ORIGINAL ARTICLE

Gas chromatography and mass spectroscopy analysis of bioactive components on the leaf extract of *Terminalia coriacea*: A potential folklore medicinal plant

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Abstract

Aim: This study aimed to investigate the bioactive constituents from methanolic extract of *Terminalia coriacea* leaves using gas chromatography and mass spectroscopy (GC-MS). **Materials and Methods:** The methanolic extract obtained was subjected to GC-MS for the determination of bioactive volatile compounds. GC-MS analysis was carried out using 6890 GC with 5973 I MSD column. **Results and Discussion:** The GC-MS analysis of the methanolic extract revealed the presence of 14 bioactive compounds with valuable biological activities. The major chemical constituents are 1H-inden-1-one,2,3-dihydro-3,3,5,6,- tetramethyl; levoglucosan; neophytadiene; phytol; hexadecanoic acid; n-hexadecanoic acid; stigmasterol; β-sitosterol; raffinose; 1,2-benzenedi carboxylic acid; undecanoic acid; (2 propyl-1,3-dioxolan-2-yl) acetic acid; 2,2 dimethyl propane, and octadecatrienoic acid. **Conclusion:** The presence of various bioactive compounds in *T. coriacea* proved the pharmaceutical importance. It can be concluded that the plant investigation has opened up a new perspective in pharmaceutical research, and plants can be used for the development of potential, novel antioxidant agents for the treatment of many diseases.

Key words: Gas chromatography and mass spectroscopy, methanolic extract, pharmaceutical importance, phytochemicals, *Terminalia coriacea*

INTRODUCTION

The genus *Terminalia* is a group of big trees of flowering plant which belongs to the family *Combretaceae*, comprising more than 100 species from tropical regions of the world. The geographical sources of *Terminalia coriacea* are India, Thailand, Myanmar, Nepal, Vietnam, Bangladesh, Laos, and Cambodia. It is found in 1000 m altitude of both moist and dry forests in South India.[1] It is widely distributed in Tamil Nadu and Andhra Pradesh. It is known as Tani in Telugu.[2] The main chemical moieties of this genus are triterpenes, tannins and its derivatives, flavonoids, phenolic contents, and other aromatics. It has been revealed that this species is rich in tannins and phenolic compounds by different data sources. It shows high anti-oxidant activity.[3] These moieties have wound healing[2] anti-epileptic,[1] antimicrobial, hepatoprotective evidence,[4,5] and anti-cancer activity. The traditional claim of *T. coriacea* is found in Indian medicine for the treatment of callous ulcer, cardiac stimulant, and atonic diarrhea.[5] Plants are a rich source of secondary metabolites with remarkable biological activities. The secondary metabolites are significant source with a variety of structural

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arrangements and properties.[6] Natural products that come out from medicinal plants are important for pharmaceutical research and for drug development as a source of therapeutic agents. At present, the demand for herbal or medicinal plant products has increased significantly.[7] GC-MS is the best technique to identify the bioactive constituents of long chain hydrocarbons, alcohols, acids, esters, alkaloids, steroids, amino, nitro compounds, etc.,[8] A wide range of medicinal plant parts is used for the extraction of raw drugs and they possess varied medicinal properties.[9] Traditionally used medicinal plants have recently attracted the attention of the biological scientific communities. This has involved the isolation and identification of secondary metabolites produced by plants and their use as active principles in medicinal preparations.[10]

Aim and Objective

The main aim of the present study is to screen the possible volatile constituents in methanolic extract of *T. coriacea* (METC) by GC-MS analysis and to find their possible pharmacological action.

MATERIALS AND METHODS

Collection and Authentication of Plant Material

The collection of plant materials was done from Tirumala Hills, Chittoor, Andhra Pradesh. The plant materials were identified and authenticated by Dr. K. Madhava Chetty, Assistant Professor, S. V. University, Tirupati, India. A voucher specimen has been deposited at the Department of Pharmacognosy (Voucher Specimen No. 1109).

Preparation of Extracts

The collected leaves were chopped into small pieces, shade-dried at room temperature, and powdered. The coarse powder of *T. coriacea* leaves (TCL) (100 g) was extracted using successive Soxhlet extraction using solvents of varying polarity such as petroleum ether, chloroform, methanol, and distilled water for 72 h. After completion of extraction, the solvent was distilled off and concentrated extract was air-dried.[11]

Gas Chromatography and Mass Spectroscopy (GC-MS) Analysis of Bioactive Compounds

The METC was subjected to GC-MS at the Council of Scientific and Industrial Research-Indian Institute of Chemical Technology, Uppal Road, Tarnaka, Hyderabad, Telangana, India, for the determination of bioactive volatile compounds. GC-MS analysis of the samples was carried out using 6890 GC with 5973 I MSD. Helium was used as the carrier gas, and the temperature programing was set with initial oven temperature at 400°C and held for 3 min and the final temperature of the oven was set at 4800°C with a rate at 100°C. A 2-µl sample was injected with split less mode. Mass spectra were recorded over 35-650 amu range with electron impact ionization energy 70 eV. The total running time for a sample is 20 min. The chemical components from the methanolic extracts of plants were identified by comparing the retention times of chromatographic peaks using Quadra pole detector with the National Institute Slandered and Technology library to relative retention indices. Quantitative determinations were made by relating respective peak areas to total ion chromatogram areas from the GC-MS.[12] The constituents obtained from GC-MS analyzer are shown in Table 1 and Figure 1.

RESULTS AND DISCUSSION

Nowadays, the study of the organic compounds from plants and their activity has increased. The combination of a best separation technique (GC) with the best identification technique (MS) made GC-MS an ideal technique for qualitative analysis for volatile and semi-volatile bioactive compounds.[13] The most abundant components found in the methanolic extract of leaves were 1H-Inden-1-one,2,3-dihydro-3,3,5,6,- tetramethyl; levoglucosan; neophytadiene; phytol; hexadecanoic acid; n-hexadecanoic acid; stigmasterol; β-sitosterol; raffinose; 1,2-benzenedi carboxylic acid; undecanoic acid; (2 propyl-1,3-dioxolan-2-yl) acetic acid; 2,2 dimethyl propane, and octadecatrienoic acid.

Investigation of medicinal value of *T. coriacea* has added a great deal in the field of phytochemistry with regard to its availability of complex phytochemical components, and antibacterial, anthelmintic, anti-inflammatory, and antiviral activities.

The GC-MS analysis revealed that the methanolic extract is mainly composed of oxygenated hydrocarbons, alkane hydrocarbon, and predominantly phenolic hydrocarbons and tannins. These phytochemicals are responsible for various pharmacological actions such as hepatoprotective, antioxidant, wound healing, and antimicrobial activities. This study is only a preliminary study of the occurrence of certain properties of TCL extract. An in-depth study will provide a good concrete base for all the biochemical and phytochemical functions mentioned above. New scientific strategies for the evaluation of natural products with specific biological activities require the implementation of large screening process. *T. coriacea* is a potential folklore medicinal plant used for many traditional medicines. Phytochemical analysis by GC-MS revealed the presence of palmitic acid, tannins, hydrocarbons, aldehydes, fatty acid esters, fatty acid amide, terpenoids, terpene alcohol, and phytol as the major compound groups. Compositional

Table 1: Bioactive compounds detected from METC

Reaction time (min)	Compound name	Area (%)	Molecular formula	Molecular weight	Pharmacological action
15.201	1H-inden-1-one, 2,3-dihydro-3,3,5,6,- tetramethyl	0.947	$C_{13}H_{16}O$	188.2655	Anti-inflammatory, antioxidant, and antimicrobial
17.496	Levoglucosan, tris (TMS)-	0.843	$C_{15}H_{34}O_5Si_3$	378.6840	Natural dye
18.076	Neophytadiene=7,11,15- trimethyl-3-methylene-1-hexadecene	0.849	$C_{20}H_{38}$	278.52	Antipyretic, analgesic, anti-inflammatory, antimicrobial, and antioxidant
18.745	Phytol=2 hexadecen-1-ol, 3,7,11,15-tetra methyl	1.682	$C_{20}H_{40}O$	296.54	Cerebellar ataxia, retinitis pigmentosa, anosmia, and hearing loss
19.199	Methyl palmitate=Hexadecanoic acid, methyl ester (CAS)	0.617	$C_{17}H_{34}O_2$	270.4507	Methyl palmitate has anti-inflammatory and anti-fibrotic effect. It prevents lung inflammation and fibrosis in rats
19.628	n-hexadecanoic acid=palmitic acid	1.267	$C_{16}H_{32}O_2$	256.4241	Antioxidant and anti-inflammatory properties
20.082	Stigmasterol TMS ether	3.497	$C_{32}H_{56}OSi$	484.8719	Anti-inflammatory, inhibits tumor promotion, anti-HIV reverse transcriptase
23.058	β-Sitosterol TMS ether	7.240	$C_{32}H_{58}OSi$	486.8878	β-sitosterol is used for heart disease and high cholesterol. It is also used for boosting the immune system
23.487	Raffinose TMS	0.136	$C_{51}H_{120}O_{16}Si_{11}$	1298.4294	Promotes the growth of beneficial intestinal bacteria, bulk sweeteners
24.88	1,2-benzenedi carboxylic acid, diisooctyl ester	1.694	$C_{24}H_{38}O_4$	390.5561	Antimicrobial and antifouling properties
26.35	Undecanoic acid	25.8	$C_{11}H_{22}O_2$	186.29	Manufacturing of a number of esters, some of which are used in perfumes, more in flavor composition
27.22	2 propyl-1,3-dioxolan-2-yl) acetic acid	3.614	$C_8H_{14}O$	174.194	Flavoring agent
28.13	2,2 dimethyl propane	6.40	C_5H_{12}	72.14	Liquid gas used as flavor
32.75	6,9,12-octadecatrienoic acid, phenyl methyl ester	14.55	$C_{19}H_{34}O_2$	294.4721	Antimicrobial agents

METC: Methanolic extract of *Terminalia coriacea*, CAS: 67-56-1, TMS: Trimethylsilyl

variation in quantities, qualities, and structural features may influence compounds' behavior on GC-MS, as well as bioactivities of their precursor fractions. It can be concluded that the plant investigation has opened up a new perspective in pharmaceutical research, and plants can be used for the development of potential, novel antioxidant agents for the treatment of many diseases.

CONCLUSION

In the present investigation, 14 bioactive compounds have been identified from METC by GC-MS. The presence of various bioactive compounds in *T. coriacea* proved pharmaceutical importance. However, further studies will require finding its bioactivity and toxicity profile.

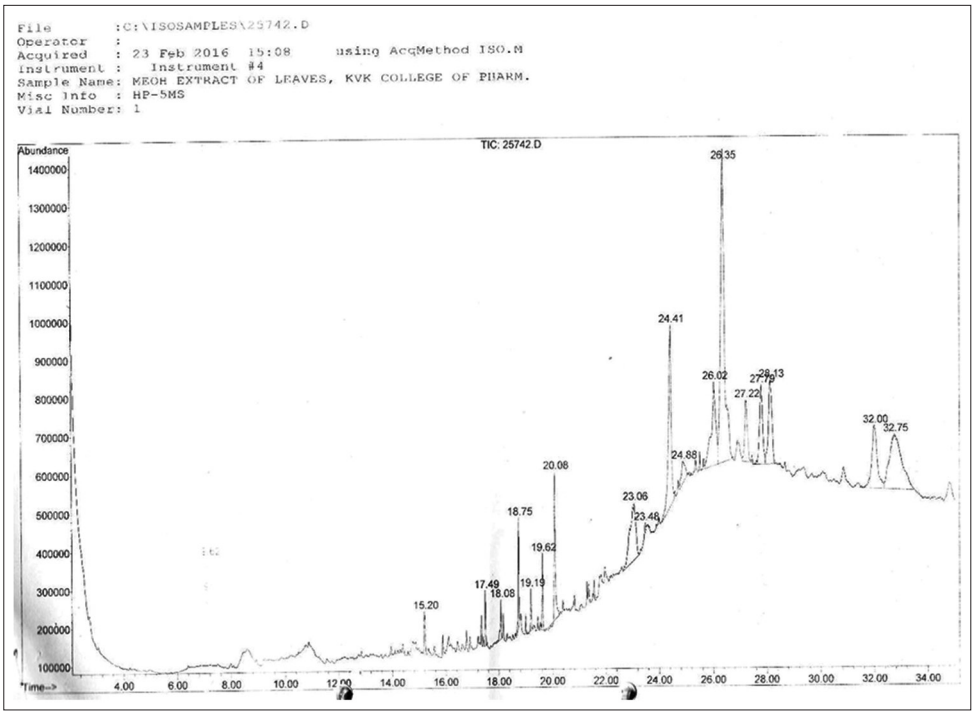

Figure 1: Gas chromatography and mass spectroscopy spectrum of methanol extract of leaves of *Terminalia coriacea*

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