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GC-MS PROFILING, BIOACTIVE COMPOUND SCREENING AND ANTIBACTERIAL EVALUATION OF *IPOMOEA ERIOCARPA* (CONVOLVULACEAE) LEAF EXTRACTS USING DIFFERENT SOLVENTS.

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Abstract

Ipomoea eriocarpa (Convolvulaceae) is a medicinal plant traditionally used to treat fever, wounds, inflammation, and gastrointestinal disorders. This study evaluated the phytochemical composition, antibacterial activity, and GC–MS profile of solvent extracts of *Ipomoea eriocarpa* leaves. Leaves extracts were prepared using Soxhlet extraction with hexane, petroleum ether, toluene, chloroform, acetone, and ethanol. Preliminary phytochemical screening revealed the presence of alkaloids, steroids, terpenoids, phenolic compounds, cardiac glycosides, coumarins, reducing sugars, quinones, amino acids, and essential oils. Antibacterial activity was assessed against *Vibrio vulnificus*, *Bacillus megaterium*, *Pseudomonas aeruginosa*, *Escherichia coli*, and *Vibrio cholerae*. Among the extracts, ethanol exhibited the highest antibacterial activity and was therefore selected for GC–MS analysis. The analysis identified several bioactive compounds with known antimicrobial properties, supporting the observed biological activity. The findings indicate that *Ipomoea eriocarpa* leaves is a promising source of bioactive phytochemicals with potential applications in the development of natural antibacterial agents and pharmaceutical formulations.

Introduction

Medicinal plants have been used for centuries as valuable sources of therapeutic agents for the prevention and treatment of various diseases. The increasing emergence of antimicrobial resistance and the side effects associated with synthetic antibiotics have stimulated worldwide

interest in identifying novel bioactive compounds from medicinal plants. Plant-derived secondary metabolites, including alkaloids, flavonoids, phenolics, terpenoids, steroids, glycosides, and coumarins, exhibit diverse pharmacological properties such as antimicrobial, antioxidant, anti-inflammatory, and anticancer activities. These natural compounds are considered promising alternatives for the development of safe and effective therapeutic agents (Atanasov et al., 2021; Sharma et al., 2022).

The genus *Ipomoea* (Convolvulaceae) comprises numerous species widely distributed in tropical and subtropical regions. Several *Ipomoea* species have been traditionally used to treat fever, inflammation, skin infections, gastrointestinal disorders, wounds, and microbial diseases. Previous phytochemical investigations have demonstrated that members of this genus contain a wide range of biologically active constituents responsible for their medicinal properties, including antimicrobial and antioxidant activities (Singh et al., 2021; Kumar et al., 2023).

Ipomoea eriocarpa R.Br. is an annual twining herb traditionally employed in folk medicine for the treatment of fever, wounds, inflammation, and digestive disorders. Despite its ethnomedicinal importance, scientific information regarding the phytochemical composition and antibacterial potential of its leaves remains limited. Therefore, comprehensive phytochemical characterization and biological evaluation are essential to validate its traditional uses and identify compounds with potential pharmaceutical applications.

Extraction using solvents of different polarities enables the recovery of a broad spectrum of phytochemicals from plant materials. Preliminary phytochemical screening provides qualitative information on major classes of secondary metabolites, while Gas Chromatography–Mass Spectrometry (GC–MS) is a reliable analytical technique for identifying volatile and semi-volatile bioactive compounds present in plant extracts. Combining phytochemical screening, antibacterial evaluation, and GC–MS analysis offers valuable insights into the relationship between chemical composition and biological activity.

Therefore, the present study aimed to investigate the phytochemical constituents, antibacterial activity, and GC–MS profile of solvent extracts prepared from the leaves of *Ipomoea eriocarpa*. The findings are expected to provide scientific evidence supporting the medicinal potential of this species and contribute to the discovery of natural antibacterial compounds for future pharmaceutical applications.

Objectives

1. To qualitatively analyze the phytochemical constituents of *Ipomoea eriocarpa* leaf extracts.

2. To screen the phytochemical composition of leaf extracts prepared using different solvents (hexane, petroleum ether, toluene, chloroform, acetone, ethanol, and aqueous).
3. To evaluate the antibacterial activity of the different leaf extracts against selected human pathogenic bacteria.
4. To identify and characterize the bioactive compounds present in the ethanol leaf extract of *Ipomoea eriocarpa* using GC–MS analysis.

Materials and Methods

Plant Material

Fresh leaves of *Ipomoea eriocarpa* (Convolvulaceae) were collected from the campus of G. Venkataswamy Naidu College (Autonomous), Kovilpatti, Tamil Nadu, India. The plant was authenticated by Dr. R. Lakshmanan, Assistant Professor, PG and Research Department of Botany, G. Venkataswamy Naidu College, using standard floras (Gamble, 1928; Matthew, 1981). The leaves were washed, shade-dried at room temperature, and powdered using a mechanical grinder (Figure.1).

Plate. 1: Natural Habit of *Ipomoea eriocarpa* R.Br.

Chemicals and Reagents

Analytical-grade solvents including hexane, petroleum ether, toluene, chloroform, acetone, ethanol, and distilled water were used for extraction (Table 1). All chemicals and reagents required for phytochemical screening and antibacterial assays were procured from Precision Scientific Suppliers, Tirunelveli.

Table. 1: Details of selected solvents and Soxhlet unit running parameters of Leaves of *Ipomoea eriocarpa* R.Br.

S.No.	Name of the Solvent	Boiling Point	Polarity	Total No. of Cycles	Soxhlet Total Running Hours
1.	Hexane	60^0 C	0.1	22	3
2.	Toluene	110.6	2.4	19	3
3.	Acetone	56.3	5.1	17	3

4.	Petroleum Ether	60	0.1	15	3
5.	Chloroform	111^0 C	4.1	13	3
6.	Ethanol	78.4	5.2	12	3
7.	Aqueous	100	10.2	11	3

Methods

Soxhlet Extraction

About 10 g of powdered leaf material was extracted separately with 200 mL of each solvent using a Soxhlet apparatus for 6–8 h. The extracts were concentrated under reduced pressure using a rotary evaporator at 40°C and stored at 4°C until further analysis.

Phytochemical Screening

The solvent extracts were qualitatively screened for the presence of alkaloids, steroids, reducing sugars, phlobatannins, coumarins, terpenoids, cardiac glycosides, phenolic compounds, quinones, amino acids, and essential oils using standard phytochemical methods described by Harborne (1998) and Trease and Evans (2009).

Antibacterial Activity Assay

The antibacterial efficacy of *Ipomoea eriocarpa* leaf extracts (hexane, toluene, acetone, petroleum ether, chloroform, ethanol, and water) was evaluated using the disc diffusion method against five pathogens: *Vibrio vulnificus*, *Bacillus megaterium*, *Pseudomonas aeruginosa*, *Escherichia coli*, and *Vibrio cholerae* (obtained from K.R. College of Arts and Science, Kovilpatti). Bacterial strains were cultured in nutrient broth at 37°C for 18–24 h and standardized to a 0.5 McFarland standard (~1 x 10^8 CFU/mL). The adjusted suspensions were spread uniformly across nutrient agar plates using a sterile spreader. Sterile filter paper discs (6 mm in diameter) impregnated with 10 µL of each extract (100 mg/mL) were placed on the inoculated media. Tetracycline and Dimethyl Sulfoxide (DMSO) served as the positive and negative controls, respectively. After incubating the plates at 37°C for 24 h, the zones of inhibition (ZOI) were measured in millimeters (mm) using a caliper to quantify antibacterial potency.

GC-MS Analysis

Bioactive compound profiling of the Ipomoea eriocarpa leaf ethanol extract was performed using a Perkin Elmer Clarus 680 Gas Chromatograph coupled with a Perkin Elmer Clarus 600 Mass Spectrometer. Chromatographic separation was achieved on Perkin Elmer Elite-5MS non-polar column (30 m x 250 µm x 0.25 µm) using helium as the carrier gas at a constant flow rate of 1.0 mL/min. A 1 µL sample was injected at 260° C with a split ratio of 10:1 and a solvent delay of 2.20

minutes. The oven temperature program was initialized at 60°C (held for 2 minutes), ramped to 250° C at a rate of 10°C/min, and held at 250°C for 5 minutes. The mass spectrometer operated with both the ion source and transfer line temperatures set at 240°C, acquiring mass spectral data across a scan range of 40–600 Da.

Results and Discussion

Qualitative Phytochemical Screening

The qualitative phytochemical screening of *Ipomoea eriocarpa* leaf extracts revealed that the extraction efficiency varied with solvent polarity (Table 2; Plate 2). Ethanol extracted the highest number of phytochemicals, including steroids, reducing sugars, coumarins, terpenoids, and phenolic compounds, indicating its superior extraction ability. Toluene and chloroform showed moderate extraction efficiency, while acetone and aqueous extracts contained fewer phytoconstituents. Petroleum ether exhibited the lowest extraction efficiency, detecting only cardiac glycosides. The presence of alkaloids, terpenoids, steroids, phenolics, and coumarins suggests that *I. eriocarpa* is a rich source of biologically active compounds with potential medicinal value.

Table. 2: Qualitative analysis of Phytochemicals Constituents of Leaves of *Ipomoea eriocarpa* using various Solvent Extracts

S.No.	Name of the Test	Hexane	Toluene	Acetone	Petroleum Ether	Chloroform	Ethanol	Aqueous
1.	Alkaloids	+	+	-	-	-	_	+
2.	Steroids	-	+	+	-	+	+	-
3.	Reducing sugar	-	-	-	-	+	+	+
4.	Phlobatanins	-	-	-	-	-	-	-
5.	Coumarins	+	-	-	-	-	+	-
6.	Terpenoids	-	+	+	-	+	+	+
7.	Cardiac glycosides	-	-	-	+	+	+	-
8.	Phenolic groups	-	-	+	-	-	+	+
9.	Quinones	+	+	+	-	-	-	-
10.	Aminoacids	-	-	-	-	-	-	-
11.	Essential oils	-	+	-	-	+	-	-
Total No. of Phytochemicals		**3**	**5**	**4**	**1**	**5**	**6**	**4**

Note: (+) Present; (-) Absent

Antibacterial Activity

The antibacterial activity of *Ipomoea eriocarpa* leaf extracts was evaluated against five human pathogenic bacteria using the disc diffusion method (Table 3). Acetone extract exhibited the highest activity against *Bacillus megaterium* (11.6 mm) and *Pseudomonas aeruginosa* (8.6 mm), whereas toluene showed maximum inhibition against *Vibrio cholerae* (17.0 mm) and *Vibrio vulnificus* (10.6 mm). Ethanol also demonstrated appreciable antibacterial activity, particularly against *Escherichia coli*. Petroleum ether showed the least activity. The antibacterial effects are likely associated with the presence of phenolics, terpenoids, steroids, and alkaloids, supporting the therapeutic potential of *I. eriocarpa*.

Table. 3: Using a disc diffusion technique, *Ipomoea eriocarpa* leaves exhibit Antibacterial activity against a variety of Human Pathogens.

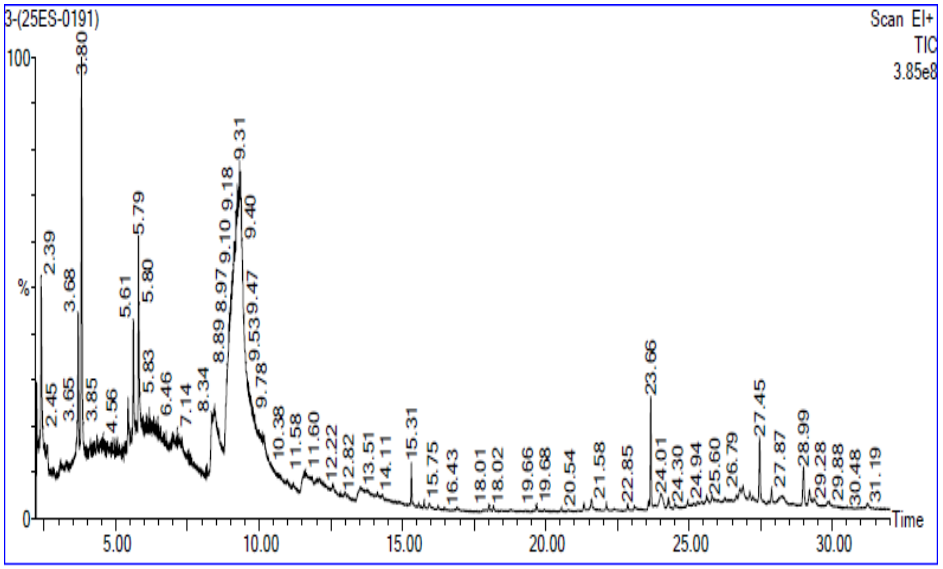
S. No	Pathogens	Antibacterial activity - Zone of Inhibition (mm)						
		Hexane	Toluene	Acetone	Petroleum Ether	Chloroform	Ethanol	Aqueous
1.	*Bacillus megaterium*	7.3	9.6	11.6	8.6	8.3	7.6	11
2.	*Pseudomonas aeruginosa*	7.6	9.6	86	11	9	9.6	7.6
3.	*Vibrio vulnificus (Green*	8.6	10.6	7	8	7.3	8.6	8.3
4.	*Vibrio cholera (Yellow)*	10	17	9	8.3	8	9.3	9.6
5.	*E.coli*	7.3	8.6	10.3	8.3	7.3	8.6	7.6

GC–MS Analysis

GC–MS analysis of the ethanol extract identified twelve bioactive compounds (Fig.2; Table 4). The major constituent was 1-Deoxy-D-Arabitol (61.816%), followed by 2-Isopropoxyethylamine (8.886%) and Diglycolic acid (6.566%). Biologically important compounds such as Squalene and Urs-12-en-28-ol were also detected, both known for their antioxidant and anti-inflammatory properties. The identified metabolites correlate well with the phytochemical screening and antibacterial results, suggesting that the

therapeutic potential of *I. eriocarpa* is due to the combined action of these bioactive compounds. Overall, the study highlights *I. eriocarpa* as a promising natural source of antimicrobial and medicinal agents.

Figure 1: GC-MS Qualitative Assessment of *Ipomoea eriocarpa* Leaves using Ethanol Extract.



#	RT	Scan	Height	Area	Area %	Norm %
1	2.238	8	112,648,072	5,023,869.5	2.566	4.15
2	2.388	38	188,608,704	17,400,148.0	8.886	14.37
3	2.604	81	33,152,780	2,411,279.0	1.231	1.99
4	3.684	297	113,553,088	4,179,951.2	2.135	3.45
5	3.804	321	329,119,840	12,857,580.0	6.566	10.62
6	5.615	683	97,632,024	3,660,482.2	1.869	3.02
7	5.790	718	161,313,888	5,634,321.0	2.877	4.65
8	8.451	1250	56,426,712	15,296,798.0	7.812	12.64
9	9.311	1422	245,812,672	121,050,040.0	61.816	100.00
10	11.602	1880	13,533,232	2,732,726.0	1.396	2.26
11	23.657	4290	91,913,216	3,136,034.5	1.601	2.59
12	27.453	5049	54,086,124	2,438,385.2	1.245	2.01

Table No. 4: Phytochemical Compounds (GC-MS) of *Ipomoea eriocarpa* Leaves using Ethanol Extract.

Peak	RT	Area %	Name of the Compound	Molecular Formula	Molecular Weight (g /mol)	IUPAC Name
1	2.238	2.566	CARBAMIMIDOTHIOIC ACID, METHYL ESTER	$C_2H_6N_2S$	90.15	methyl carbamimidothioate
2	2.388	8.886	2-ISOPROPOXYETHYLAMINE	$C_5H_{13}NO$	103.16	2-propan-2-yloxyethanamine
3	2.604	1.231	FORMIC ACID, 1-METHYLETHYL ESTER	$C_4H_8O_2$	88.11	propan-2-yl formate
4	3.684	2.135	ACETAMIDE, N-METHYL-2-(METHYLAMINO)-2-THIOXO-	$C_4H_8N_2OS$	132.19	N-methyl-2-(methylamino)-2-sulfanylideneacetamide
5	3.804	6.566	DIGLYCOLIC ACID	$C_4H_6O_5$	134.09	2-(carboxymethoxy)acetic acid
6	5.615	1.869	1-PROPANAMINE, N,2-DIMETHYL-N-NITROSO-	$C_5H_{12}N_2O$	116.16	N-methyl-N-(2-methylpropyl)nitrous amide
7	5.790	2.877	UREA, TRIMETHYL-	$C_4H_{10}N_2O$	102.14	1,1,3-trimethylurea
8	8.451	7.812	O-METHYLISOUREA	$C_2H_6N_2O$	74.08	methyl carbamimidate
9	9.311	61.816	1-DEOXY-D-ARABITOL	$C_5H_{12}O_4$	136.15	pentane-1,2,3,4-tetrol
10	11.602	1.396	CYCLOBUTANOL	C_4H_8O	72.11	cyclobutanol
11	23.657	1.601	SQUALENE	$C_{30}H_{50}$	410.7	(6E,10E,14E,18E)-2,6,10,15,19,23-hexamethyltetracosa-2,6,10,14,18,22-hexaene
12	27.453	1.245	URS-12-EN-28-OL	$C_{30}H_{50}O$	426.7	[(1S,2R,4aS,6aR,6aS,6bR,8aS,12aS,14bS)-1,2,6a,6b,9,9,12a-heptamethyl-2,3,4,5,6,6a,7,8,8a,10,11,12,13,14b-tetradecahydro-1H-picen-4a-yl]methanol

Discussion

Phytochemical Screening and GC-MS Profile

Phytochemical screening of *Ipomoea eriocarpa* revealed a rich profile of bioactive secondary metabolites, including alkaloids, flavonoids, phenolic compounds, terpenoids, and glycosides, which underpin its traditional medicinal applications. These findings align with Kumar et al. (2018), who linked similar alkaloid and flavonoid profiles to antimicrobial activity. The identification of squalene in this study corroborates findings by Liu et al. (2020), emphasizing its potential antioxidant and anticancer benefits. Furthermore, the presence of sugar alcohols like 1-deoxy-D-arabitol—noted by Yang et al. (2019) for mitigating oxidative stress and microbial growth—complements the well-documented antioxidant and anti-inflammatory properties of flavonoids and phenolics. The identified terpenoid profile

aligns with reports on related species, such as *Ipomoea aquatica* and *Ipomoea batatas* (Soni et al., 2015; Kumar et al., 2020), reinforcing the conserved chemical diversity and broad therapeutic potential across the genus *Ipomoea*.

Antibacterial Efficacy

I.eriocarpa leaf extracts displayed marked antibacterial efficacy against key human pathogens, with acetone and ethanol extracts demonstrating superior potency against *Escherichia coli*, *Vibrio cholerae*, and *Pseudomonas aeruginosa*. These results mirror prior observations in *I.aquatica* and *I.batatas* (Soni et al., 2015; Kumar et al., 2020). The observed antimicrobial potency is primarily driven by the synergistic action of polar bioactive constituents—such as flavonoids, phenolics, and terpenoids—which disrupt microbial cell membranes and metabolic pathways (Chavez et al., 2017; Yang et al., 2019). Conversely, the minimal activity observed in petroleum ether extracts indicates that non-polar solvents are less effective for extracting these active antimicrobial constituents. Overall, these findings substantiate the ethnobotanical utility of *I.eriocarpa* and highlight its potential as a source of natural antimicrobial agents.

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