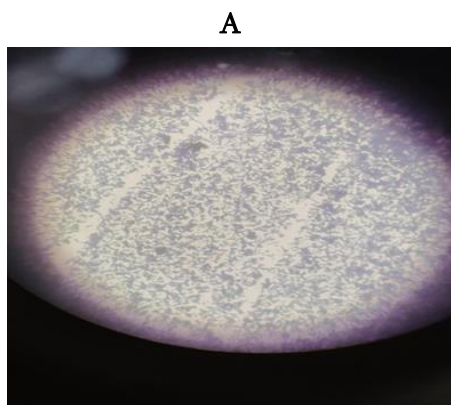
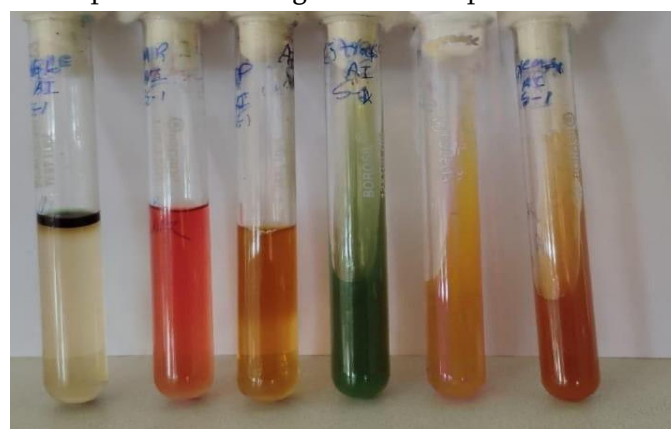
S.No	Organisms	Morphological characteristics
1	<i>E coli</i>	Gram negative rod appear in pink colour
2	<i>Staphylococcus sp</i>	Gram positive cocci appear in violet colour in cluster form
3	<i>Pseudomonas sp</i>	Gram negative rod appears in pink colour.

Biochemical tests

Table 3: biochemical tests

S	Biochemical test	<i>E coli</i>	<i>Staphylococcus sp</i>	<i>Pseudomonas sp</i>
1	Indole	+ve	-	-ve
2	Methyl red	+ve	-	-ve
3	Vogesproskaur	-ve	-	-ve
4	Citrate	-ve	-	+ve
5	TSI	A/A/gas	-	Alk/alk
6	Urease	-ve	-	-ve
7	Catalase	+ve	+ve	+ve
8	Oxidase	-ve	-ve	+ve

+ ve = positive -ve = negative - = Not performed

Fig :3 A- *E coli* B- *Staphylococcus sp* C - *Pseudomonas sp*Fig 4: A - *E coli*B - *Pseudomonas sp*

+ ve = positive -ve = negative - = Not performed

GC - MS analysis

Peak	R.Ti me	Area %	Name	Name Biological activities
6	18.78	15.31	2,4-Di-tert-butyl phenol	Antioxidant, antifungal and antibacterial
24	44.88	12.27	Gamma-sitosterol	Antihyperglycemic, Antiulcer, anticancer
9	26.84	6.77	1-Nonadecene	Anti-inflammatory
16	34.92	5.16	Octacosanol	Anti-inflammatory, antioxidant, Hepatoprotective, Neuroprotective
8	21.85	4.38	Hexadecane	Antibacterial, antioxidant
10	27.01	4.29	Eicosane	Anti-inflammatory and antimicrobial
19	38.34	3.78	1-Heptacosanol	Anti-hypercholesterolemic
4	14.49	3.75	1-Tetradecanol	Antimicrobial

GC-MS Analysis

Peak Report TIC			
Peak#	R.Time	Area	Area% Name
1	7.397	106981	2.05 1-Dodecanol
2	7.654	161492	3.09 TETRADECANE
3	13.981	161486	3.09 Biphenyl
4	14.490	195766	3.75 1-Tetradecanol
5	14.810	167145	3.20 TETRADECANE
6	18.786	798791	15.31 2,4-Di-tert-butylphenol
7	21.621	337220	6.46 1-Nonadecene
8	21.852	228397	4.38 Hexadecane
9	26.849	353539	6.77 1-Nonadecene
10	27.017	223799	4.29 Eicosane
11	27.837	86351	1.65 Neophytadiene
12	30.273	75923	1.45 Dibutyl phthalate
13	31.145	321227	6.16 1-Nonadecene
14	31.275	191955	3.68 Eicosane
15	33.344	81339	1.56 PHYTOL ISOMER
16	34.924	269352	5.16 Octacosanol
17	35.029	120104	2.30 Dotriacontane
18	37.555	181554	3.48 O O'-BIPHENOL, 4,4',6,6'-TETRA-T-BUTYL
19	38.346	197436	3.78 1-Heptacosanol
20	38.434	80429	1.54 Dotriacontane
21	41.496	132096	2.53 Octacosanol
22	41.569	43871	0.84 Tetrapentacontane
23	44.416	62177	1.19 1-Hexacosanol
24	44.886	640098	12.27 gamma-Sitosterol
		5218528	100.00

Antibacterial activity

*E coli**Staphylococcus sp**Pseudomonas sp*

GC-MS Chromatogram of ethanolic extract

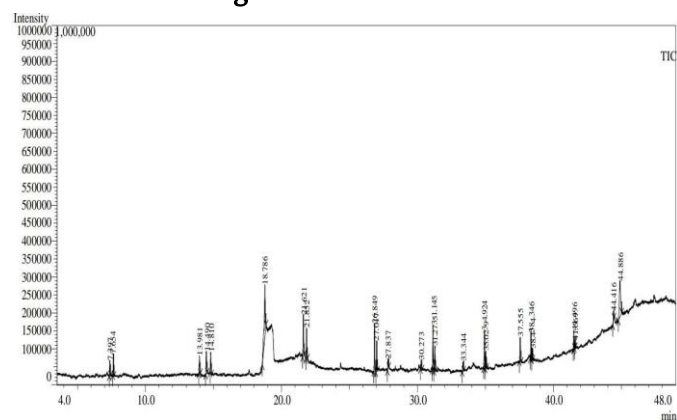


Table 4: Antibacterial activity

Organisms	Zone of inhibition			
	20µl	40µl	60µl	80µl
<i>E coli</i>	9mm	15mm	17mm	18mm
<i>Staphylococcus sp</i>	10mm	17mm	20mm	22mm
<i>Pseudomonas sp</i>	11mm	13mm	15mm	17mm

IV. DISCUSSION

In this study the preliminary phytochemical screening of ethanolic extract of *Anacardium occidentale* showed the presence of alkaloids, terpenoids, saponins, phenol, tannins, glycoside and reducing sugar. (Abulude et al., 2010) reported the presence of flavonoids and absences of tanins on the leaf extract. GC-MS revealed that 2,4-Di-tert-butylphenol is higher in ethanolic extract, which shows biological activities like Antioxidant, Antifungal and antibacterial. The other components of leaf extract have properties of Antiulcer, Anticancer, Anti-inflammatory, Antioxidant, Antimicrobial etc. Each of the components present on leaf extract have pharmaceutical application. The leaf extract showed the antibacterial activities against both gram negative and gram positive bacteria that causes UTI. Zone of inhibition is greater on *Staphylococcus* sp than *E coli* and *Pseudomonas* sp. (Akash et al., 2009) reported that the *Staphylococcus* sp have greater zone of inhibition

V. CONCLUSION

In this study it is concluded that the ethanolic extract of *Anacardium occidentale* leaf have various phytochemical constituents. GC-MS analysis revealed the presence of components that will lower the risks of numerous diseases. The leaf extract showed antibacterial activity against both gram positive and gram negative bacteria. This suggests the possibility of different antibiotic substances in the leaf, which could lead to the creation of new antibacterial agents. The extracts can be utilized for the creation of new medications because they exhibit broad spectrum antibacterial action.

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