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EVALUATION OF PHYTOCONSTITUENTS OF *ERIGERON CANADENSIS* L. BY FTIR AND GC-MS ANALYSIS

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ABSTRACT: The Nilgiris District is one of the most botanized areas of Southern India. Asteraceae family is one of the largest families consisting of medicinal and aromatic plants in Nilgiris. The chemical compositions of *Erigeron canadensis* L. plant were investigated using Perkin-Elmer Gas Chromatography-Mass Spectrometry, while the mass spectra of the compounds found in the extract were matched by the National Institute of Standards and Technology (NIST) library. FT-IR and GC-MS analysis of ethanol extracts of *Erigeron canadensis* L. The shade-dried plant was powdered and subjected to selective sequential extraction using solvents of increasing polarity through percolation, for instance, using ethanol to obtain an ethanolic extract. Then, each of the extracts was further subjected to gas chromatography-mass spectrometry. GC-MS analysis of an ethanolic extract of *Erigeron canadensis* L. This revealed the existence of Methanethioamide, N,N-Dimethy (46.57%), N-Methylthio-acetamide (21.19%), Beta.-Sitosterol (7.80%), Disiloxane, Pentamethyl-(3.20%), Toluene P297 (3.18%), Benzene, 1,2-Dimethyl-(2.46%), Stigmasterol (2.40%), Acetic Acid, Diethoxy-, Ethyl Ester (2.39%), Benzene, 1, 2-Dimethyl-(2.15%), Phytol (1.41%), 1-Heptatriacotanol (1.09%) and Lupeol (0.90%). These results indicate that the ethanol extract of whole plant of *Erigeron canadensis* L. GC-MS analysis revealed 23 essential bioactive compounds as well as the presence of antioxidant, anti-inflammatory, anticancer, antibacterial properties, enabling its recommendation as a plant of phytopharmaceutical importance.

INTRODUCTION: Nilgiris District, Tamil Nadu, is one of the most botanized areas of Southern India. The family Asteraceae which contains over 1600 genera and more than 23000 species, is the largest family with rich phytochemical constituents and has broad medicinal utilization worldwide [1]. It is represented overall by 130 genera and with more than 1100 species in Turkey [2, 3].

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The genus *Conyza* Less. which belongs to the family Asteraceae consists of about fifty species from all over the world. In Turkey, the genus *Conyza* is represented by three species, namely *Erigeron canadensis* (L.) Cronquist, *Erigeron bonariensis* (L.) Cronquist and *Erigeron albida* Willd. ex. Sprengel [2, 3] . *Erigeron canadensis* (syn. *Conyza canadensis* L.), known as 'Canadian fleabane' or 'horseweed', is native throughout North America and is also widespread in Europe. It is an annual plant, erecting with one to several sparse hairy stems reaching 10–180 cm high [4]. In India, it is found growing in Western Himalayas, Punjab, Upper Gangetic plains, Valleys of Kashmir, Shillong, Western Ghats, and Nilgiris [5].

In traditional medicine, *Erigeron canadensis* is used for the treatment of gastrointestinal disorders such as diarrhoea, dysentery and as a diuretic agent as well as a medication for rheumatic symptoms [6]. *Conyza canadensis* have been used throughout the world as traditional or official herbal medicine for the treatment of gastrointestinal symptoms, more commonly diarrhea and dysentery, and as a diuretic agent. In Chinese native medicine, the species *Conyza canadensis* has also been prescribed for the treatment of sores, bumps, and pains caused by arthritis [7]. The essential oil of the plant was applied for bronchitis and cystitis in India [8]. In addition, a decoction of the whole herb is traditionally used in China to inhibit the growth of bacteria. It was also reported that the essential oil of the plant could inhibit allergic diarrhoea in children due to cow's milk [9]. In Turkey, a decoction of the aerial parts of the plant locally named 'bit otu', is traditionally used as a de-lousing ointment and externally applied once a time a day for a week [10]. Over the past few decades, great attention has been focused on plant's natural products for their potential as active principles in the management and treatment of diseases. Knowledge of the chemical constituents of plants is desirable for the discovery of therapeutic agents, as templates for the synthesis of complex chemical substances, and for discovering the actual significance of traditional remedies [11].

As a result of accumulated experience from the past generation, today, cultures all over the world have extensive knowledge of herbal medicine. 75% of the world population have used plants for therapy and prevention. The plant showed a wide range of pharmacological activities, including antimicrobial, antioxidant, anticancer, hypolipidemic, cardio-vascular, central nervous, respiratory, immune-logical, anti-inflammatory, analgesic, antipyretic, and many other pharmacological curative effects and properties [12-13]. The synthetic drugs that are used in the treatment of analgesia and thrombosis have different types of adverse effects, and some are costly [14]. Phytochemical studies of *Conyza canadensis* revealed the presence of C10 acetylenes, sesquiterpene hydrocarbons, flavonoids, sterols, triterpenes, and sphingolipids [15-16]. A recent study from Turkey showed anti-microbial activities of *Erigeron canadensis* essential oil; however, the different chemical composition of this plant oil was reported [17]. Phytochemical studies have indicated that the main constituents of the genus are sesquiterpene lactones, triterpenes, steroids, carotenoids, flavonoids, lignoids, alkaloids, and tannins [18]. Until now, several studies on the essential oils from different parts of *Erigeron canadensis*, such as leaves, aerial parts, and roots collected from various origins, were reported in which the presence of monoterpenes, sesquiterpenes, and acetylene derivative constituents was demonstrated [9, 19-28]. Additionally, several studies have reported that *Erigeron canadensis* extracts have a wide range of biological activities, including cytotoxic, antifungal, antibacterial, antiviral, anti-inflammatory, antioxidant, and antiagregant [17, 29-36]. However, only a few studies on the biological activity of the essential oils from *Erigeron canadensis* have been conducted. In these studies, it was stated that *Erigeron canadensis* oils have antimicrobial and cytotoxic properties and act as a growth inhibitor and act as an inhibitor of seed germination of the receptor plants [26 -28, 37-41].

Gas chromatography, coupled with Mass spectrometry (GC-MS) constitutes a simple, direct, reliable, and valuable analytical technique that has been increasingly applied in the detection and analysis of various samples such as non-polar components of volatile essential oil fatty acids and lipids. For example, through extensive GC-MS investigations, traditional medicines and medicinal plants have been found to possess a high number of phytochemicals that display various and sometimes overlapping biological activities. In Natural Products Chemistry, 'plant' includes trees, shrubs, weeds, bushes, grasses, *etc*., as well as what one normally associates with the term plant; and all parts of a plant can be explored for their phytochemistry and bioactivity potentials [42]. In the last few years, Gas Chromatography-Mass Spectrometry (GC-MS) has become firmly established as a key technological platform for secondary metabolite profiling in plant and non-plant species [43-44].

MATERIALS AND METHODS:

Plant Collection and Extract Preparation: The Plant of *Erigeron canadensis* L. was collected from Udhagamandalam, Tamil Nadu, India. The voucher specimen for the species was identified, and

confirmation of Plant specimen is kept in the Centre of Medicinal Plants Research in Homoeopathy Herbarium, at Emerald Acronym SMPRGH, The Nilgiris District, Tamil Nadu under CCRH, Ministry of AYUSH, Emerald [45]. The plant was cleaned and dried in the shade for 15 days and then ground well to a fine powder. About 500g of dry powder was extracted with ethanol (80%) at 70°C by continuous hot percolation using Soxhlet apparatus. The extraction was continued for 24 h, and the ethanolic extract was then filtered and kept in a hot air oven at 40 °C for 24 h to evaporate the ethanol from it. A dark brown residue was obtained. The residue was kept separately in airtight containers and stored in a deep freezer.

FIG. 1: *ERIGERON CANADENSIS* L. FIELD VIEW

Systemic Position: [46]

Kingdom	:	Plantae
Clade	:	Tracheophytes
Clade	:	Angiosperms
Clade	:	Eudicots
Clade	:	Asterids
Order	:	Asterales
Family	:	Asteraceae
Genus	:	Erigeron
Species	:	*Erigeron canadensis* L.

Phytochemical Analysis Tests: The phyto-chemical screening of aqueous, ethanol, methanol, acetone, and ethyl acetate extracts was subjected to different chemical tests for the detection of different phytoconstituents using standard procedures, identifying the presence of alkaloids, flavonoids, tannins, saponins, steroids, terpenoids, glycosides, phenols, carbohydrates, amino acid and proteins [46-48].

Fourier Transform Infrared Spectrophotometer (FTIR): Fourier Transform Infrared Spectrophoto-meter (FTIR) is perhaps the most powerful tool for identifying the types of chemical bonds (functional groups) present in compounds. The wavelength of light absorbed is characteristic of the chemical bond as can be seen in the annotated spectrum. By interpreting the infrared absorption spectrum, the chemical bonds in a molecule can be determined. Dried powder of different solvent extracts of *Erigeron canadensis* plant was used for FTIR analysis. 10 mg of the dried extract powder was encapsulated in 100 mg of KBr pellet, in order to prepare translucent sample discs. The powdered sample of each plant specimen was loaded in FTIR spectroscope (Shimadzu, IR Affinity 1, Japan), with a Scan range from 400 to 4000 cm^{-1} with a resolution of 4 cm^{-1}.

Gas Chromatography-Mass Spectroscopy (GC-MS): The shade-dried 50 grams powder of plant was subjected to extraction in Soxhlet extractor with 70% ethanol for 72 h, and after extraction, the extract was collected. The collected extract was evaporated to dryness and stored at 4 ºC until used. The GC–MS analysis was carried out using a Clarus 500 Perkin – Elmer (Auto system XL) gas chromatograph equipped and coupled to a mass detector Turbo mass gold – Perkin Elmer. The instrument was set to an initial temperature of 110 ºC and maintained at this temperature for 2 min. At the end of this period, the oven temperature rose up to 280 ºC, at the rate of an increase of 5 ºC /min, maintained for 9 min. Injection port temperature

was ensured as 200 ºC and helium flow rate as one ml/min. The ionization voltage was 70 eV. The samples were injected in split mode as 10:1. Mass spectral scan range was set at 45-450 (m/z). Using computer searches on a NIST Version –Year 2011 MS data library and comparing the spectrum obtained through GC–MS, compounds present in the plant sample were identified.

Identification of Functional Groups: The FTIR spectrum was used to identify the functional groups of the active components present in the plant sample based on the peak values in the region of IR radiation. When the plant extract was passed into FTIR, the functional groups of the components were separated based on its peak ratio.

Identification of Compounds: Interpretation of mass spectrum of GC-MS was conducted using the database of National Institute Standard and Technology (NIST) having more than 62,000 patterns. The spectrum of the known 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. The relative percentage amounts of each component were calculated by comparing its average peak area to the total area. The spectrum of the unknown component was compared with the spectrum of the component stored in the NIST library version (2005), software, Turbomas 5.2.

RESULTS AND DISCUSSION: The results of phytochemical characterization ethanolic extracts of *Erigeron canadensis* L. are shown in **Table 1**. Phytochemical analysis of an ethanolic extract of the plant also revealed the presence of alkaloids, flavonoids, tannins, saponins, steroids, terpenoids, glycosides, phenols, carbohydrates, amino acid, and proteins.

TABLE 1: QUALITATIVE PHYTOCHEMICAL ANALYSIS OF *ERIGERON CANADENSIS* L.

Phytochemicals	Aqueous	Ethanol	Methanol	Ethyl acetate	Chloroform
Alkaloids	++	++	+++	++	+
Phenols	+	++	+	-	-
Flavonoids	+	++	+	+	+
Tannins	+	+++	+	+	+
Saponins	-	++	+	-	-
Terpenoids	-	+++	++	+	-
Steroids	-	+	-	+	-
Carbohydrates	+	+	+	+	+
Glycosides	-	++	+	+	+
Amino acids	-	++	++	+	+
Proteins	+	++	++	+	+

+ → present in small concentration; ++ → present in moderately high concentration;
+++ → present in very high concentration; - → absent.

Alkaloids were detected using Mayer's reagent. The test was positive indicating the presence of Moderate higher concentration level of alkaloids in ethanol solution. Phenols were tested using ferric chloride. Phenols were positive for moderate higher concentration in ethanol solution. Flavonoids were tested using few fragments of magnesium ribbon and few drops of concentrated hydrochloric acid. Flavonoids were tested indicating the Ethanol solution present in moderately higher concentration of flavonoids. Tannin was detected using concentrated Ferric chloride test. The test was positive indicating the presence of very high concentration of Ethanol solution. Saponins were tested using distilled water; observed the presence indicating to moderate.

Terpenoids were detected using a concentrated Ferric chloride test. The test was positive indicating the presence of Ethanol solution. Steroids were detected by the Liebermann-Burchard test. The red colour was observed, which is indicative of the presence of steroids. Carbohydrate was tested using Benedict's solution.

Carbohydrates were tested positive, indicating the presents of Carbohydrate. Glycosides were tested using an aqueous sodium hydroxide reagent. The yellow colour is indicative of the presence of glycosides. Amino Acid and Proteins were tested by Biuret's Test. Purple colouration was observed, which is indicative of the presence of Amino Acid and proteins.

Fourier Transform Infrared Spectrophotometer (FTIR) Analysis: FTIR spectrum was used to identify the functional group of the active compounds based on the peak value in the region of infrared radiation. The FTIR spectrum profile is illustrated in **Fig. 1**. The result of FTIR peak values and functional groups is represented in **Table 2**. The FTIR spectrum profile is illustrated in **Fig. 2**. FTIR spectrum confirmed the presence of alcohol, phenol, alkanes, alkyl haide, amino acid, carbolic acid, aromatic, and amines in the plant powder of the medicinal plant taken.

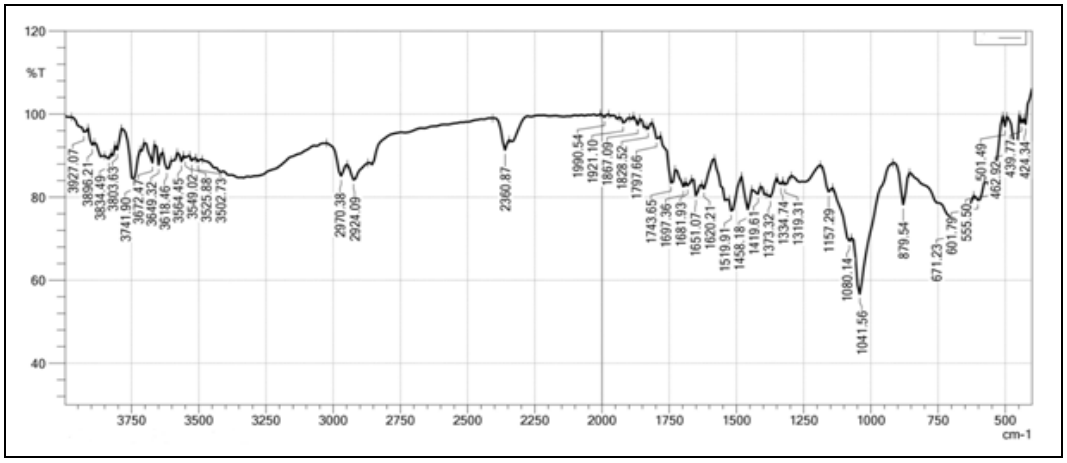


FIG. 2: FTIR SPECTRUM ANALYSIS OF PLANT OF *ERIGERON CANADENSIS* L.

The more intense band occurring at 3618.46 cm^{-1}, 2970.38 cm^{-1}, 2924.09 cm^{-1}, 1743.65 cm^{-1}, 1697.36 cm^{-1}, 1681.93 cm^{-1}, 1651.07 cm^{-1}, 1620.21 cm^{-1}, 1519.91 cm^{-1}, 1458.18 cm^{-1}, 1419.61 cm^{-1}, 1334.74 cm^{-1}, 1319.31 cm^{-1}, 1157.29 cm^{-1}, 1080.14 cm^{-1}, 1041.56 cm^{-1}, 879.54 cm^{-1}, 671.23 cm^{-1} and 555.50 cm^{-1} corresponding to O-H/H/C-H/H-C=0/C=O/C-O/C=C/N-O/C-C/C-H/C-N/C-Cl/C=C-H/C-Br.

TABLE 2: FTIR SPECTRUM ANALYSIS OF PLANT OF *ERIGERON CANADENSIS* L.

S. no.	Frequency (cm^{-1})	Intensity	Assignment	Characterization
1	3618.46	Strong, Sharp	O-H stretch, free hydroxyl	Alcohol, phenols
2	2970.38	Medium Medium	O–H stretch, C–H stretch	Carboxylic acids, alkanes
3	2924.09	Medium Medium	O–H stretch, C–H stretch	Carboxylic acids, alkanes
4	1743.65	Strong Strong	C=O stretch, C=O stretch	Carbonyls (general) esters, saturated aliphatic
5	1697.36	Strong	C=O stretch	α,β–unsaturated aldehydes, ketones
6	1681.93	Strong	C=O stretch	α,β–unsaturated aldehydes, ketones
7	1651.07	Medium	–C=C– stretch	Alkenes
9	1620.21	Medium	N–H bend	1° amines
10	1519.91	Strong	N–O asymmetric stretch	Nitro compounds
11	1458.18	Medium Medium	C–C stretch (in–ring), C–H bend	Aromatics, alkanes
12	1419.61	Medium	C–C stretch (in–ring)	Aromatics
13	1334.74	Medium	N–O symmetric stretch	Nitro compounds
14	1319.31	Medium Strong	N–O symmetric stretch, C–N stretch	Nitro compounds ,Aromatic amines
15	1157.29	Strong, Medium, Medium	C–O stretch , C–H wag (–CH_2 X), C–N stretch	Alcohols, carboxylic acids, esters, ethers, alkyl halides, aliphatic amines
16	1080.14	Strong, Medium	C–O stretch, C–N stretch	Alcohols, carboxylic acids, esters, ethers, aliphatic amines
17	1041.56	Strong, Medium	C–O stretch, C–N stretch	Alcohols, carboxylic acids, esters, ethers, aliphatic amines
18	879.54	Strong; Strong, Broad;Strong	=C–H bend; N–H wag; C–H "oop"	Alkenes; 1°, 2° amines; Aromatics
19	671.23	Strong; Strong, Broad; Medium; Broad, Strong; medium	=C–H bend; N–H wag; C–Cl stretch; –C =C–H: C–H bend; C–Br stretch	Alkynes; 1°, 2° amines ; alkyl halides; alkynes; alkyl halides
20	555.50	Medium	C–Br stretch	Alkyl halides

The result of FTIR spectroscopic analysis revealed the presents of alcohol, amines, amides, amino acids, aromatics, alkanes, alkynes, alkyl halides, carboxylic acids, carbonyls, nitro compounds, phenols, and substituted compounds in plants of *Erigeron canadensis* in **Table 2**.

Gas Chromatography-Mass Spectroscopy (GC-MS) Analysis: Table 3 shows GC-MS analysis, 23 active components were detected from the ethanolic extract of *Erigeron canadensis* L. The identification of phytochemical compounds was based on retention time. Molecular formula, peak area; molecular weight and medicinal activity are presented. Among the identified compounds, Methanethioamide, N, N-Dimethyl is found to be the major compound which attained the largest peak (46.57 %) with the retention time (2.792 min). This is followed by N-Methylthioacetamide (21.19 %). Another compound .beta.-Sitosterol, showed the peak area of 7.80%. The compound Disiloxane, Pentamethyl- showed a peak area of 3.20%. Toluene P297 - showed a peak area of 3.18%. Benzene, 1,2-Dimethyl- showed a peak area of 2.46%. Stigmasterol showed a peak area of 2.40%. Acetic acid, diethoxy-, ethyl ester showed a peak area of 2.39%. Benzene, 1,2-Dimethyl- showed a peak area of 2.15%. Phytol showed a peak area of 1.41%. Methyl laurate showed a peak area of 1.17%. 1-Heptatriacotanol showed a peak area of 1.09%. 1-Octadecyne showed a peak area of 0.98%. Lupeol showed a peak area of 0.90%. 1, 2-Benzenedicarboxylic Acid, D showed a peak area of 0.84%. 1- Eicosanol showed a peak area of 0.52%. Ethane, 1,1,2,2-tetramethoxy-showed the peak area of 0.47%. Benzene, Bromo- showed the peak area of 0.33%. Acetophenone, 2-(Allyloxy)- showed a peak area of 0.26%. 1, 3-Methanonaphthalen-8(2H)-ON showed a peak area of 0.20%. 1-Dodecanol showed a peak area of 0.18 % with a retention time of 48.853 min. The other compounds showing less prominent peaks are presented in **Fig. 3**.

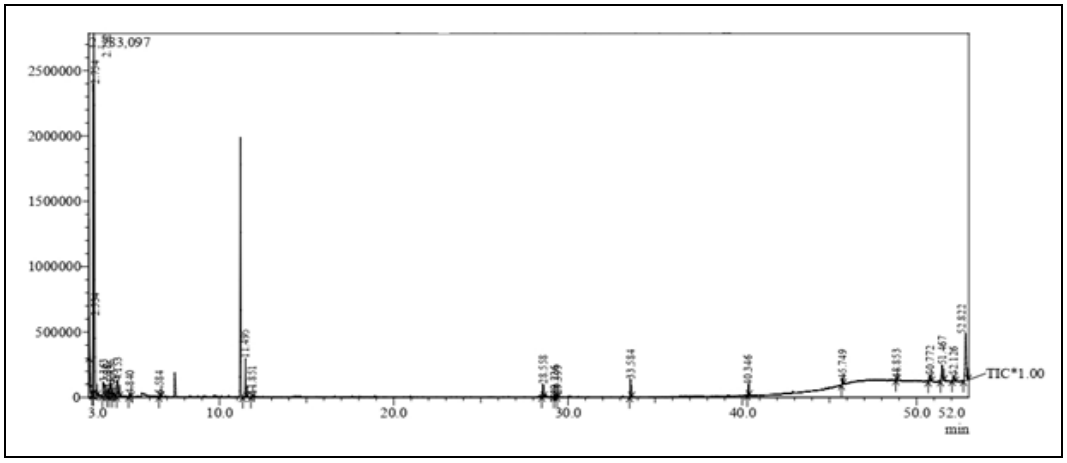
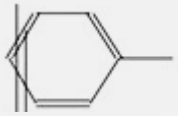
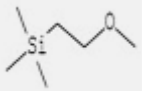
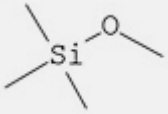
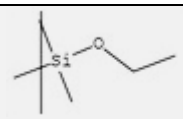
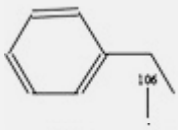
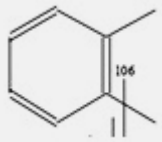
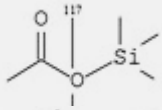
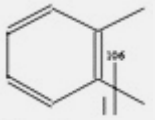
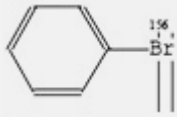
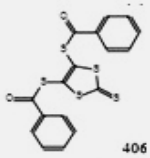
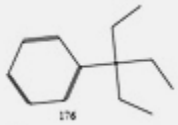
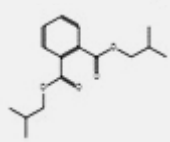
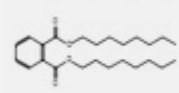
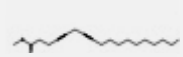
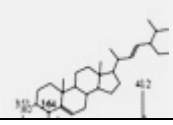


FIG. 3: GC-MS RESULT OF *ERIGERON CANADENSIS* L.

TABLE 3: GC-MS ANALYSIS SHOWED PHYTOCHEMICAL COMPOUNDS, THEIR NATURE, AND ACTIVITIES OF ETHANOL EXTRACT OF *ERIGERON CANADENSIS* L.

S. no.	R. T.	Name of Compound	Molecular formula	Molecular weight	CAS Registry No.	Peak Area %	Structure
1	2.534	Toluene P297	C_7H_8	92	108-88-3	3.18	
2	2.754	N-Methylthioacetamide	$C_6H_{16}OSi$	132	18173-63-2	21.19	
3	2.792	Methanethioamide, N,N-Dimethy	$C_4H_{12}OSi$	104	1825-61-2	46.57	

4	3.363	Acetic acid, diethoxy-, ethyl ester	$C_5H_{14}OSi$	118	1825-62-3	2.39	
5	3.586	Methyllaurate	C_8H_{10}	106	100-41-4	1.17	
6	3.736	Benzene, 1,2-Dimethyl-	C_8H_{10}	106	95-47-6	2.15	
7	3.903	Ethane, 1,1,2,2-tetramethoxy-	$C_5H_{12}O_2Si$	132	2345-38-2	0.47	
8	4.153	Benzene, 1,2-Dimethyl-	C_8H_{10}	106	95-47-6	2.46	
9	4.840	Benzene, Bromo-	C_6H_5Br	156	108-86-1	0.33	
10	6.584	Acetophenone, 2-(Allyloxy)-	$C_{17}H_{10}O_2S_5$	406	68494-08-6	0.26	
11	9.721	Disiloxane, Pentamethyl-	$C_9H_{24}OSi_2$	204	67875-54-1	3.20	
12	11.851	1,3-Methanonaphthalen-8(2h)-On	$C_{13}H_{20}$	176	4170-84-7	0.20	
13	28.558	1-Octadecyne	$C_{16}H_{32}O$	240	7320-37-8	0.98	
14	29.226	1,2-Benzenedicarboxylic Acid, B	$C_{16}H_{22}O_4$	278	84-69-5	0.15	
15	29.399	1-Undecyne	$C_{10}H_{18}$	138	764-93-2	0.16	
16	33.584	Phytol	$C_{20}H_{40}O$	296	150-86-7	1.41	
17	40.346	1,2-Benzenedicarboxylic Acid, D	$C_{24}H_{38}O_4$	390	117-84-0	0.84	
18	45.749	1-Eicosanol	$C_{18}H_{38}O$	270	112-92-5	0.52	
19	48.853	1-Dodecanol	$C_{18}H_{38}O$	270	112-92-5	0.18	
20	50.772	1-Heptatriacotanol	$C_{19}H_{30}O_2$	290	18202-20-5	1.09	
21	51.467	Stigmasterol	$C_{29}H_{48}O$	412	83-48-7	2.40	

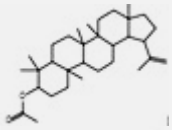
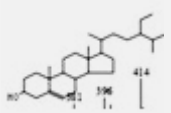
22	52.126	Lupeol	$C_{32}H_{52}O_2$	468	1617-68-1	0.90	
23	52.822	.beta.-Sitosterol	$C_{29}H_{50}O$	414	83-47-6	7.80	

TABLE 4: SHOWED BIOLOGICAL ACTIVITIES OF ETHANOL EXTRACT OF *ERIGERON CANADENSIS* L.

S. no.	R. T	Name of Compound	Molecular formula	Molecular weight	Peak Area %	Bioactive Compound
1	2.792	Methanethio Amide, N,N-Dimethy	$C_4H_{12}OSi$	104	46.57	Antioxidant, Antimicrobial, Anti-diabetic property [49-51]
2	2.754	N-Methylthio Acetamide	$C_6H_{16}OSi$	132	21.19	Anti-microbial, Antioxidant, and Anticancer activities [52]
3	52.822	.Beta.-Sitosterol	$C_{29}H_{50}O$	414	7.80	Anti-microbial, Anti-cancer, Anti-inflammatory & Antiasthma [53-54]
4	9.721	Disiloxane, Pentamethyl-	$C_9H_{24}OSi_2$	204	3.20	Cure for toxicity, irritation and carcinogenicity [55-56]
5	2.534	Toluene P297	C_7H_8	92	3.18	Anti-bacterial property [57-58]
6	4.153	Benzene, 1,2-Dimethyl-	C_8H_{10}	106	2.46	Antioxidant property [59-60, 58]
7	51.467	Stigmasterol	$C_{29}H_{48}O$	412	2.40	Thyroid inhibiting, Anti-peroxidative hypoglycaemic property [61-62]
8	3.363	Acetic Acid, Di -Ethoxy-, Ethyl Ester	$C_5H_{14}OSi$	118	2.39	Cure for skin Irritation, Eye irritation [63]
9	3.736	Benzene, 1,2-Dimethyl-	C_8H_{10}	106	2.15	Antioxidant activities [59]
10	33.584	Phytol	$C_{20}H_{40}O$	296	1.41	Antimicrobial, anticancer, anti-inflammatory properties [64-68]
11	52.126	Lupeol	$C_{32}H_{52}O_2$	468	0.90	Antimicrobial, anticancer, anti-inflammatory properties [69]
12	50.772	1-Heptatriacotanol	$C_{19}H_{30}O_2$	290	1.09	Antimicrobial [70]

RT= Retention Time

Table 4 Methanethioamide, N, N-Dimethy compound. It has a 2.792 RT value, $C_4H_{12}OSi$ molecular formula, and 104 molecular weight. Mallappa Kumara Swamy *et al.*, has reported used for its antimicrobial, antioxidant properties of different solvent extract Malaysian *Plectranthus ambonicus* leaves [49]. Anti-diabetic [50-51]. N-Methylthioacetamide compound. It has a 2.754 RT value, $C_6H_{16}OSi$ molecular formula, and 132 molecular weight. It was used as antimicrobial, antioxidant, and anticancer medicine [52]. beta.-Sitosterol compound. It has a 52.822 RT value, $C_{29}H_{50}O$ molecular formula, and 414 molecular weight. It was used for its anti-microbial, anti-inflammatory, anti-cancer, and antiasthma properties [53-54]. Disiloxane, Pentamethyl-compound. It has 9.721 RT value, $C_9H_{24}OSi_2$ molecular formula, and 204 molecular weight, it was used for toxicity, irritation, and carcinogenicity treatment [55-56]. Toluene P297 compound. It has a 2.534 RT value, C_7H_8 molecular formula, and 92 molecular weight, it was used for Anti-bacterial treatment reported by [57-58]. Benzene, 1, 2-Dimethyl- compound. It has a 4.153 RT value, C8H10 molecular formula, and 106 molecular weights, it was used as an anti-oxidant [59-60, 58].

Stigmasterol compound. It has a 51.467 RT value, $C_{29}H_{48}O$ molecular formula, and 412 molecular weight, it was used as thyroid inhibiting, anti-peroxidative hypoglycaemic [61], and anti-hepatotoxic treatments and multiple activities [62]. Acetic acid, diethoxy-, ethyl ester compound. It has 3.363 RT value, $C_5H_{14}OSi$ molecular formula, and 118 molecular weight, it was used in the treatment for skin Irritation, Eye irritation [63]. Benzene, 1, 2-Dimethyl-compound. It has a 3.736 RT value, C_8H_{10} molecular formula, and 118 molecular weight, it was used as an Antioxidant [59]. Phytol compound. It has a 33.584 RT value, $C_{20}H_{40}O$ molecular formula and 296 molecular weight; it was used as an antimicrobial, anticancer, anti-

inflammatory medicine reported by [64]. Phytol was observed to have anti-bacterial properties against *Staphylococcous aureus* by causing damage to cell membranes due to leakage of potassium ions from bacterial cells [65-66]. Phytol is acyclic diterpene alcohol with known antimicrobial, anticancer, anti-inflammatory, and diuretic properties [67]. It is used in cosmetics, shampoos, detergents [68]. Lupeol compound. It has a 52.126 RT value, $C_{32}H_{52}O_2$ molecular formula and 468 molecular weight, it is used as a antimicrobial, anticancer, anti-inflammatory medicine [69]. 1-Heptatriacotanol compound. It has a 50.772 RT value, $C_{19}H_{30}O_2$ molecular formula, and 290 molecular weight; it is used as an Antimicrobial compound [70].

FTIR Spectroscopic studies revealed the presence of alcohol, phenols, alkanes, alkynes, alkyl, halides, aldehydes, carboxylic acids, aromatics, and nitro compounds and amines were observed from ethanol leaf extract of *Gmelina asiatica* [71]. FTIR analysis of the crude methanol extract of *Ceropegia juncea* revealed the presence of functional groups of alcohol, aldehyde, alkyne, alkene, and amines, except ester. The result of the present study is in accordance with study [72]. Similarly, the present investigation FTIR analysis revealed the presence of the functional group, alkene at peak value of 1644.52. But other functional groups are absent. Early studies if FTIR analysis were also reported in some medicinal plants, *Calotropis gigantea* [73], *Tylophora pauciflora* [74], *Caralluma geniculata* [75], and *Caralluma nilagiriana* [76]. Kalimuthu and Prabakaran [77] reported 28 compounds with different chemical structures in the methanol extract of *Ceropegia pusilla*. Palawat and Payal [78] Carried out the Gas chromatography Mass spectroscopic investigation of methanol extract of *Ceropegia bulbosa*, an annual land plant using GC-MS technique. They compared the mass spectra of the compounds with the standard library of NIST.

CONCLUSION: This type of GC-MS analysis is the first step towards understanding the nature of active principles in this medicinal plant. This type of study will be helpful in a further detailed study. This investigation has given preliminary information to determine the chemical composition of *Erigeron canadensis* using FTIR and GC-MS techniques. In the present study, 23 chemical constituents have been identified from an ethanolic plant extract of *Erigeron canadensis* by Gas Chromatogram-Mass Spectrometry (GC-MS) analysis. GC-MS is widely used in pharmaceutical industries for analytical research and development, quality control, quality assurance, production, and pilot plant departments for active pharmaceutical ingredients (API), bulk drugs, and formulations.

It is used for process and method development as well as identification of impurities in API. It is an integral part of research associated with medicinal chemistry (synthesis and characterization of compounds), pharmaceutical analysis (stability testing and impurity profiling), pharmacognosy, pharmaceutical process control, and pharmaceutical biotechnology.

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