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Research Article

DETERMINATION OF BIOACTIVE COMPONENTS OF *BARLERIA COURTALLICA* NEES (ACANTHACEAE) BY GAS CHROMATOGRAPHY–MASS SPECTROMETRY ANALYSIS

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ABSTRACT

Objective: The present investigation was carried out to determine the possible bioactive components of stem, root, and leaf of *Barleria courtallica* Nees using a gas chromatography–mass spectrometry (GC-MS).

Methods: The phytocomponents of the ethanol extracts of stem, root, and leaf of *B. courtallica* were investigated using PerkinElmer GC-MS, while the mass spectra of the compounds found in the extracts were matched with the National Institute of Standards and Technology version II library.

Results: 25, 23, and 28 compounds were identified in the ethanol extracts of stem, root, and leaf of *B. courtallica*, respectively. The prevailing compounds of stem were β-sitosterol (20.27%), stigmasterol (17.07%), eicosane, 7-hexyl- (6.64%), 3,7,11,15-tetramethyl-2-hexadecan-1-ol (5.97%), and tetracosane, 11-decyl- (5.91%). The major constituents recorded from root extract of *B. courtallica* were β-sitosterol (22.94%), stigmasterol (20.17%), urs-12-en-28-oic acid, 3-hydroxy-, methyl ester, (3β)- (18.42%), and eiosane, 7-hexyl- (7.06%). The prevailing compounds of leaf were 3,7,11,15- tetramethyl-2-hexadecan-1-ol (34.42%), phytol (14.18%), β-sitosterol (12.71%), squalene (11.25%), stigmasterol (8.15%), phytol acetate (6.53%).

Conclusions: From the results, it is evident that *B. courtallica* contains various bioactive compounds and is recommended as a plant of phytopharmaceutical importance.

Keywords: *Barleria courtallica,* Bioactive components, Phytol, Acetate, Squalene.

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INTRODUCTION

Medicinal plants besides therapeutic agents are also a big source of information for a wide variety of chemical constituents which could be developed as drugs with precise selectively. These are the reservoirs of potentially useful chemical compounds which could serve as newer leads and clues for modern drug design [1]. The most important of these bioactive constituents of plants are alkaloids, tannins, flavonoids, glycosides, saponins, and phenolic compounds [2]. Correlation between the phytoconstituents and the bioactivity of the plant is desirable to know for the synthesis of compounds with specific activities to treat various health ailments and chronic diseases as well [3].

A knowledge of the chemical constituents of plants is desirable not only for the discovery of therapeutic agents but also because such information may be of great value in disclosing new sources of economic phytocompounds for the synthesis of complex chemical substances and for discovering the act was significance of folkloric remedies [4]. Hence, a thorough validation of the herbal drugs has emerged as a new branch of science emphasizing and prioritizing the standardization of the natural drugs and products because several of the phytochemicals have complementary and overlapping mechanism of action. Mass spectrometry (MS), coupled with chromatographic separations such as gas chromatography (GC/MS), is normally used for direct analysis of components existing in traditional medicines and medicinal plants. In recent years, GC-MS studies have been increasingly applied for the analysis of medicinal plants as this technique has proved to be a valuable method for the analysis of non-polar components and volatile essential oil, fatty acids, lipids, and alkaloids [5-7].

Genus *Barleria* belongs to the family Acanthaceae. Whole-plant extract *Barleria* contains a number of active compounds such as alkaloids, terpenes, flavonoids, glycosides, lignins, and phenolics, which have shown potent therapeutic activities against several diseases [8-11]. *Barleria* also shows various pharmacological effects such as antimicrobial, anthelmintic, antifertility, antioxidant, antidiabetic, antiarthritic, hepatoprotective, diuretic, cytoprotective, antidiarrheal, analgesic, antileukemic, anti-inflammatory, and hypoglycemic properties without any toxic effects [12,13]. Taking into consideration of the medicinal importance of the plant, the ethanol extract of *Barleria courtallica* was analyzed for GC-MS. Till now, the investigation of phytocomponents by GC-MS has not been done on *B. courtallica* Nees. The present study was carried out to identify some of the phytocomponents present in the ethanol extracts of *B. courtallica* (stem, root, and leaf) by GC-MS technique, to ascertain the medicinal properties of the plant.

METHODS

Collection of plant sample

The whole plant of *B. courtallica* Nees was collected from Agasthyamala Biosphere Reserve, Western Ghats, Tamil Nadu. The plant was identified with the help of local flora and authenticated in Botanical Survey of India, Southern Circle, Coimbatore, Tamil Nadu. The voucher specimens (VOCB3336) were preserved in the Ethnopharmacology Unit, Research Department of Botany, V.O. Chidambaram College, Tuticorin, Tamil Nadu.

Preparation of plant extract

Stem, root, and leaf of *B. courtallica* were cleaned, shade-dried, and pulverized to powder in a mechanical grinder. Required quantity of each powder samples (stem, root, and leaf) was weighed and transferred to stoppered flask separately and treated with ethanol until the powder is fully immersed. The flask was shaken every hour for the first 6 hrs,

and then it was kept aside and again shaken after 24 hrs. This process was repeated for 3 days, and then the extracts were filtered. The extracts were collected and evaporated to dryness using vacuum distillation unit. The final residue thus obtained was then subjected to GC-MS analysis.

GC-MS analysis

GC-MS analysis of ethanol extract was performed with GC Clarus 500 PerkinElmer system and GC interfaced to an MS equipped with Elite-1 fused silica capillary column (30×0.25 mm 1D × 1 um df, composed of 100% dimethyl polysiloxane). For GC-MS detection, electron ionization system with ionizing energy of 70 eV was used. Helium gas (99.999%) was used as the carrier gas at constant flow rate 1 ml/minute and an injection volume of 2 µl was employed (split ratio of 10:1); injector temperature 250°C; ion source temperature 280°C. The oven temperature was programmed from 110°C (isothermal for 2 minutes) with an increase of 10°C/minutes, to 200°C, then 5°C/minutes to 280°C, ending with 9 minutes isothermal at 2800C. Mass spectra were taken at 70 eV, a scan interval of 0.5 seconds and fragments from 45 to 450 Da. Total GC running time was 36 minutes. The relative % amount of each component was calculated by comparing its average peak area to the total areas; software adopted to handle mass spectra and chromatograms was a turbomass. Interpretation on mass spectrum of GC-MS was done using the database of National Institute of Standard and Technology (NIST) having more than 62,000 patterns. The mass spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library. The name, molecular weight, and structure of the components of the test materials were ascertained.

RESULTS

The compounds present in the ethanol extract of stem, root, and leaf of *B. courtallica* were identified by GC-MS analysis (Figs. 1-3).

The active principles with their retention time, molecular formula, molecular weight, peak area %, and molecular structures are presented in Tables 1-3.

25, 23, and 28 compounds were identified in the ethanol extracts of stem, root, and leaf of *B. courtallica*, respectively. The prevailing compounds of stem were β-sitosterol (20.27%), stigmasterol (17.07%), eicosane, 7-hexyl- (6.64%), 3,7,11,15-tetramethyl-2-hexadecan-1-ol (5.97%), tetracosane, 11-decyl- (5.91%), dodecyl cis-9,10-epoxyoctadecanoate (5.84%), 9-octadecenamide, (Z)- (5.47%), dibutyl phthalate (5.08%), vitamin E (4.67%), squalene (4.32%), 2-methylhexacosane (4.20%), phytol (3.54%), and Z,Z-3,15-octadecadien-1-ol acetate (3.26%). The major constituents recorded from root extract of *B. courtallica* were β-sitosterol (22.94%), stigmasterol (20.17%), urs-12-en-28-oic acid, 3-hydroxy-, methyl ester, (3β)-(18.42%), eiosane, 7-hexyl- (7.06%), 9-octadecenamide, (Z)- (4.82%), 2-methyl hexacosane (3.54%), dodecyl cis-9,10-epoxyoctadecanoate (3.15%), androstane-11, 17-dione, 3-[(trimethylsilyl)oxy]-,17-[0-(phenylmethyl)oxime], (3α, 5α)- (2.89%), dibutyl phthalate (2.83%), and heptacosane (2.81%). The prevailing compounds of leaf were 3,7,11,15-tetramethyl-2-hexadecan-1-ol (34.42%), phytol (14.18%), β-sitosterol (12.71%), squalene (11.25%), stigmasterol (8.15%), phytol acetate (6.53%), vitamin E (3.13%), tetracosane, 11-decyl-(1.69%), and lupeol (1.60%). Table 4 lists the various phytoconstituents which contribute to the biological activity of ethanol extracts of stem, root, and leaf of *B. courtallica*.

DISCUSSION

The results pertaining to GC-MS analysis led to the identification of number of compounds from the GC fraction of the ethanol extracts of *B. courtallica* stem, root, and leaf. These compounds were identified

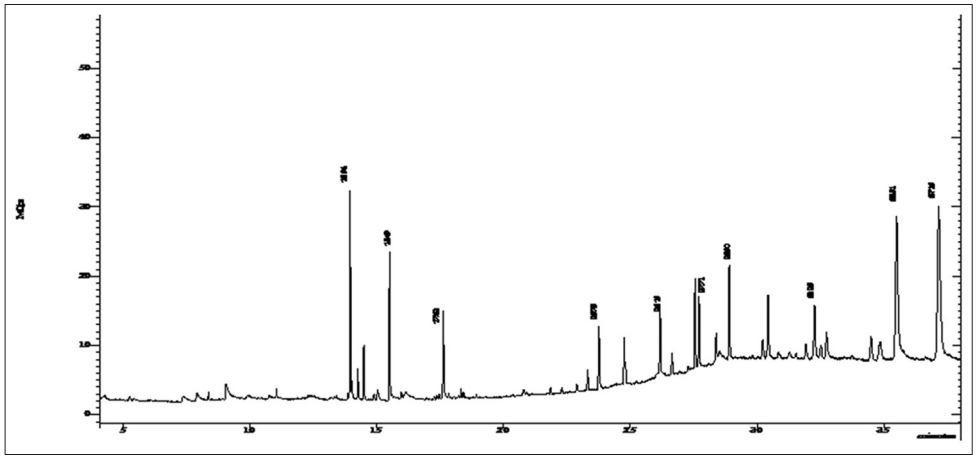


Fig. 1: Gas chromatography-mass spectrometry chromatogram of the ethanol extract of stem of *Barleria courtallica*

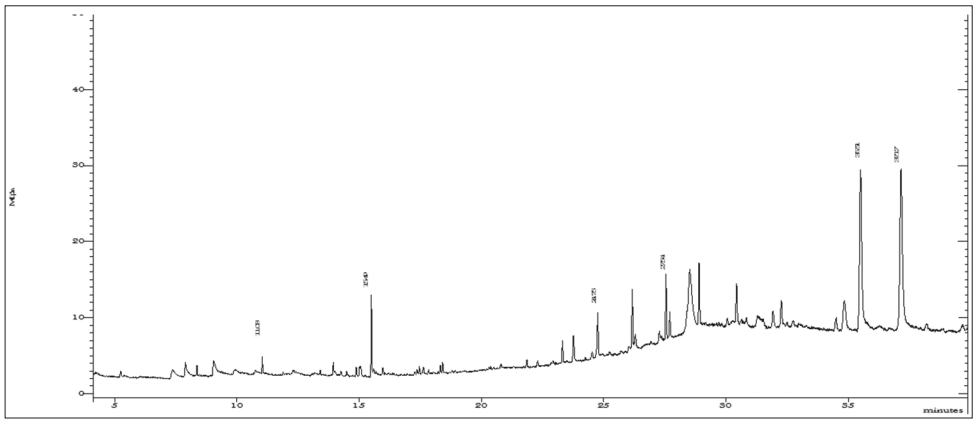


Fig. 2: Gas chromatography-mass spectrometry chromatogram of the ethanol extract of root of *Barleria courtallica*

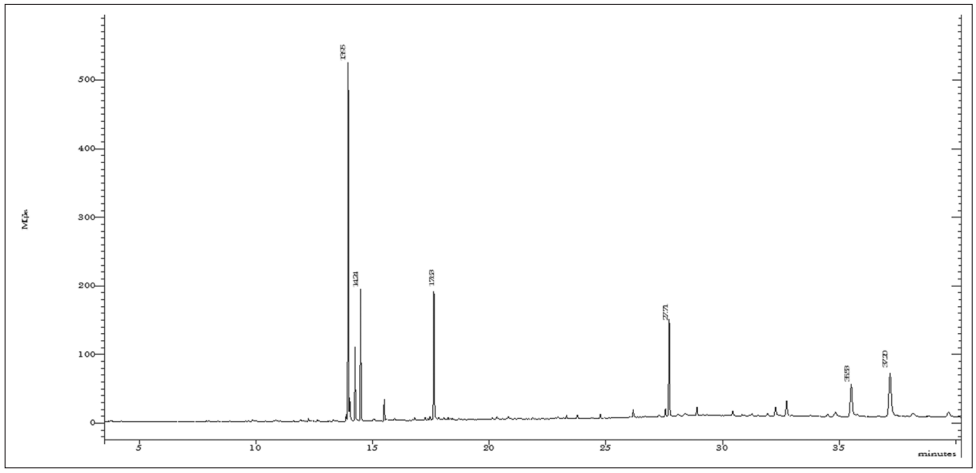
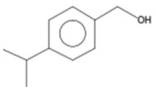
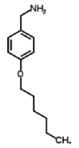
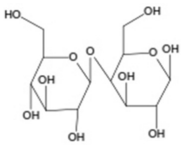
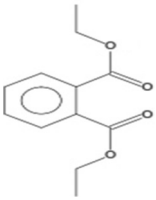
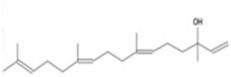
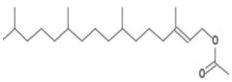
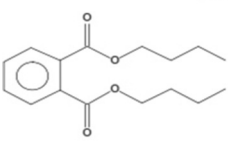
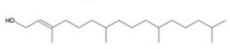


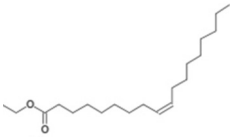
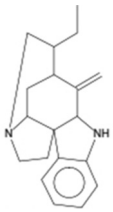
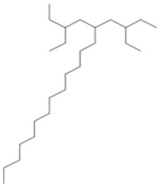
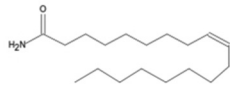
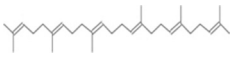
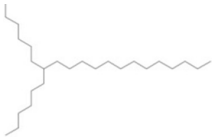
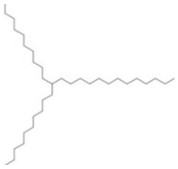
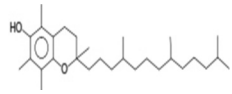
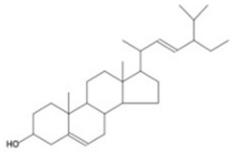
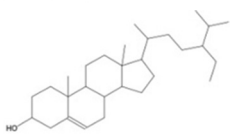
Fig. 3: Gas chromatography-mass spectrometry chromatogram of the ethanol extract of leaf of *Barleria courtallica*

Table 1: Phytocomponents detected in stem of *B. courtallica*

RT	Name of the compound	Molecular formula	Molecular weight	Peak area %	Molecular structure
7.38	p-Cymen-7-ol	$C_{10}H_{14}O$	150	0.12	
7.92	1,4-methanoazulene-9-methanol, decahydro-4,8,8-trimethyl-, [1S-(1α,3aβ,4α,8aβ,9R*)]-	$C_{15}H_{26}O$	222	0.13	
8.39	4,7,7-Trimethylbicyclo[2.2.1]heptan-2-one O-allyloxime	$C_{13}H_{21}NO$	207	0.20	
9.04	α-D-Glucopyranose, 4-O-β-D-galactopyranosyl-	$C_{12}H_{22}O_{11}$	342	0.41	
11.03	Diethyl phthalate	$C_{12}H_{14}O_4$	222	0.30	
13.94	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	296	5.97	
14.24	5-Nonadecen-1-ol	$C_{19}H_{38}O$	282	0.96	
14.48	Phytol acetate	$C_{22}H_{42}O_2$	338	1.62	
15.49	Dibutyl phthalate	$C_{16}H_{22}O_4$	278	5.08	
17.62	Phytol	$C_{20}H_{40}O$	296	3.54	
18.31	9,12-Octadecadienoic acid (Z, Z)-, methyl ester	$C_{19}H_{34}O_2$	294	0.28	

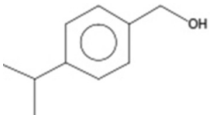
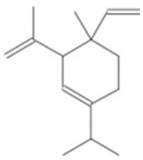
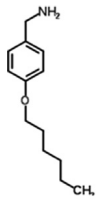
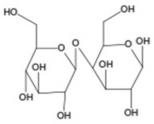
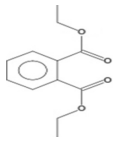
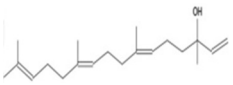
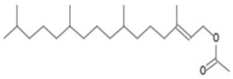
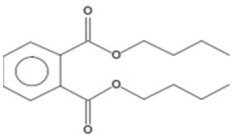
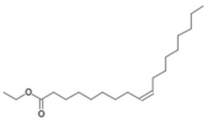
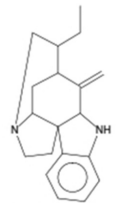
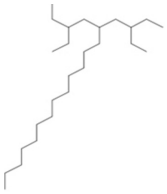
(Contd...)

Table 1: (*Continued...*)

RT	Name of the compound	Molecular formula	Molecular weight	Peak area %	Molecular structure
18.41	Ethyl oleate	$C_{20}H_{38}O_2$	310	0.26	
21.85	Curan, 16,17-didehydro-, (20.xi.)-	$C_{19}H_{24}N_2$	280	0.29	
23.32	Octadecane, 3-ethyl-5-(2-ethylbutyl)-	$C_{26}H_{54}$	366	1.00	
23.75	Z, Z-3,15-Octadecadien-1-ol acetate	$C_{20}H_{36}O_2$	308	3.26	
24.75	Heptacosane	$C_{27}H_{56}$	380	2.22	
26.16	2-methylhexacosane	$C_{27}H_{56}$	380	4.20	
27.54	9-Octadecenamide, (Z)-	$C_{18}H_{35}NO$	281	5.47	
27.71	Squalene	$C_{30}H_{50}$	410	4.32	
28.90	Eicosane, 7-hexyl-	$C_{26}H_{54}$	366	6.64	
30.43	Dodecyl cis-9,10-epoxyoctadecanoate	$C_{30}H_{58}O_3$	466	5.84	
32.28	Tetracosane, 11-decyl-	$C_{34}H_{70}$	478	5.91	
32.74	Vitamin E	$C_{29}H_{50}O_2$	430	4.67	
35.51	Stigmasterol	$C_{29}H_{48}O$	412	17.07	
37.16	β-Sitosterol	$C_{29}H_{50}O$	414	20.27	

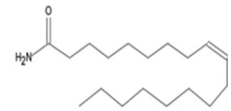
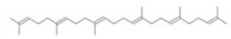
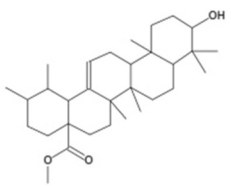
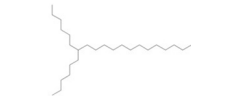
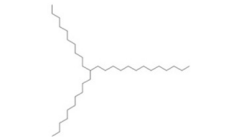
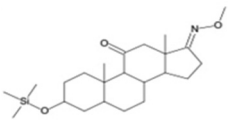
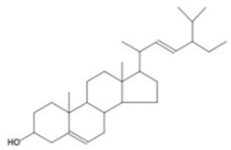
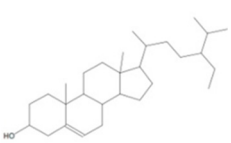
B. courtallica: Barleria courtallica

Table 2: Phytocomponents detected in root of *B. courtallica*

RT	Name of the compound	Molecular formula	Molecular weight	Peak area %	Molecular structure
7.38	p-Cymen-7-ol	$C_{10}H_{14}O$	150	0.14	
7.87	Cyclohexene, 4-ethenyl-4-methyl-3-(1-methylethenyl)-1-(1-methylethyl)-, (3R-trans)-	$C_{15}H_{24}$	204	0.91	
8.36	4,7,7-trimethylbicyclo[2.2.1]heptan-2-one O-allyloxime	$C_{13}H_{21}NO$	207	0.27	
9.04	α-D-glucopyranose, 4-O-β-D-galactopyranosyl-	$C_{12}H_{22}O_{11}$	342	0.54	
11.03	Diethyl phthalate	$C_{12}H_{14}O_4$	222	0.52	
13.94	3,7,11,15-tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	296	0.41	
14.48	Phytol, acetate	$C_{22}H_{42}O_2$	338	0.18	
15.49	Dibutyl phthalate	$C_{16}H_{22}O_4$	278	2.83	
18.42	Ethyl oleate	$C_{20}H_{38}O_2$	310	0.37	
21.85	Curan, 16,17-didehydro-, (20.xi.)-	$C_{19}H_{24}N_2$	280	0.20	
23.32	Octadecane, 3-ethyl-5-(2-ethylbutyl)-	$C_{26}H_{54}$	366	1.00	
23.76	Z, Z-3,15-octadecadien-1-ol acetate	$C_{20}H_{36}O_2$	308	1.69	

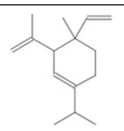
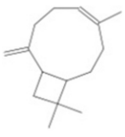
(Contd...)

Table 2: (*Continued...*)

RT	Name of the compound	Molecular formula	Molecular weight	Peak area %	Molecular structure
24.75	Heptacosane	$C_{27}H_{56}$	380	2.81	
26.16	2-methylhexacosane	$C_{27}H_{56}$	380	3.54	
27.54	9-octadecenamide, (Z)-	$C_{18}H_{35}NO$	281	4.82	
27.71	Squalene	$C_{30}H_{50}$	410	2.82	
28.52	Urs-12-en-28-oic acid, 3-hydroxy-, methyl ester, (3β)-	$C_{31}H_{50}O_3$	470	18.42	
28.90	Eicosane, 7-hexyl-	$C_{26}H_{54}$	366	7.06	
30.43	Dodecyl cis-9,10-epoxyoctadecanoate	$C_{30}H_{58}O_3$	466	3.15	
32.25	Tetracosane, 11-decyl-	$C_{34}H_{70}$	478	2.32	
34.85	Androstane-11,17-dione, 3-[(trimethylsilyl)oxy]-, 17-[O-(phenylmethyl)oxime], (3α,5α)-	$C_{29}H_{43}NO_3Si$	481	2.89	
35.51	Stigmasterol	$C_{29}H_{48}O$	412	20.17	
37.17	β-Sitosterol	$C_{29}H_{50}O$	414	22.94	

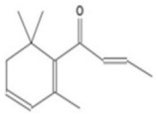
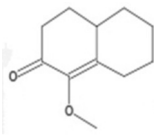
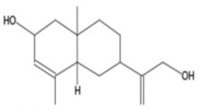
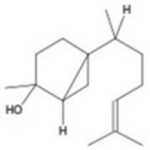
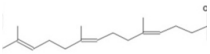
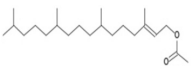
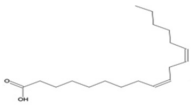
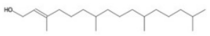
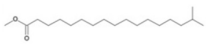
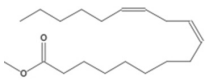
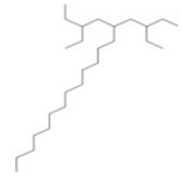
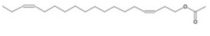
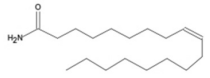
B. courtallica: Barleria courtallica

Table 3: Phytocomponents detected in leaf of *B. courtallica*

RT	Name of the compound	Molecular formula	Molecular weight	Peak area %	Molecular structure
7.87	Cyclohexene, 4-ethenyl-4-methyl-3-(1-methylethenyl)-1-(1-methylethyl)-, (3R-trans)-	$C_{15}H_{24}$	204	0.10	
8.88	Caryophyllene	$C_{15}H_{24}$	204	0.07	

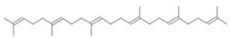
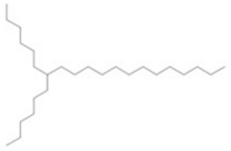
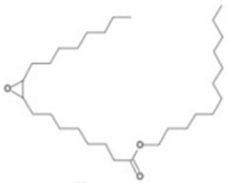
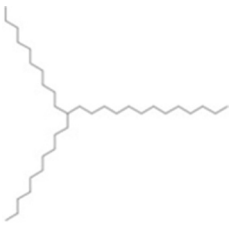
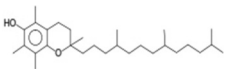
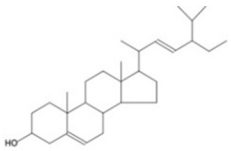
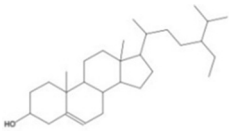
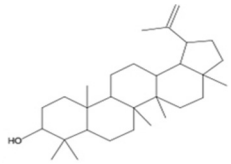
(Contd...)

Table 3: (*Continued...*)

RT	Name of the compound	Molecular formula	Molecular weight	Peak area %	Molecular structure
9.66	3-buten-2-one, 4-(2,6,6-trimethyl-1-cyclohexen-1-yl)-	$C_{13}H_{20}O$	192	0.07	
10.41	2(3H)-naphthalenone, 4,4a,5,6,7,8-hexahydro-1-methoxy-	$C_{11}H_{16}O_2$	180	0.10	
10.85	Bicyclo[4.4.0]dec-2-ene-4-ol, 2-methyl-9-(prop-1-en-3-ol-2-yl)-	$C_{15}H_{24}O_2$	236	0.07	
11.93	7-epi-cis-sesquisabinene hydrate	$C_{15}H_{26}O$	222	0.17	
13.32	Isoaromadendrene epoxide	$C_{15}H_{24}O$	220	0.21	
13.95	3,7,11,15-tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	296	34.42	
14.24	Phytol acetate	$C_{22}H_{42}O_2$	338	6.53	
17.25	9,12-octadecadienoic acid (Z, Z)-	$C_{18}H_{32}O_2$	280	0.34	
17.46	9-Octadecenoic acid (Z)-, methyl ester	$C_{19}H_{36}O_2$	296	0.49	
17.63	Phytol	$C_{20}H_{40}O$	296	14.18	
17.83	Heptadecanoic acid, 16-methyl-, methyl ester	$C_{19}H_{38}O_2$	298	0.20	
18.23	9,12-octadecadienoic acid (Z, Z)-, methyl ester	$C_{19}H_{34}O_2$	294	0.27	
22.93	9,12,15-octadecatrienoic acid, 2,3-dihydroxypropyl ester, (Z, Z, Z)-	$C_{21}H_{36}O_4$	352	0.38	
23.32	Octadecane, 3-ethyl-5-(2-ethylbutyl)-	$C_{26}H_{54}$	366	0.41	
23.78	Z, Z-3,15-octadecadien-1-ol acetate	$C_{20}H_{36}O_2$	308	0.51	
24.76	Heptacosane	$C_{27}H_{56}$	380	0.54	
27.28	9-octadecenamide, (Z)-	$C_{18}H_{35}NO$	281	0.17	

(Contd...)

Table 3: (*Continued...*)

RT	Name of the compound	Molecular formula	Molecular weight	Peak area %	Molecular structure
27.71	Squalene	$C_{30}H_{50}$	410	11.25	
28.91	Eicosane, 7-hexyl-	$C_{26}H_{54}$	366	1.17	
30.44	Dodecyl cis-9,10-epoxyoctadecanoate	$C_{30}H_{58}O_3$	466	0.84	
32.29	Tetracosane, 11-decyl-	$C_{34}H_{70}$	478	1.69	
32.73	Vitamin E	$C_{29}H_{50}O_2$	430	3.13	
35.53	Stigmasterol	$C_{29}H_{48}O$	412	8.15	
37.20	β-Sitosterol	$C_{29}H_{50}O$	414	12.71	
39.70	Lupeol	$C_{30}H_{50}O$	426	1.60	

B. courtallica: Barleria courtallica

Table 4: Activity of phytocomponents identified in the ethanol extract of stem, root and leaf of *B. courtallica*

Name of the compound	Peak area %	Compound nature	**Activity
p-Cymen-7-ol	0.12	Essential oil	Antimicrobial Anti-inflammatory Fragrance
1,4-methanoazulene-9-methanol, decahydro-4,8,8-trimethyl-, [1S-(1α,3aβ,4α,8aβ,9R*)]-	0.13	Sesquiterpene alcohol	Antitumor, Analgesic Antibacterial, anti-inflammatory sedative, fungicide
4,7,7-trimethylbicyclo[2.2.1]heptan-2-one O-allyloxime	0.20	Nitrogen compound	Antimicrobial
α-D-glucopyranose, 4-O-β-D-galactopyranosyl-	0.41	Sugar moiety	Preservative
Diethyl phthalate	0.30	Plasticizer compound	Antimicrobial Antifouling
3,7,11,15-tetramethyl-2-hexadecen-1-ol	5.97	Terpene alcohol	Antimicrobial
Phytol, acetate	1.62	Diterpene compound	Antimicrobial Anti-inflammatory Anticancer Diuretic
Dibutyl phthalate	5.08	Plasticizer compound	Antimicrobial Anti-inflammatory

(Contd...)

Table 4: (*Continued...*)

Name of the compound	Peak area %	Compound nature	**Activity
Phytol	3.54	Diterpene	Antimicrobial Anti-inflammatory Anticancer Diuretic
9,12-Octadecadienoic acid (Z, Z)-, methyl ester	0.28	Linoleic acid ester	Hypocholesterolemic, Nematicide Antiarthritic Hepatoprotective Antiandrogenic, Hypocholesterolemic 5-alpha reductase inhibitor, Antihistaminic Anticoronary Insectifuge Antieczemic Antiacne
Ethyl Oleate	0.26	Oleic acid ester	Cancer-preventive Flavor Hypocholesterolemic 5-Alpha reductase inhibitor Antiandrogenic Perfumery Insectifuge Anti-inflammatory Anemiagenic Dermatitigenic Choleretic
Curan, 16,17-didehydro-,(20.xi.)-	0.29	Nitrogen compound	Antimicrobial
9-Octadecenamide, (Z)-	5.47	Amide compound	Antimicrobial Anti-inflammatory
Squalene	4.32	Triterpene	Antibacterial Antioxidant Antitumor Cancer preventive Immunostimulant Chemo-preventive Lipoxygenase-inhibitor Pesticide
Vitamin E	4.67	Vitamin compound	Antitumor antispasmodic Antioxidant Vasodilator analgesic Antidiabetic Hepatoprotective Hypocholesterolemic Hypoglycemic Antisterility
Stigmasterol	17.07	Steroids	Antioxidant Anti-inflammatory sedative Antihepatotoxic Cancer-preventive Antiviral ovulant Hypocholesterolemic Estrogenic artemicide
β-Sitosterol	20.27	Steroids	Antimicrobial Anti-inflammatory Anticancer Antiasthma Hepatoprotective Diuretic
Cyclohexene,4-ethenyl-4-methyl-3-(1-methylethenyl)-1-(1-methylethyl)-, (3R-trans)-	0.91	Sesquiterpene	Antitumor, analgesic antibacterial, anti-inflammatory sedative, fungicide
Urs-12-en-28-oic acid, 3-hydroxy-, methyl ester, (3β)-	18.42	Ester compound	Antimicrobial Anti-inflammatory Cytotoxic
Androstane-11,17-dione, 3-[(trimethylsilyl) oxy]-, 17-[O-(phenylmethyl) oxime], (3α,5α)-	2.89	Steroids	Antimicrobial Anti-inflammatory Anticancer Antiasthma Hepatoprotective Diuretic

(Contd...)

Table 4: (*Continued...*)

Name of the compound	Peak area %	Compound nature	**Activity
Androstane-11,17-dione, 3-[(trimethylsilyl)oxy]-, 17-[O-(phenylmethyl) oxime], (3α,5α)-	2.89	Steroids	Antimicrobial Anti-inflammatory Anticancer Antiasthma Hepatoprotective Diuretic
Caryophyllene	0.07	Sesquiterpene	Anti-tumor, analgesic Antibacterial, anti-inflammatory sedative, fungicide
α-D-Glucopyranoside, methyl 2-(acetylamino)-2-deoxy-3-O-cyclic methyl	0.24	Amino compound	Antimicrobial Anti-inflammatory
7-epi-cis-sesquisabinene hydrate	0.17	Sesquiterpene alcohol	Antitumor, analgesic antibacterial, anti-inflammatory sedative, fungicide
Isoaromadendrene epoxide	0.21	Sesquiterpene oxide	Antitumor, analgesic antibacterial, anti-inflammatory sedative, fungicide
9,12-Octadecadienoic acid (Z, Z)-	0.34	Linoleic acid	Hypocholesterolemic Nematicide Antiarthritic Hepatoprotective Antiandrogenic Hypocholesterolemic 5-Alpha reductase inhibitor Antihistaminic Anticoronary Insectifuge Antieczemic antiacne
9-Octadecenoic acid (Z)-, methyl ester	0.49	Oleic acid ester	Cancer preventive Flavor Hypocholesterolemic 5-Alpha reductase inhibitor Antiandrogenic Perfumery Insectifuge Anti-inflammatory Anemiagenic Dermatitigenic Choleretic
9,12,15-Octadecatrienoic acid, 2,3-dihydroxypropyl ester, (Z, Z, Z)-	0.38	Linolenic acid ester compound	Hypocholesterolemic Nematicide Antiarthritic Hepatoprotective antiandrogenic Hypocholesterolemic 5-alpha reductase inhibitor Antihistaminic Anticoronary insectifuge Antieczemic Antiacne
Lupeol	1.60	Triterpene	Antimicrobial Anti-inflammatory Anti-cancer Analgesic Antioxidant

B. courtallica: Barleria courtallica, **activity source: Dr. Duke's phytochemical and ethnobotanical databases

through MS attached with GC. Among the identified phytochemicals, phytol is one among the compounds of the present study. Phytol was observed to have antibacterial activities against *Staphylococcus aureus* by causing damage in cell membrane; as a result, there is a leakage of potassium ions from bacterial cells [14]. Phytol is a key acyclic diterpene alcohol that is a precursor for vitamin E and K_1. It is used along with simple or corn syrup as a hardener in candies. Phytol is detected in stem, root, and leaf of *B. courtallica* which was also found to be effective at different stages of arthritis. It was found to possess as well as preventive and therapeutic results against arthritis [15]. Squalene has the property of antioxidant [16]. Recently, squalene possesses chemopreventive activity against colon carcinogenesis [17,18]. Stigmasterol is used as a precursor in the manufacture of semisynthetic progesterone, a valuable human hormone that plays an important physiological role in the regulatory and tissue rebuilding mechanisms related to estrogen effects, as well as acting as an intermediate in the biosynthesis of androgens, estrogens, and corticoids. It is also used as the precursor of vitamin D_3 [19,20]. β-sitosterol limits the amount of cholesterol absorption in the intestines, therefore decreasing the levels of cholesterol in the body. It is helpful with benign prostatic hyperplasia due to its anti-inflammatory effects and its ability to improve urinary symptoms and flow [21]. Vitamin E is the main lipid-soluble antioxidant in the body. As antioxidant, vitamin E acts in cell membrane where prevents the propagation of free radical reaction although it has been also shown to have prooxidant activity [22]. Vitamin E supplements may help reduce PMS symptoms, including anxiety, craving, and depression. Vitamin E keeps the skin young by reducing the appearance of fine lines and wrinkles. Vitamin E is thought to be important chain breaking antioxidant, which plays an important role in various stages of carcinogenesis through its contribution and immunocompetence, membrane and DNA repair, and decreasing oxidative DNA damage [23].

Phthalate, esters of phthalic acid, are mainly applied as plasticizers. Phthalic acid derivatives were suggested to have been used to

cure chronic cardiovascular and cerebrovascular diseases and had antitumor, anti-inflammatory, and antibacterial functions [24]. Phthalates are reported to have antimicrobial and the pharmacological activities [25]. Lupeol exhibited a broad spectrum of biological activities and can be used as antiprotozoal, anti-inflammatory, antitumor, and chemopreventive agents [26]. The above-said compounds were found in the ethanol extracts of *B. courtallica* which are being used for the pharmacological work.

The presence of various bioactive compounds in the *B. courtallica* justifies the use of whole plant for various ailments. However, isolation of individual phytochemical constituents and subjecting it to the biological activity will definitely give fruitful results. From the results, it could be concluded that *B. courtallica* contains various bioactive compounds. Therefore, it is recommended as a plant of phytopharmaceutical importance.

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