

GC-MS Based Profiling, Antimicrobial Activity of *Corchorus trilocularis* L. Leaf Extract from area of Lonar Lake: A Distinctive Saline Crater Lake in India

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ABSTRACT

Lonar Lake is a unique salt water lake. Crater Lake, situated in Maharashtra's Buldhana district, India, is surrounded by thick forest that contain a variety of medicinal plants. *Corchorus trilocularis* L., a plant from the Tiliaceae family, is used in traditional medicine. The species in this family have cholesterol-lowering, anti-inflammatory, and demulcent properties. The present research was undertaken in order to assess *Corchorus trilocularis* L.'s phytoconstituents and in vitro pharmacological evaluations. Analysis for the ethyl acetate extracts yielded 35 phytochemical substance, however the acetone extracts yielded 33 phytochemical compounds. These compounds were identified via examining mass spectra and comparing their retention time and peak area to those reported in the literature. Antibacterial and antifungal characteristics of extracts prepared with solvents such as water, methanol, ethanol, acetone, ethyl acetate and n-hexane were examined using the agar disc diffusion method. Beyond its anti-inflammatory, antimicrobial, and antioxidant capacities, *Corchorus trilocularis* L. phytoconstituents could bring more positive results for therapy such as lowering requirements for synthetic medicines.

Keywords: GC-MS, Phytochemicals, Lonar Lake, *Corchorus trilocularis* L. Antibacterial activity, Antifungal activity.

INTRODUCTION

Impact structures formed by extraterrestrial bolide collisions, such as the Barringer Crater in Arizona, USA, and the Lonar Crater in Maharashtra, India represent uncommon geomorphological features on the terrestrial surface [1,2]. Lonar Lake, situated in Maharashtra's Buldhana district (India), is a saline crater lake generated by the impact of a large extraterrestrial body. Distinguished as the sole hypersaline lake in Asia, it represents a unique geomorphological formation resulting from meteorite collision. The lake is encircled by dense vegetation, comprising a biodiverse forest ecosystem that harbors numerous valuable flora with pharmacological significance [3]. Plants serve as a significant reservoir of bioactive compounds, particularly within ethnomedicinal practices, and these phytochemicals are employed in the management of diverse pathological conditions [4]. In India, the traditional practices of Unani, Ayurveda, Homeopathy, and

Siddha prescribe over 90% plant-based medications [5]. Research has demonstrated that the pharmacological efficacy of medicinal plants is attributed to their secondary metabolites, such as alkaloids, terpenoids, glycosides, phenolics, and various organic constituents that are biosynthesized throughout various tissues of the plant [6]. The existence of these compounds increases the potential for antidiabetic [7], antioxidant [8], anti-inflammatory [9,10], antimicrobial activities [11,12], anti-urease [13] of medicinal plants in a lesser or larger capacity [14]. *Corchorus trilocularis* L. (Tiliaceae) is a popular plant in India, and it is available year-round. The herb has been claimed to exhibit anti-inflammatory and demulcent properties [15]. *Corchorus trilocularis* is also utilized for the treatment of syphilis in Indian traditional folklore medicine [16]. The *Corchorus trilocularis* L. Leaf extracts holds significant pharmacological value. In order to encourage industrialization and modernization, this study focuses on the GC-MS study of the phytochemicals

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present in the leaves and their respective fractions. Subsequently, *in vitro* assays will be conducted to determine the different extracts that predominantly exhibits antimicrobial activity for the first time. Gas chromatography mass spectrometry (GC–MS) is an analytical methodology that integrates the principles of gas–liquid chromatographic separation with mass spectrometric detection, enabling the identification and characterization of diverse chemical constituents within a given specimen^[17,18]. Gas chromatography–mass spectrometry (GC–MS) was employed to profile phytoconstituents present in acetone and ethyl acetate fractions. The antimicrobial efficacy of extracts prepared with solvents including n-hexane, ethyl acetate, acetone, ethanol, methanol, and water was subsequently evaluated through the agar disc-diffusion assay to assess antibacterial activity^[19]. Foliar specimens were collected from Lonar Crater Lake, Maharashtra, India.

MATERIALS AND METHODS

Sample collection

Foliar specimens were sampled during the monsoon season (June 2023) from the Lonar Crater Forest locality (Latitude: 19.975964; Longitude: 76.501528), Buldhana District, Maharashtra, India. The collected material was taxonomically identified and subsequently deposited in the Herbarium of the Department of Botany Herbarium Dr. Babasaheb Ambedkar Marathwada, University Chh.Sambhajinagar (Accession no.-01157). Vegetal specimens were air-dried under shade, pulverized into fine powder, and stored at -4°C for subsequent experimental utilization.

Preparation of Extracts

Approximately 5 g of pulverized foliar material was sequentially extracted employing a Soxhlet extractor with the following solvents: n-hexane, ethyl acetate, acetone, ethanol, and methanol^[20,21]. An aqueous extract was prepared through maceration, wherein pulverized foliar material was immersed in distilled water for 72h with intermittent agitation. The mixture was subsequently filtered through Whatman No.1 filter paper, and the resulting crude filtrate was utilized for preliminary phytochemical screening.

Phytochemical Analysis

Preliminary Phytochemical Screening of the Extracts

Phytochemical profiling of n-hexane, ethyl acetate, acetone, ethanol, and methanol fractions was performed following standardized protocols to elucidate the bioactive constituents. The qualitative assessment encompassed alkaloids, saponins, phenolics, tannins, anthraquinones, terpenoids, flavonoids, and steroids^[22–25].

Test for Alkaloids (Wagner's Reagent Test) ^[26]

The phytochemical fractions were acidified with hydrochloric acid and subsequently filtered. Wagner's reagent (iodine solution in potassium iodide) was then applied to the filtrates, wherein the formation of a reddish-brown precipitate confirmed the presence of alkaloids.

Phenol Test (Ferric Chloride Test) ^[27]

A 50 mg portion of the extract was solubilized in 5 mL of distilled water, followed by the addition of several drops of a neutral 5% ferric chloride solution. The emergence of bluish-green or black coloration signified the presence of phenolic constituents.

Test for Saponins (Foam Test) ^[28]

In a test tube, the crude extract was mixed with 5 mL of distilled water and vigorously agitated for 30 s. The persistence of stable froth for a duration of 10 min indicated the presence of saponins

Test for Terpenoids ^[29]

A portion of the crude extract was solubilized in 2 mL of chloroform and evaporated to dryness. Subsequently, 2 mL of concentrated sulfuric acid was introduced, and the development of a reddish-brown coloration at the interface confirmed the presence of terpenoids.

Test for Tannins (Ferric Chloride Test) ^[30]

Each phytochemical fraction was combined with 1 mL of distilled water and subsequently filtered. The filtrate was treated with ferric chloride reagent, and



the formation of a blue-black, green, or bluish-green precipitate indicated the presence of tannins.

Test for Steroids ^[31]

Each of the four phytochemical fractions was treated with 10 mL of chloroform, followed by the addition of 1 mL of acetic anhydride. Subsequently, 2 mL of concentrated sulfuric acid was carefully introduced along the walls of the test tube. The development of a blue-green coloration at the interface confirmed the presence of steroids.

Test for Flavonoids (Alkaline Reagent Test) ^[32]

The extract was treated with 2–3 drops of sodium hydroxide solution, resulting in the development of an intense yellow coloration that signified the presence of flavonoids. Upon the subsequent addition of a few drops of concentrated sulfuric acid, the coloration was discharged, confirming the reaction.

The outcomes of the preliminary phytochemical screening are summarized in Table 1.

Table 1. Preliminary phytochemical screening of *Corchorus trilocularis* L. leaves

Sr.No	Phytoconstituents	n-hexane	Ethyl acetate	Acetone	MeOH	EtOH	H ₂ O
1	Alkaloids	+	+	-	-	-	-
2	Carbohydrates	-	-	-	+	+	+
3	Glycosides	-	-	-	+	+	+
4	Flavonoids	-	-	+	+	+	-
5	Phenols/Tannins	-	-	+	+	+	-
6	Steroids	-	+	-	-	-	-
7	Terpenoids	+	+	-	+	+	+
8	Saponins	-	-	-	-	-	+
9	Proteins	-	-	-	+	+	+
10	Amino Acids	-	-	-	+	+	+

RESULTS

Antimicrobial Assay

The antimicrobial assay employed four bacterial strains: Gram-positive *Bacillus subtilis* (NCIM 2250) and *Staphylococcus aureus* (NCIM 2079), along with Gram-negative *Salmonella typhimurium* (MTCC 3224) and *Klebsiella pneumoniae* (NCTC 13368). The fungal strains utilized included *Penicillium chrysogenum* (ATCC 10106), *Trichoderma viride* (ATCC 20476), and *Aspergillus niger* (NCIM 1196). Microorganisms were maintained on nutrient agar slants for culture. Vancomycin was employed as the standard reference antibiotic, with concentrations prepared in accordance with NCCLS guidelines^[33].

The ethyl acetate leaf fraction demonstrated pronounced antibacterial activity, producing inhibition zones of 20 mm against *Staphylococcus aureus*, 18.5 mm against *Bacillus subtilis*, 21 mm against *Salmonella typhimurium*, and 23.5 mm against *Klebsiella pneumoniae*, as presented in Table 2. The maximum zone of inhibition was 23.5 mm observed against *Klebsiella pneumoniae*. Neither the hexane fraction nor the aqueous extract exhibited detectable antibacterial activity against any of the tested bacterial strains. While the acetone fraction exhibited no inhibitory activity against *Bacillus subtilis*, it produced the maximum zone of inhibition against *Staphylococcus aureus* (25 mm). The outcomes of the antibacterial assays are illustrated in Figure 1, wherein the inhibition zones were recorded in millimeters (mm).



Table 2. Antibacterial activity of leaf extract of *Chorchorus trilocularis* L. Leaves

Sr. No.	Solvent	Zone of inhibition in (mm)			
		<i>Staphylococcus aureus</i>	<i>Bacillus subtilis</i>	<i>Salmonella typhimurium</i>	<i>Klebsiella pneumoniae</i>
1	n-hexane	NA	NA	NA	NA
2	Ethyl acetate	20	18.5	21	23.5
3	Acetone	25	NA	22.5	15
4	Ethanol	15.5	12.5	19.5	19
5	Methanol	16.5	12.5	20.5	14
6	Water	NA	NA	NA	NA
7	DMSO	NA	NA	NA	NA
8	Vancomycin	19	24	28	23

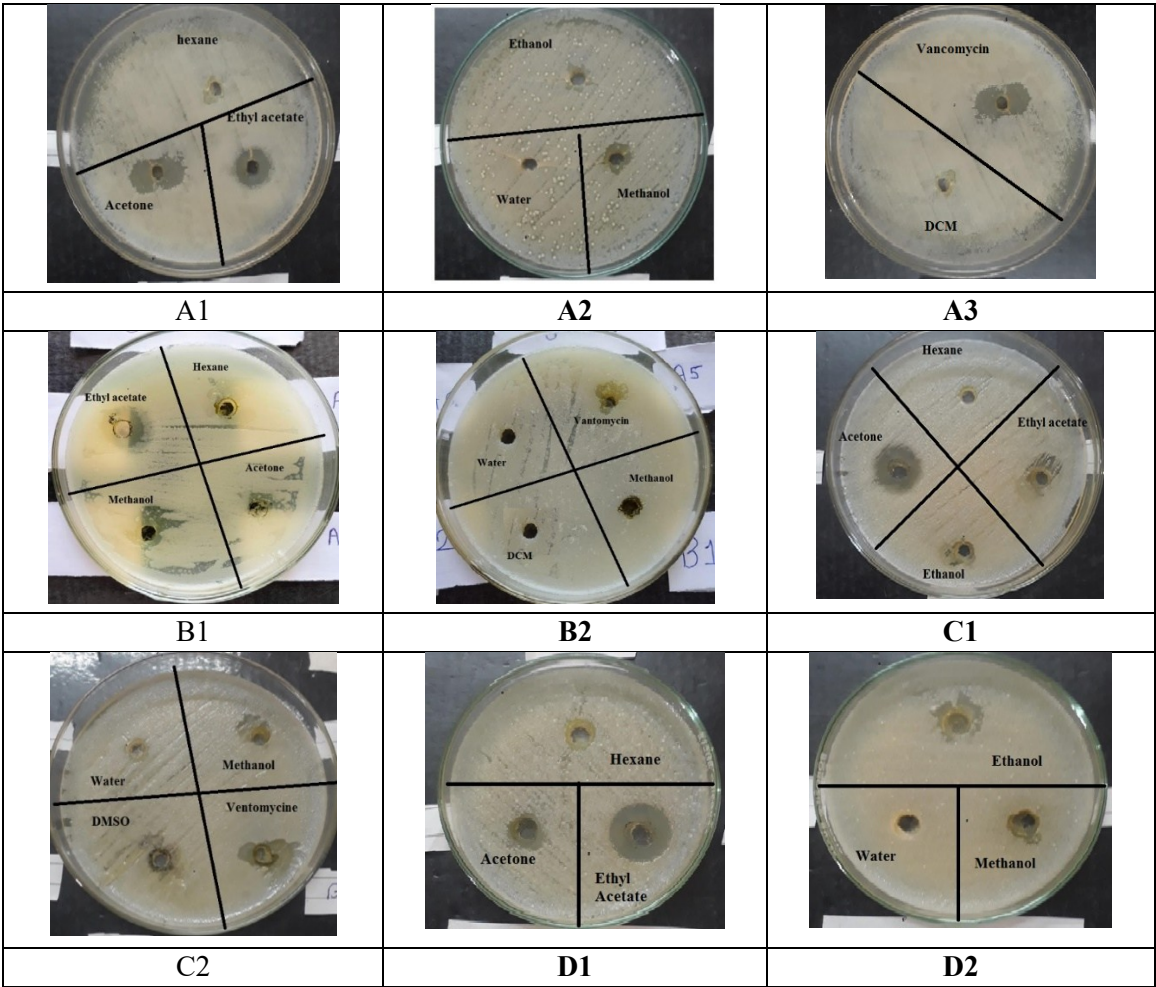


Figure 1: Antibacterial assays of crude extract of *Corchorus trilocularis* L.. against human pathogens [(A1,A2,A3)- *Staphylococcus aureus*,(B1,B2)- *Bacillus subtilis*, (C1,C2)- *Salmonella typhimurium*, (D1,D2)- *Klebsiella pneumonia*

Antifungal Activity

Antifungal efficacy was evaluated employing the disc diffusion assay^[34]. Fungal spore suspensions were standardized to 1×10^8 CFU mL⁻¹ using the

McFarland standard and uniformly swabbed onto potato dextrose agar plates. Sterile discs (90 mm in diameter) were impregnated with 50 μ L of each extract dilution prior to placement on the inoculated medium.Nystatin (50 μ L) served as the positive

control, while solvent-impregnated discs functioned as the negative control. The inoculated plates were incubated at 37 °C for 8 h, after which the diameters of the inhibition zones surrounding the discs were measured. All experiments were conducted in triplicate, and the mean diameters of the inhibition zones were subsequently calculated^[35].

All extracts exhibited antifungal activity against the tested fungal strains (Table 3). The ethyl acetate

fraction demonstrated the strongest inhibition against *Aspergillus niger*, with a zone of 33 ± 0.50 mm at 50 μ L. The n-hexane fraction inhibited *Penicillium chrysogenum* with a 25 mm zone at 50 μ L, while the ethyl acetate fraction also showed pronounced activity against *Trichoderma viride*, producing a 28 mm inhibition zone at 50 μ L. In contrast, the aqueous extract displayed the lowest antifungal efficacy among all tested fungi.

Table 3. Antifungal activity of leaf extract of *Chorchorus trilocularis* L.

Sr. No.	Solvent	Zone of inhibition in (mm)		
		<i>Penicillium chrysogenum</i>	<i>Trichoderma viride</i>	<i>Aspergillus niger</i>
1	n-hexane	25	27	27
2	Ethyl acetate	NA	28	33.5
3	Acetone	NA	24.5	26
4	Ethanol	21.5	10	19
5	Methanol	19	09	19.5
6	Water	NA	NA	NA
7	Nystatin	26	46	36

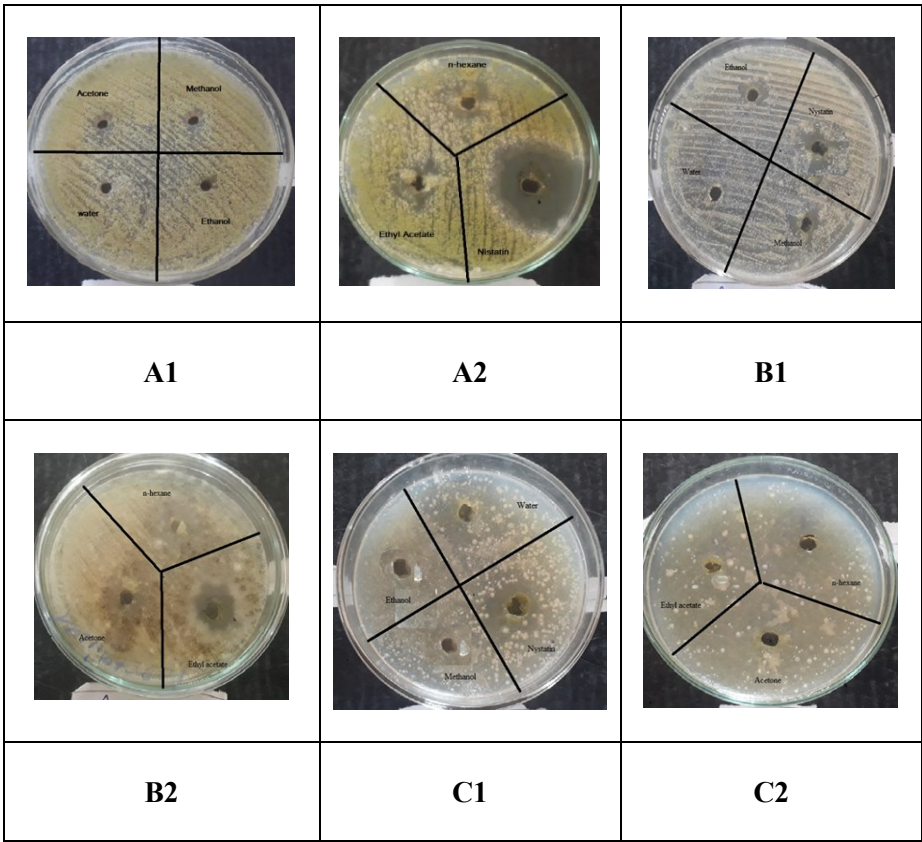


Figure 2. Antifungal activity of crude extracts of *Corchorus trilocularis* L. against (A1,A2) *Trichoderma viride*; (B1,B2) *Aspergillus niger*; (C1,C2) *Penicillium chrysogenum*

GC-MS Analysis

The extract was subjected directly to GC–MS analysis using a GCMS-QP2010 Plus system (Shimadzu, Kyoto, Japan) equipped with a headspace sampler (AOC-20s) and auto-injector (AOC-20i). The instrument was operated with a mass-selective detector under the following conditions: ion source temperature, 230 °C; interface temperature, 260 °C;

solvent cut time, 2.50 min; threshold, 1,000 eV; and mass scan range, 40–650 m/z.

Chemical Characterization via (GC-MS) Analysis

The GC-MS analysis of acetone extract revealed the presence of a number of medicinally important constituents. Plants with these constituents have been reported for the Antimicrobial, Anti-inflammatory, Anti-oxidant and other pharmacological activities.

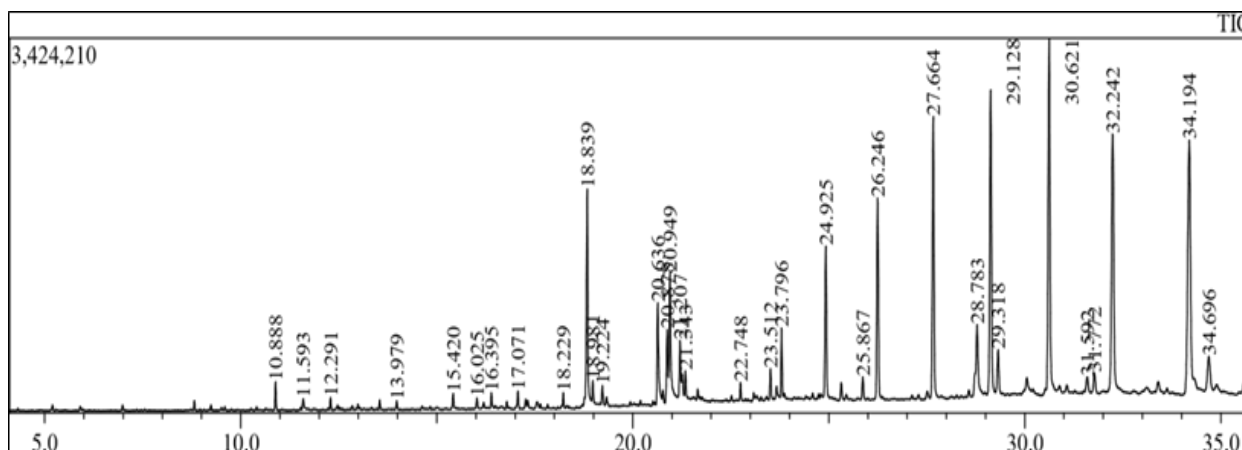


Figure 3. GC-MS chromatogram showing relative abundance and retention time of the acetone leaf extracts of *Corchorus trilocularis* L.

The chromatogram shown in (Figure 3) and phytochemical constituents with activities shown in the (Table 4).

Table 4. Phytochemical constituents identified in the acetone leaf extracts of *Corchorus trilocularis* L. using gas chromatography-mass spectrometry (GC-MS) and their activities

Peak No.	R.T.	Peak Area %	Name of compound	Activity*
1.	10.888	0.57	Tetradecane	Antimicrobial activity ^[36]
2.	11.593	0.24	Coumarin	Antimicrobial, Anti-Inflammatory, Antidiabetic.
3.	12.291	0.24	Heptadecane	Antibacterial, Antioxidant Activities
4.	13.979	0.18	Heneicosane	Antipyretic agent
5.	15.420	0.30	Eicosane	antifungal activity
6.	16.025	0.24	Triacotane	Antioxidant activity
7.	16.395	0.29	Heptadecane	Higher Alkane
8.	17.071	0.40	Isopropyl myristate	Used in Cosmetics.
9.	18.229	0.27	Eicosane	Antifungal Activity
10.	18.839	6.20	n-Hexadecanoic acid	Hepatoprotective, anti-inflammatory, antihistaminic, and anti-arthritic activity ^[37] .
11.	18.981	0.44	Octadecane	Higher Alkane
12.	19.224	0.46	Hexadecanoic acid	Hepatoprotective, anti-inflammatory, antihistaminic, and anti-arthritic activity.



13.	20.636	3.14	Phytol	Cytotoxic, antioxidant, autophagy- and apoptosis-inducing, antinociceptive, anti-inflammatory, immune-modulating, and antimicrobial effect ^[38] .
14.	20.878	1.38	9,12-Octadecadienoic acid	Anti-inflammatory, antihistaminic, anti-arthritic, and hepatoprotective activity.
15.	20.949	2.38	9,12,15-Octadecatrienoic acid	Anti-inflammatory, antihistaminic, anti-arthritic, and hepatoprotective activity.
16.	21.207	1.01	Octadecanoic acid	Anti-inflammatory activities ^[39,40]
17.	21.343	0.50	Heneicosane	Antioxidant, and Antimicrobial activity
18.	22.748	0.39	n-Dotriacontane	Antimicrobial, antioxidant, and anticonvulsant effects ^[41]
19.	23.512	0.73	2-Methyltetracosane	Antibacterial activity. ^[42]
20.	23.796	1.46	Dotriacontane	Antimicrobial, antioxidant, and anticonvulsant effects ^[41]
21.	24.925	4.20	Dotriacontane	Antimicrobial, antioxidant, and anticonvulsant effects ^[41]
22.	25.867	0.63	3-Methylpentacosane	Antioxidant, and Antimicrobial activity
23.	26.246	6.33	Dotriacontane	Antimicrobial, antioxidant, and anticonvulsant effects ^[41]
24.	27.664	9.11	n-Pentacosane	Antioxidant, and Antimicrobial activity
25.	28.783	3.53	13-Docosenamide	Antimicrobial and cytotoxic activities ^[43] .
26.	29.128	10.91	Bicetyl	Plant Metabolite
27.	29.318	1.44	Squalene	antioxidant, anti-inflammatory, and immune-modulating effects ^[44] .
28.	30.621	12.93	n-Hexatriacontane	Antioxidant activity
29.	31.592	0.64	Tetrapentacontane	Antioxidant activity. ^[45]
30.	31.772	0.79	2-Methyloctacosane	antioxidant, and antimicrobial activity
31.	32.242	11.90	n-Hexatriacontane	Antioxidant activity
32.	34.194	14.85	Hexatriacontane	Antioxidant activity
33.	34.696	1.91	α -Tocopherol	Source of vitamin E

*Dr. Duke's Phytochemical and Ethnobotanical Databases.

Medicinally important thirty five phytoconstituents were found in the Ethyl acetate extract according to the GC-MS analysis.

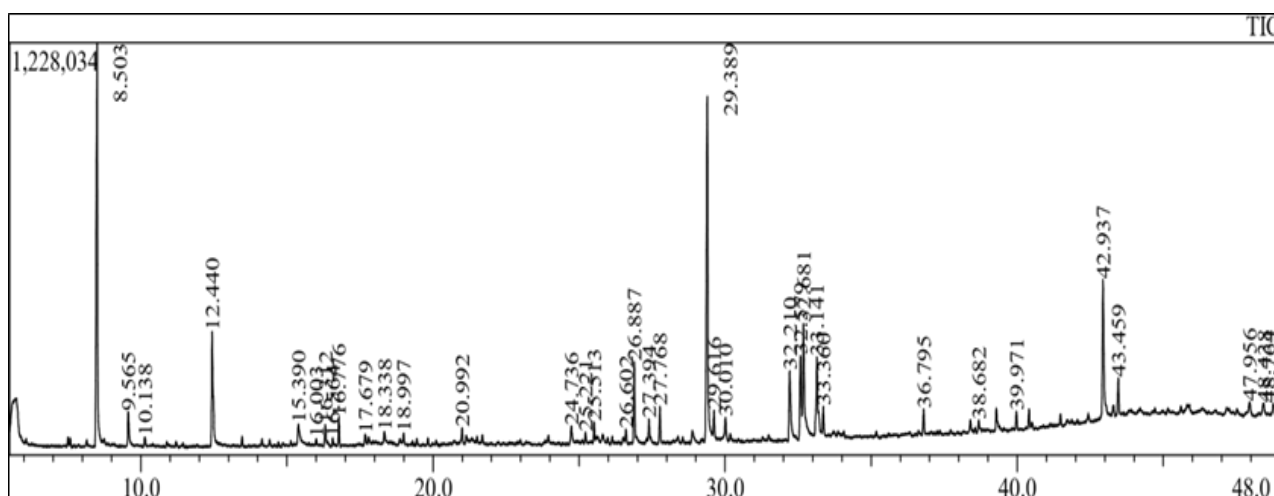


Figure 4. GC-MS chromatogram showing relative abundance and retention time of the Ethyl acetate leaf extracts of *Corchorus trilocularis* L.



The chromatogram is shown in (Fig. 4) and phytochemical constituents with activities are shown in the (Table 5).

Table 16. Phytochemical constituents identified in the ethyl acetate leaf extracts of *Corchorus trilocularis* L. using gas chromatography-mass spectrometry (GC-MS) and their activities.

Peak No.	R.T.	Peak Area %	Name of compound	Activity*
1.	8.503	21.70	1,2,3-Propanetriol 1 acetate	Dermatological agent used as an antiseptic ^[46]
2.	9.565	1.86	1-Monoacetin	Used as Glycerol in biodiesel production
3.	10.138	0.36	Benzofuran	Antihyperglycemic, analgesic, anti- inflammatory, antibacterial, antifungal, antitumor, antiviral, antipyretic
4.	12.440	6.46	1,2,3-Propanetriol	Dermatological agent used as an antiseptic ^[46]
5.	15.390	1.34	2,3-Dihydroxypropyl acetate	Dermatological agent used as an antiseptic ^[46]
6.	16.003	0.23	Decane	Alkane
7.	16.312	0.97	Hydrocoumarin	Antimicrobial Agent
8.	16.564	0.27	n-Tridecan-1-ol	Used as Lubricant
9.	16.776	1.14	Tetradecane	Antimicrobial activity ^[36]
10.	17.679	0.49	Coumarin	Antimicrobial Agent
11.	18.338	0.50	1,2,3-Propanetriol	Dermatological agent used as an antiseptic ^[46]
12.	18.997	0.40	Heneicosane	Antimicrobial Agent
13.	20.992	0.73	Pentadecane	Alkane
14.	24.736	1.03	Loliolide	Improve estrogen deficiency-related symptoms
15.	25.221	0.46	Tetradecanoic acid	Antimicrobial and Anticancer activity ^[47] .
16.	25.513	0.70	Heptadecane	Alkane
17.	26.602	0.60	Isopropyl myristate	Emollient as used in cosmetics
18.	26.887	3.28	Neophytadiene	Anti-inflammatory, antimicrobial, antioxidant, and neuroprotective effects ^[48] .
19.	27.394	0.72	Neophytadiene	
20.	27.768	1.59	Neophytadiene	
21.	29.389	19.98	n-Hexadecanoic acid	Hepatoprotective, anti-inflammatory, antihistaminic, and anti-arthritis activity ^[37] .
22.	29.616	0.99	Triacotane	Higher alkane
23.	30.010	1.23	Hexadecanoic acid, ethyl ester	Hepatoprotective, anti-inflammatory, antihistaminic, and anti-arthritis activity
24.	32.210	4.37	Phytol	Cytotoxic, antioxidant, autophagy- and apoptosis-inducing, antinociceptive, anti-inflammatory, immune-modulating, and antimicrobial effect ^[38] .
25.	32.579	3.32	9,12-Octadecadienoic acid	Anti-inflammatory, antihistaminic, anti-arthritis, and hepatoprotective activity.
26.	32.681	4.54	9,12,15-Octadecatrienoic acid	Anti-inflammatory, antihistaminic, anti-arthritis, and hepatoprotective activity.
27.	33.141	5.17	Octadecanoic acid	Anti-inflammatory activities ^[39,40]
28.	33.360	1.17	Triacotane	Higher Alkane
29.	36.795	1.24	2-Methyltetracosane	Antibacterial activity. ^[42]
30.	38.682	0.45	2-Ethylbutyric acid	used as additives in foods, perfumes,
31.	39.971	0.80	3-Methylpentacosane	Antioxidant, and antimicrobial activity
32.	42.937	8.12	13-Docosenamide	Antimicrobial and cytotoxic activities ^[43] .
33.	47.956	0.57	Stigmast-5-en-3-ol, oleate	Used in Cosmetics

34.	48.438	0.81	Fumaric acid,	Used to treat psoriasis
35	48.764	0.78	α -Tocopherol	Source of vitamin E

*Dr. Duke's Phytochemical and Ethnobotanical Databases.

DISCUSSION

Tetradecane reported to possess antimicrobial properties.^[36] Coumarins have numerous pharmacological properties, including anticoagulant, antibacterial, anti-inflammatory, neuroprotective, antidiabetic, anticonvulsant, and antiproliferative^[49]. scientific studies have shown that n-hexadecanoic acid (also known as palmitic acid) possesses antifungal, antibacterial, and antioxidant properties, while hexadecane itself is less studied but sometimes reported in extracts with bioactivity^[37]. Phytol exhibited anxiolytic, metabolism-modulating, cytotoxic, antioxidant, autophagy- and apoptosis-inducing, antinociceptive, anti-inflammatory, immune-modulating, and antibacterial properties^[38]. Octadecanoic acid (stearic acid), 9,12-hexadecadienoic acid (a polyunsaturated fatty acid), and 9,12,15-octadecatrienoic acid (linolenic acid) represent biologically significant fatty acids that serve as precursors in prostaglandin biosynthesis. These compounds are associated with a broad spectrum of pharmacological activities, including hepatoprotective, anti-inflammatory, antihistaminic, and anti-arthritis effects^[39,40]. Dotricontane, Hexatricontane, tetrapentacontane shows antioxidant activity.^[45] 3-methylpentacosane, 2-Methyltetracosane shows antibacterial activity.^[42] α -Tocopherol is the type of vitamin E^[50]. 1, 2, 3-Propanetriol, 1- acetate shows bacterial inhibiting effect.^[51] Monoacetin is the glycerol used in biodiesel production.^[52] Derivatives of benzofuran exhibit antibacterial, enzyme inhibition, enzyme activation, receptor agonist and antagonist, anti-inflammatory, anticancer, antiviral, antitubercular, antioxidant, anticonvulsant, and anti-alzheimer properties.^[53] 1, 2, 3-propanetriol as dermatological agent used as antiseptic.^[54] Anticoagulant, antibacterial, anti-inflammatory, neuroprotective, antidiabetic, anticonvulsant, and antiproliferative are among the pharmacological properties of coumarins^[49]. Hexadecane and hexadecanoic acid were found to possess antifungal, antibacterial, and antioxidant

properties^[37]. α -Tocopherol is the type of vitamin E.^[50] The compounds octadecanoic acid, 9,12 hexadecadienoic acid, and 9,12,15 octadecatrienoic acid are crucial for the prostaglandin production of cell membranes and have a number of biological effects, including hepatoprotective, anti-inflammatory, antihistaminic, and anti-arthritis properties^[39,40]. Fumaric acid is a pharmaceutically active substance, used to treat psoriasis.^[55]

CONCLUSIONS

In the present study, GC-MS analysis were performed to explore the phytochemical constituent's profile of this *Corchorus trilocularis* L. collected from the dense forest near Lonar Lake: A Distinctive Saline Crater Lake in India. **From the leaves of *Corchorus trilocularis* L., thirty-five phytoconstituents were characterized in the ethyl acetate fraction, whereas thirty-three phytochemical compounds were identified in the ethanol fraction.** The use of leaves in traditional medicine is supported by this study. In the world of pharmacy, the substances found in this study may be isolated and measured to create a novel medication that can be used as an antibiotic, fungicide, pesticide, antioxidant, or anti-inflammatory. As a result, *Corchorus trilocularis* L. may be used as an essential candidate for pharmacological activity testing. Thus, further pharmacological research are required to confirm the exact compound/compounds responsible for health benefits.

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Data availability statement: All data generated or analyzed during this study are included in this published article.

REFERENCES

1. Iqbal N, Vahia MN, Masood T, Ahmad A. A Probable Meteor Impact Crater in Kashmir Valley (India).
2. Lyttleton RA. The Moon, Meteorites, and Comets. 1964;
3. Surve RR, Shirke AV, Athalye RR, Sangare MM. A Review on Chemical and Ecological Status of Lonar Lake. *Curr World Environ* [Internet]. 2021 [cited 2025 Feb 10];16(1):61–9. doi:10.12944/CWE.16.1.07
4. Ahmad Khan MS, Ahmad I. Herbal Medicine. In: *New Look to Phytomedicine* [Internet]. Elsevier; 2019 [cited 2025 Feb 10]. p. 3–13. doi:10.1016/B978-0-12-814619-4.00001-X
5. Shukia R, Sharma SB, Puri D, Prabhu KM, Murthy PS. Medicinal plants for treatment of diabetes mellitus. *Indian J Clin Biochem* [Internet]. 2000 [cited 2025 Feb 10];15(S1):169–77. doi:10.1007/BF02867556
6. A. Hussein R, A. El-Anssary A. Plants Secondary Metabolites: The Key Drivers of the Pharmacological Actions of Medicinal Plants. In: F. Builders P, editor. *Herbal Medicine* [Internet]. IntechOpen; 2019 [cited 2025 Feb 10]. doi:10.5772/intechopen.76139
7. Shokeen P, Anand P, Murali YK, Tandon V. Antidiabetic activity of 50% ethanolic extract of *Ricinus communis* and its purified fractions. *Food and Chemical Toxicology* [Internet]. 2008 [cited 2025 Feb 12];46(11):3458–66. doi:10.1016/j.fct.2008.08.020
8. Sharifi Rad J, Hoseini Alfatemi SM, Sharifi Rad M, Iriti M. Free Radical Scavenging and Antioxidant Activities of Different Parts of *Nitraria schoberi* L. *Journal of Biologically Active Products from Nature* [Internet]. 2014 [cited 2025 July 25];4(1):44–51. doi:10.1080/22311866.2014.890070
9. Saini AK, Goyal R, Gauttam VK, Kalia AN. Evaluation of anti-inflammatory potential of *Ricinus communis* Linn leaves extracts and its flavonoids content in Wistar rats. *Journal of Chemical and Pharmaceutical Research*. 2010;2(5):690–5.
10. Sharifi-Rad M, Panda J, Mohanta YK, Pohl P, Zengin G, Moloney MG. Essential oil of *Cleome coluteoides* (Boiss.): phytochemical constituents, antioxidant, antimicrobial, antiproliferative, anti-inflammatory, enzymatic inhibition, and xanthine oxidase inhibitory properties. *Journal of Herbal Medicine* [Internet]. 2025 [cited 2025 July 25];52:101036. doi:10.1016/j.hermed.2025.101036
11. Rao N, Mittal S, Menghani E. Assessment of phytochemical screening, antioxidant and antibacterial potential of the methanolic extract of *Ricinus communis* L. *Asian Journal of Pharmacy and Technology*. 2013;3(1):20–5.
12. Sharifi-Rad M, Mohanta YK, Pohl P, Jaradat N, Aboul-Soud MAM, Zengin G. Variation of phytochemical constituents, antioxidant, antibacterial, antifungal, and anti-inflammatory properties of *Grantia aucheri* (Boiss.) at different growth stages. *Microbial Pathogenesis* [Internet]. 2022 [cited 2025 July 25];172:105805. doi:10.1016/j.micpath.2022.105805
13. Benmohamed M, Guenane H, Messaoudi M, Zahnit W, Egbuna C, Sharifi-Rad M, et al. Mineral Profile, Antioxidant, Anti-Inflammatory, Antibacterial, Anti-Urease and Anti- α -Amylase Activities of the Unripe Fruit Extracts of *Pistacia atlantica*. *Molecules* [Internet]. 2023 [cited 2025 July 25];28(1):349. doi:10.3390/molecules28010349
14. Shaiq Ali M, Ahmed F, Kashif Pervez M, Azhar I, Ibrahim SA. Parkintin: A new flavanone with epoxy-isopentyl moiety from *Parkinsonia aculeata* linn. (Caesalpiniaceae). *Natural Product Research* [Internet]. 2005 [cited 2025 Feb 10];19(1):53–6. doi:10.1080/14786410310001643812
15. Kumari N, Choudhary SB, Sharma HK, Singh BK, Kumar AA. Health-promoting properties of



- Corchorus leaves: A review. *Journal of Herbal Medicine* [Internet]. 2019 [cited 2025 Sept 17];15:100240. doi:10.1016/j.hermed.2018.10.005
16. Siringo CG, Mbugua PM, Chege BM, Oluoch LL. Gastro-protective and anti-acidic effects of *Corchorus trilocularis* Linn against diclofenac-induced gastric ulcers. *Disc Phytomed* [Internet]. 2020 [cited 2025 Sept 17];7(1):33. doi:10.15562/phytomedicine.2020.116
17. Kell DB, Brown M, Davey HM, Dunn WB, Spasic I, Oliver SG. Metabolic footprinting and systems biology: the medium is the message. *Nat Rev Microbiol* [Internet]. 2005 [cited 2025 Feb 10];3(7):557–65. doi:10.1038/nrmicro1177
18. Robertson DG. Metabonomics in Toxicology: A Review. *Toxicological Sciences* [Internet]. 2005 [cited 2025 Feb 10];85(2):809–22. doi:10.1093/toxsci/kfi102
19. Balouiri M, Sadiki M, Ibensouda SK. Methods for in vitro evaluating antimicrobial activity: A review. *Journal of Pharmaceutical Analysis* [Internet]. 2016 [cited 2025 Feb 10];6(2):71–9. doi:10.1016/j.jpha.2015.11.005
20. Torres-Rodriguez A, Darvishzadeh R, Skidmore AK, Fränzel-Luiten E, Knaken B, Schuur B. High-throughput Soxhlet extraction method applied for analysis of leaf lignocellulose and non-structural substances. *MethodsX* [Internet]. 2024 [cited 2025 Feb 11];12:102644. doi:10.1016/j.mex.2024.102644
21. Stanojević LP, Stanković MZ, Cvetković DJ, Cakić MD, Ilić DP, Nikolić VD, et al. The effect of extraction techniques on yield, extraction kinetics, and antioxidant activity of aqueous-methanolic extracts from nettle (*Urtica dioica* L.) leaves. *Separation Science and Technology* [Internet]. 2016 [cited 2025 Feb 11];51(11):1817–29. doi:10.1080/01496395.2016.1178774
22. Rao Um. Hytochemical Screening, Total Flavonoid And Phenolic Content Assays Of Various Solvent Extracts Of Tepal Of *Musa paradisiaca*. *MJAS* [Internet]. 2016 [cited 2025 Feb 11];20(5):1181–90. doi:10.17576/mjas-2016-2005-25
23. Nortjie E, Basitere M, Moyo D, Nyamukamba P. Extraction Methods, Quantitative and Qualitative Phytochemical Screening of Medicinal Plants for Antimicrobial Textiles: A Review. *Plants* [Internet]. 2022 [cited 2025 Feb 11];11(15):2011. doi:10.3390/plants11152011
24. Ramaswamy N, Samatha T, Srinivas P, Chary RS. *International Journal Of Pharmacy & Life Sciences*. Life Sci. 2013;4(1).
25. Mensah Donkor A. In Vitro Bacteriostatic and Bactericidal Activities of *Senna alata*, *Ricinus communis* and *Lannea barteri* extracts Against Wound and Skin Disease Causing Bacteria. *JAPLR* [Internet]. 2016 [cited 2025 Feb 12];3(1). doi:10.15406/japlr.2016.03.00046
26. Shaikh JR, Patil M. Qualitative tests for preliminary phytochemical screening: An overview. *Int J Chem Stud* [Internet]. 2020 [cited 2025 Feb 11];8(2):603–8. doi:10.22271/chemi.2020.v8.i2i.8834
27. Gibbs HD. Phenol Tests. *Journal of Biological Chemistry* [Internet]. 1927 [cited 2025 July 24];72(2):649–64. doi:10.1016/s0021-9258(18)84338-1
28. Chen C, Li R, Li D, Shen F, Xiao G, Zhou J. Extraction and purification of saponins from *Sapindus mukorossi*. *New J Chem* [Internet]. 2021 [cited 2025 July 24];45(2):952–60. doi:10.1039/d0nj04047a
29. Rahman A, Sitepu IR, Tang S-Y, Hashidoko Y. Salkowski's Reagent Test as a Primary Screening Index for Functionalities of Rhizobacteria Isolated from Wild Dipterocarp Saplings Growing Naturally on Medium-Strongly Acidic Tropical Peat Soil. *Bioscience, Biotechnology, and Biochemistry* [Internet]. 2010 [cited 2025 July 24];74(11):2202–8. doi:10.1271/bbb.100360
30. Falcão L, Araújo MEM. Tannins characterisation in new and historic vegetable tanned leathers fibres by spot tests. *Journal of Cultural Heritage* [Internet]. 2011 [cited 2025 July 24];12(2):149–56. doi:10.1016/j.culher.2010.10.005
31. Cook RP. Reactions of steroids with acetic anhydride and sulphuric acid (the Liebermann-Burchard test). *Analyst* [Internet]. 1961 [cited 2025 July 24];86(1023):373. doi:10.1039/an9618600373
32. Chen M, He X, Sun H, Sun Y, Li L, Zhu J, et al. Phytochemical analysis, UPLC-ESI-Orbitrap-MS analysis, biological activity, and toxicity of extracts from *Tripleurospermum limosum* (Maxim.) Pobed. *Arabian Journal of Chemistry*

- [Internet]. 2022 [cited 2025 July 24];15(5):103797. doi:10.1016/j.arabjc.2022.103797
33. Ginocchio CC. Role of NCCLS in antimicrobial susceptibility testing and monitoring. *American Journal of Health-System Pharmacy* [Internet]. 2002 [cited 2025 Feb 11];59(suppl_3):S7–11. doi:10.1093/ajhp/59.suppl_3.S7
 34. Lai HY, Lim YY, Tan SP. Antioxidative, Tyrosinase Inhibiting and Antibacterial Activities of Leaf Extracts from Medicinal Ferns. *Bioscience, Biotechnology, and Biochemistry* [Internet]. 2009 [cited 2025 Feb 12];73(6):1362–6. doi:10.1271/bbb.90018
 35. Mostafa AA, Al-Askar AA, Almaary KS, Dawoud TM, Sholkamy EN, Bakri MM. Antimicrobial activity of some plant extracts against bacterial strains causing food poisoning diseases. *Saudi Journal of Biological Sciences* [Internet]. 2018 [cited 2025 Feb 12];25(2):361–6. doi:10.1016/j.sjbs.2017.02.004
 36. Nasr Z, El-shershaby H, Sallam K, Abed N, Abd-El Ghany I, Sidkey N. Evaluation of Antimicrobial Potential of Tetradecane Extracted from *Pediococcus acidilactici* DSM: 20284 - CM Isolated from Curd Milk. *Egypt J Chem* [Internet]. 2021 [cited 2025 Feb 15];0(0):0–0. doi:10.21608/ejchem.2021.92658.4385
 37. Kim DH, Park MH, Choi YJ, Chung KW, Park CH, Jang EJ, et al. Molecular Study of Dietary Heptadecane for the Anti-Inflammatory Modulation of NF- κ B in the Aged Kidney. Yang C-M, editor. *PLoS ONE* [Internet]. 2013 [cited 2025 Feb 15];8(3):e59316. doi:10.1371/journal.pone.0059316
 38. Islam MT, Ali ES, Uddin SJ, Shaw S, Islam MA, Ahmed MI, et al. Phytol: A review of biomedical activities. *Food and Chemical Toxicology* [Internet]. 2018 [cited 2025 Feb 15];121:82–94. doi:10.1016/j.fct.2018.08.032
 39. Henry GE, Momin RA, Nair MG, Dewitt DL. Antioxidant and Cyclooxygenase Activities of Fatty Acids Found in Food. *J Agric Food Chem* [Internet]. 2002 [cited 2025 Feb 15];50(8):2231–4. doi:10.1021/jf0114381
 40. Grace OM-A, Kolawole IA, Cajethan. GC-MS analysis of bioactive compounds and evaluation of antimicrobial activity of the extracts of *Daedalea elegans*: A Nigerian mushroom. *Afr J Microbiol Res* [Internet]. 2020 [cited 2025 Feb 15];14(6):204–10. doi:10.5897/AJMR2019.9120
 41. Gomes LC, Merino FJZ, Golin Pacheco SD, Cansian FC, De Oliveira LF, Gaspari Dias JDF, et al. Activation of human neutrophils by dotriacontane from *Tynanthus micranthus* Corr. Mélo (Bignoniaceae) for the production of superoxide anions. *CeN* [Internet]. 2020 [cited 2025 July 13];42:e4. doi:10.5902/2179460x41253
 42. Youssef AMM, Maaty DAM, Al-Saraireh YM. Phytochemical Analysis and Profiling of Antioxidants and Anticancer Compounds from *Tephrosia purpurea* (L.) subsp. *apollinea* Family Fabaceae. *Molecules* [Internet]. 2023 [cited 2025 Feb 16];28(9):3939. doi:10.3390/molecules28093939
 43. El-Gazzar N, Said L, Al-Otibi FO, AbdelGawwad MR, Rabie G. Antimicrobial and cytotoxic activities of natural (Z)-13-docosenamide derived from *Penicillium chrysogenum*. *Front Cell Infect Microbiol* [Internet]. 2025 [cited 2025 July 7];15. doi:10.3389/fcimb.2025.1529104
 44. Cheng L, Ji T, Zhang M, Fang B. Recent advances in squalene: Biological activities, sources, extraction, and delivery systems. *Trends in Food Science & Technology* [Internet]. 2024 [cited 2025 July 13];146:104392. doi:10.1016/j.tifs.2024.104392
 45. Makeen HA, Menachery SJ, Moni SS, Alqahtani SS, Rehman ZU, Alam MS, et al. Documentation of bioactive principles of the exudate gel (EG) from the stem of *Caralluma retrospiciens* (Ehrenb) and in vitro antibacterial activity – Part A. *Arabian Journal of Chemistry* [Internet]. 2020 [cited 2025 Feb 15];13(8):6672–81. doi:10.1016/j.arabjc.2020.06.022
 46. Claesen J. Topical Antiseptics and the Skin Microbiota. *Journal of Investigative Dermatology* [Internet]. 2018 [cited 2025 July 24];138(10):2106–7. doi:10.1016/j.jid.2018.06.001
 47. Sokmen BB, Hasdemir B, Yusufoglu A, Yanardag R. Some Monohydroxy Tetradecanoic Acid Isomers as Novel Urease and Elastase Inhibitors and as New Antioxidants. *Appl Biochem Biotechnol* [Internet]. 2014 [cited 2025 July 7];172(3):1358–64. doi:10.1007/s12010-013-0595-2



48. Rajeswaran S, Rajan DK. Neophytadiene: Biological activities and drug development prospects. *Phytomedicine* [Internet]. 2025 [cited 2025 July 7];143:156872. doi:10.1016/j.phymed.2025.156872
49. Wardrop D, Keeling D. The story of the discovery of heparin and warfarin. *Br J Haematol* [Internet]. 2008 [cited 2025 Feb 15];141(6):757–63. doi:10.1111/j.1365-2141.2008.07119.x
50. Burton GW, Ingold KU. Vitamin E: application of the principles of physical organic chemistry to the exploration of its structure and function. *Acc Chem Res* [Internet]. 1986 [cited 2025 Feb 16];19(7):194–201. doi:10.1021/ar00127a001
51. Van HT, Le NT, Nguyen DL, Tran GB, Huynh NTA, Vo HS, et al. Chemical profile and antibacterial activity of acetone extract of *Homalomena cochinchinensis* Engl. (Araceae). *Plant Sci Today* [Internet]. 2021 [cited 2025 Feb 16];8(1):58–65. doi:10.14719/pst.2021.8.1.971
52. Sedghi R, Shahbeik H, Rastegari H, Rafiee S, Peng W, Nizami A-S, et al. Turning biodiesel glycerol into oxygenated fuel additives and their effects on the behavior of internal combustion engines: A comprehensive systematic review. *Renewable and Sustainable Energy Reviews* [Internet]. 2022 [cited 2025 Feb 16];167:112805. doi:10.1016/j.rser.2022.112805
53. Nevagi RJ, Dighe SN, Dighe SN. Biological and medicinal significance of benzofuran. *European Journal of Medicinal Chemistry* [Internet]. 2015 [cited 2025 Feb 16];97:561–81. doi:10.1016/j.ejmech.2014.10.085
54. Naik SN, Saxena DK, Dole BR, Khare SK. Potential and Perspective of Castor Biorefinery. In: *Waste Biorefinery* [Internet]. Elsevier; 2018 [cited 2025 Feb 16]. p. 623–56. doi:10.1016/B978-0-444-63992-9.00021-5
55. Sauer M, Mattanovich D, Marx H. Microbial production of organic acids for use in food. In: *Microbial Production of Food Ingredients, Enzymes and Nutraceuticals* [Internet]. Elsevier; 2013 [cited 2025 Feb 16]. p. 288–320. doi:10.1533/9780857093547.2.288.

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