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Research Article

# SCREENING AND EVALUATION OF BIOACTIVE COMPONENTS OF *CENCHRUS CILIARIS* L. BY GC-MS ANALYSIS

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**ABSTRACT**

Plants are rich source of secondary metabolites with interesting biological activities. *Cenchrus ciliaris* L. is an important forage plant belonging to grass family (Poaceae). The objective of the present investigation was to characterize possible bioactive phytochemical constituents from the whole plant of C. ciliaris L. using methanol by gas chromatography-mass spectrometry (GC-MS) analysis. The shade-dried plant powder was extracted with methanol using Soxhlet extractor and crude extract was subjected to GC-MS. The phytochemical constituents were investigated using Perkin-Elmer gas chromatography-mass spectrometry, while the mass spectra of the compounds found in the extract was matched with the National Institute of Standards and Technology (NIST) and Willey 8 library. Maximum % area is found for Stigmasta-5, 22-Dien-3-ol, is present in maximum amount (12.68%) with RT = 36.461 min. in the methanolic root extract. 6,6-Dideutero-nonen-1-ol-3, is present in maximum amount (31.92 %) with RT=12.088 min. in the methanolic stem extract and Pentadecanoic acid is present in maximum amount (20.04%) with RT= 16.328 min. in the leaf extract of *Cenchrus ciliaris* L. Green plants synthesize and preserve a variety of biochemical compounds, these products include flavonoids, phenols, saponins, terpenes, steroids and glycosides. C4 plants, specifically in warm conditions may show more potentialities to defend themselves. These compounds are commercially important and are used by pharmaceutical industries as well as the traditional practitioners for making herbal/synthetic drug formulations.

**Keywords:** *Cenchrus ciliaris* L., Gas Chromatography – Mass Spectroscopy, Secondary metabolites, Pharmaceutical, Antibiotics, Therapeutic drugs.

## INTRODUCTION

Plants defend themselves from pathogens and other herbivore enemies by elaborating a variety of bioactive secondary metabolites that may have multiple molecular sites of action. Accordingly, exploitation of these useful plants has spread rapidly to safeguard increasing population from various pathogens and ailments. Many plants are good sources of antioxidants and other bioactive compounds containing phenolics, alkaloids, amino acids, ascorbic acid etc. Due to increasing demand, seeking therapeutic drugs from plants has grown tremendously. Such preparations contain various bioactive compounds of high therapeutic value and becoming popular in the area of medicine for their less expense and less side effects etc., compared to modern allopathic drugs. The traditional medicines in the last few decades emerged to have immense acknowledgements and it is estimated that 80% of community depend on traditional medicine for their primary healthcare[1]. More than 70% of India's 1.1 billion population still use non-allopathic systems of medicine[2]. Natural bioactive phytocompounds have been suggested as alternative sources for antibiotics. The chemical features of these constituents differ considerably among different species. This approach is alluring, in part, because they constitute a potential source of bioactive compounds that have been professed by the general public as comparatively safe and often act at multiple and novel target sites, thereby increasing the potential for resistance[3]. Extraction is the main step for the recovery and isolation of bioactive components from plant parts. The analysis and extraction of plant matrices play an important role in the development, modernization and quality control of herbal formulations[4].The extraction of bioactive compounds from plants for therapeutic targets also needs active principle to be identified[5].

GC-MS method can serve as an interesting tool for identification of active principles of herbs. It combines two analytical techniques to a single method of analyzing mixtures of chemical compounds. Gas chromatography separates the components of the mixture and mass spectroscopy analyzes each of the components separately[6].

*Cenchrus ciliaris*, commonly known as Dhaman grass, is extremely variable, tufted and perennial species. This grass is gaining attention in various field of research as it is more competitive in high temperature, solar radiation and low moisture. It is most suitable and highly nutritive grass for environmental conditions of desert[7].

## MATERIALS AND METHODS

### Collection of plant material

Fresh, disease free plants of *C. ciliaris* were collected from natural habitats of Jodhpur (Rajasthan) during July to October. Further identification and authentication of the specimens was done from Botanical survey of India, Jodhpur (Raj.) The samples were washed thoroughly in running tap water to remove soil particles and other adhered debris and finally washed with sterile distilled water. The vegetative plant was dried under shade at room temperature and powdered using an electric grinder. After sieving the powder was transferred to airtight polyethylene zipper bags.

**Preparation of plant extracts**

The powdered components (5 g) were successively extracted with methanol. Crude extracts of diff. plant parts were prepared with methanol by using hot extraction method[8] in soxhlet assembly. The extracts were stored at -4 °C for further use. Repeated extraction was done if needed with same solvent until a colorless extract was obtained. All the plant extracts were evaporated to dryness. The GC-MS analysis was performed at AIRF (Advanced Instrumentation Research Facility), Jawaharlal Nehru University, New Delhi, India. Identification of phytoconstituents was based on Willey 8 and NIST libraries attached to GC-MS instrument. Retention indices of extracted compounds were compared with stored components & results were tabulated.

**RESULTS AND DISCUSSION**

Gas chromatography coupled with mass spectrometry is a commonly used technique for separating and identifying the components of complex volatile mixtures, it can be a valuable tool assisting in the separation and identification of isolated components. GC is known for its high resolution separation of structurally similar compounds. The use of electron ionization in mass spectrometry produces distinctive mass spectral fragmentation patterns enabling mass spectra for unknown to be searched against libraries[9].

GC-MS chromatogram of the methanol extracts of root, stem, and leaf of *C. ciliaris* L. revealed 46, 46 and 66 peaks (Figure 1-3) indicating the presence of 42, 44 and 61 bioactive compounds respectively. The GC-MS analysis of methanol extract of whole plant of *C. ciliaris* L. revealed the presence of 147 phytoconstituents that could contribute the medicinal quality of the plant. 26, 17 & 35 phytochemicals (table 1-3) were identified in root, stem & leaf extract respectively with various biological activities. Structure and nature of common phytocompounds were identified in the methanolic extract of whole plant (Table 4). Mass spectrum of different compounds are shown (Figure 4-25).

Stigmasta-5, 22-Dien-3-OL[10] is present in maximum amount (12.68%), followed by Pentadecanoic acid (11.35%), Stigmast-5-en-3-ol, (3.beta.)- (8.50%), Ergost-5-en-3-ol, (3.beta.,24r)- (7.08%) and Octadec-9-Enoic acid (4.55%) in methanolic root extract. 6,6-Dideutero-nonen-1-ol-3 is present in maximum amount (31.92%), followed by Pentadecanoic acid (11.50%), Stigmasta-5,22-dien-3-ol (6.22%), 9,12,15-octadecatrienoic acid,(z,z,z)- (5.43%), and 10,12-Hexadecadien-1-ol (4.49%) in methanolic stem extract and Pentadecanoic acid is present in maximum amount (20.04%), followed by 9,12,15-octadecatrienoic acid (z,z,z)- (10.67%), Stigmasta-5,22-dien-3-ol (8.75%), Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester (3.96%) and Stigmast-5-en-3-ol, (3.beta.)- (3.49%), Ergost-5-en-3-ol, (3.beta.,24r)- (2.99%) and Vitamin E (2.82%) in methanolic leaf extract of *C. ciliaris* L. Phytosterols have been clinically proved to reduce blood cholesterol and scientific reports suggest that they posses antioxidant activity[11]. Beta-sitosterol is mainly known and used for its cholesterol lowering property[12]. Activities revealed by other valuable compounds have been tabulated. They are being used in a variety of ways in cure of various ailments & in supplementing and supplanting human health and welfare[13-18].

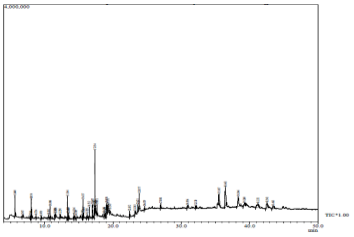


**Figure 1: GC-MS Chromatogram of *Cenchrus ciliaris* L. methanolic root extract**

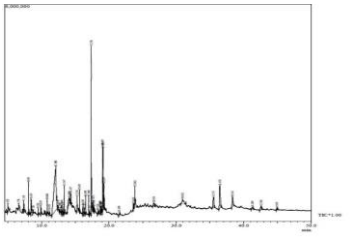


**Figure 2: GC-MS Chromatogram of *Cenchrus ciliaris* L. methanolic stem extract**

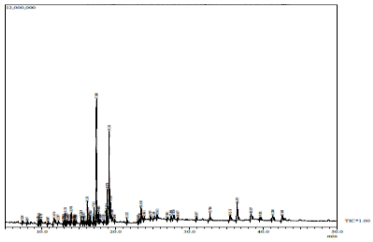


**Figure 3: GC-MS Chromatogram of *Cenchrus ciliaris* L. methanolic leaf extract**

**Table 1: Bioactivity of compounds identified in the methanolic extract of root**

| S. No. | RT (min.) | Compound | Mol. weight | Mol. formula | Bioactivities |
|---|---|---|---|---|---|
| 1 | 6.767 | Hexanoic acid,2-Ethyl- | 144 | $C_8H_{16}O_2$ | Plasticizer, Lubricants |
| 2 | 7.944 | 1-Undecanol | 172 | $C_{11}H_{24}O$ | Bactericidal |
| 3 | 8.056 | Naphthalene | 128 | $C_{10}H_{28}$ | Antiseptic, Carcinogenic |
| 4 | 9.479 | 2-Undecanone | 170 | $C_{11}H_{22}O$ | Natural non-toxic insect repellant |
| 5 | 10.806 | 1-Tetradecene | 196 | $C_{14}H_{28}$ | Anti tuberculosis |
| 6 | 12.250 | Naphthalene, 2-bromo- | 207 | $C_{10}H_7Br$ | Dye preparation |
| 7 | 13.344 | 9-Eicosene, (E)- | 280 | $C_{20}H_{40}$ | Antimicrobial, Cytotoxic |
| 8 | 13.495 | 1,2-Benzenedicarboxylic acid, Diethyl ester | 222 | $C_{12}H_{14}O_4$ | Cosmetics, Insecticides, Plasticizer |
| 9 | 14.316 | 8-Pentadecanone | 226 | $C_{15}H_{30}O$ | Hepatotoxic, Demyelination, Conjunctivitis |
| 10 | 14.585 | Heptadecane, 2,6,10,15-tetramethyl- | 296 | $C_{21}H_{44}$ | Sex hormone in Algae |
| 11 | 15.617 | n-Heptadecanol-1 | 256 | $C_{17}H_{36}O$ | Antiarthritis, In treatment of skin diseases |
| 12 | 15.686 | Tetradecane | 198 | $C_{14}H_{30}$ | Antifungal, Antibacterial, Nematicidal |
| 13 | 16.198 | 2-Pentadecanone, 6,10,14-Trimethyl- | 268 | $C_{18}H_{36}O$ | Allelopathic, Antibacterial |

| | | | | | |
|---|---|---|---|---|---|
| 14 | 17.007 | Octadecanoic acid, Methyl ester | 298 | $C_{19}H_{38}O_2$ | Antifungal, Antibacterial, Antimicrobial, Emulsifier, Perfumery Industry |
| 15 | 17.267 | cis-13-Octadecenoic acid | 282 | $C_{18}H_{34}O_2$ | Therapeutic uses in medicine, surgery |
| 16 | 17.354 | Pentadecanoic acid | 242 | $C_{15}H_{30}O_2$ | Lubricants, Adhesive agents |
| 17 | 19.567 | n-Nonadecanol-1 | 284 | $C_{19}H_{40}O$ | Antimicrobial, Cytotoxic |
| 18 | 19.074 | Octadec-9-enoic acid | 282 | $C_{18}H_{34}O_2$ | Antihypertensive, Increases HDL & decrease LDL |
| 19 | 19.271 | Octadecanoic acid | 284 | $C_{18}H_{36}O_2$ | Antifungal, Antitumor, Antibacterial |
| 20 | 22.432 | Octadecanal | 268 | $C_{18}H_{38}O$ | Sex Pheromone |
| 21 | 24.639 | 2-Hexadecyloxirane | 268 | $C_{18}H_{36}O$ | Antibacterial, Antimicrobial, Antioxidant, Antipyretic, AntiInflammatory, Analgesic |
| 22 | 30.936 | .gamma.-Tocopherol | 416 | $C_{28}H_{48}O_2$ | Antioxidant, Cardio protective, Anticancer, AntiInflammatory |
| 23 | 35.547 | Ergost-5-en-3-ol, (3.beta.,24r)- | 400 | $C_{28}H_{48}O$ | Liver disease, Jaundice, Arthrosclerosis |
| 24 | 36.461 | Stigmasta-5,22-dien-3-ol | 412 | $C_{29}H_{48}O$ | Synthetic Progesterone |
| 25 | 38.346 | Stigmast-5-en-3-ol, (3.beta.)- | 414 | $C_{29}H_{50}O$ | AntiInflammatory, Antipyretic, Anti ulcer, Antiarthritic |
| 26 | 43.463 | Androst-4-en-3-one, 17-hydroxy-, (17.beta.)- | 288 | $C_{19}H_{28}O_2$ | Regulation of spermatogenesis |

**Table 2: Bioactivity of compounds identified in the methanolic extract of stem**

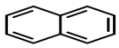
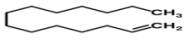
| S. No. | RT (min.) | Compound | Mol. Weight | Mol. formula | Bioactivities |
|---|---|---|---|---|---|
| 1 | 7.339 | 2,3-Dihydro-3,5- dihydro -6-methyll-4h-pyran-4-one | 144 | $C_6H_8O_4$ | Antimicrobial, AntiInflammatory |
| 2 | 8.050 | Napthalene | 204 | $C_{10}H_8$ | Antiseptic, Carcinogenic |
| 3 | 8.429 | 2,3-Dihydro-benzofuran | 120 | $C_8H_8O$ | In treatment of Diabetic Retinopathy and Arthritis |
| 4 | 9.879 | 2-Methoxy-4-vinylphenol | 150 | $C_9H_{10}O_2$ | Antibacterial |
| 5 | 13.347 | 9-Eicosene | 280 | $C_{20}H_{40}O$ | Antimicrobial, Cytotoxic |
| 6 | 14.317 | 8-Pentadecanone | 226 | $C_{15}H_{30}O$ | Hepatotoxic, Demyelination, Conjunctivitis |
| 7 | 9.470 | 2-Undecanone | 170 | $C_{11}H_{22}O$ | Natural non-toxic insect repellent |
| 8 | 15.258 | Tetradecanoic acid | 228 | $C_{14}H_{28}O_2$ | Antioxidant,Anticancer, Hypocholesterolemic |
| 9 | 16.509 | 8-Octadecanone | 268 | $C_{18}H_{36}O$ | Antimicrobial |
| 10 | 17.009 | Hexadecanoic acid, methyl ester | 270 | $C_{17}H_{34}O_2$ | Antioxidant, Antifungal, Hypocholesterolemic, Antimicrobial, Pesticide Nematicide |
| 11 | 17.675 | n-Nonadecanol-1 | 284 | $C_{19}H_{40}O$ | Antimicrobial, Cytotoxic |
| 12 | 18.688 | 9,12-Octadecadienoic acid (z,z)-,methyl ester | 294 | $C_{19}H_{34}O_2$ | Hepatoprotective, Anti-histaminic, Antieczemic , Hypocholesterolemic |
| 13 | 18.758 | 9,12,15-Octadecatrienoic acid, methyl ester, (z,z,z) | 292 | $C_{19}H_{32}O_2$ | AntiInflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective |
| 14 | 19.045 | 10,12-Hexadecadien-1-ol | 238 | $C_{16}H_{30}O$ | Sex pheromone |
| 15 | 21.509 | 9-Octadecanoic acid (z)- | 282 | $C_{18}H_{34}O_2$ | Antihypertensive, Increases HDL & decrease LDL |
| 16 | 23.624 | Octadecanal | 268 | $C_{18}H_{36}O$ | Sex pheromone |
| 17 | 26.656 | 1-Hentetracontanol | 593 | $C_{41}H_{84}O$ | Antimicrobial |

**Table 3: Bioactivity of phytochemical compounds identified in the methanol extract of leaf**

| S. No. | RT (min.) | Compound | Mol. Weight | Mol. formula | Bioactivities |
|---|---|---|---|---|---|
| 1 | 7.339 | 2,3-Dihydro-3,5-dihydroxy-6-methyl-4h-pyran | 144 | $C_6H_8O_4$ | Antimicrobial, AntiInflammatory |
| 2 | 9.878 | 2-Methoxy-4-vinylphenol | 150 | $C_9H_{10}O_2$ | Antibacterial |
| 3 | 10.807 | 1-Tetradecene | 196 | $C_{14}H_{28}$ | Antituberculosis |
| 4 | 11.654 | Guanosine | 283 | $C_{10}H_{13}N_5O_5$ | Cytotoxic against T cells lines, Anti viral against Vero cells infected with HSV-1 |
| 5 | 12.207 | Heptadecane | 240 | $C_{17}H_{36}$ | Antioxidant |
| 6 | 12.964 | Dodecanoic acid | 200 | $C_{12}H_{24}O_2$ | Antimicrobial |

| | | | | | |
|---|---|---|---|---|---|
| 7 | 13.390 | Megastigmatrienone | 190 | $C_{13}H_{18}O$ | Aroma |
| 8 | 13.493 | 1,2-Benzene dicarboxylic acid, diethyl ester | 222 | $C_{12}H_{14}O_4$ | Cosmetics, Insecticides, Plasticizer |
| 9 | 14.364 | n- Tridecan-1-ol | 200 | $C_{13}H_{28}O$ | Natural mosquito control agent |
| 10 | 14.466 | 5-Octadecene, (E)- | 252 | $C_{18}H_{36}$ | Stronger sexual characters |
| 11 | 14.589 | 2-Methyltetracosane | 352 | $C_{25}H_{52}$ | Free radical scavenging |
| 12 | 15.260 | Tetradecanoic acid | 228 | $C_{14}H_{28}O_2$ | Antioxidant, Anticancer, Hypocholesterolemic |
| 13 | 16.133 | 2,6,10-Trimethyl, 14-ethylene-14-pentadecne | 296 | $C_{20}H_{38}$ | Antiproliferative |
| 14 | 16.204 | 2-Pentadecanone, 6,10,14-Trimethyl- | 268 | $C_{18}H_{36}O$ | Allelopathic, Antibacterial |
| 15 | 16.328 | Pentadecanoic acid | 242 | $C_{15}H_{30}O_2$ | Lubricants, Adhesive agents |
| 16 | 16.390 | 2-Hexadecen-1-ol, 3,7,11,15-tetramethyl-, [r-[r*r*,(e)]] | 296 | $C_{20}H_{40}O$ | Antimicrobial, Sedatives and anesthetics |
| 17 | 16.520 | 1,2-Benzenedicarboxylic Acid, bis(2-Methylpropyl) Ester | 278 | $C_{16}H_{22}O_4$ | Antimicrobial, Antifouling |
| 18 | 17.011 | Hexadecanoic acid, methyl ester | 270 | $C_{17}H_{34}O$ | Antioxidant, Insecticide,hemolytic, Hypo – cholesterolemic |
| 19 | 17.183 | 13-Docosanoic acid | 338 | $C_{22}H_{42}O_2$ | Surfactant, Precursor to Biodiesel fuel |
| 20 | 17.268 | cis-13-Octadecenoic acid | 282 | $C_{18}H_{34}O_2$ | Therapeutic uses in medicine, surgery |
| 21 | 17.681 | Hexadecanoic acid , ethyl ester | 284 | $C_{18}H_{36}O_2$ | Antioxidant, hypocholesterolemic Antiandrogenic, Hemolytic, 5-Alpha reductase inhibitor |
| 22 | 18.330 | Heptadecanoic acid | 270 | $C_{17}H_{34}O_2$ | Antimicrobial |
| 23 | 18.688 | 9,12-Octadecadienoic acid (z,z,)-, methyl ester | 294 | $C_{19}H_{34}O_2$ | Hepatoprotective, Anti-histaminic, Antieczemic, Hypocholesterolemic |
| 24 | 18.758 | 9,12,15-Octadecatrienoic acid, methyl ester, (z,z,z)- | 292 | $C_{19}H_{32}O_2$ | AntiInflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective |
| 25 | 19.051 | 9,12-Octadecadienoic acid (z,z,)- | 280 | $C_{18}H_{32}O_2$ | AntiInflammatory, Antibacterial, Antiarthritic, Hepatoprotectiv, Anti-histaminic, Anticoronary |
| 26 | 19.133 | 9,12,15-Octadecatrienoic acid, (z,z,z)- | 278 | $C_{18}H_{30}O_2$ | Preventive against cardiovascular diseases |
| 27 | 19.281 | Octadecanoic acid | 284 | $C_{18}H_{36}O_2$ | Antifungal, Antitumor, Antibacterial |
| 28 | 19.506 | (E)-9-Octadecenoic acid ethyl ester | 310 | $C_{20}H_{38}O_2$ | Steroids and primer pheromone |
| 29 | 19.846 | Phytol, acetate | 338 | $C_{22}H_{42}O_2$ | flavor and fragrance |
| 30 | 27.001 | Squalene | 410 | $C_{30}H_{50}$ | Antioxidant, Anticancer Pesticide, Sunscreen, Perfumery, Chemo preventive |
| 31 | 30.927 | .gamma.-Tocopherol | 416 | $C_{28}H_{48}O_2$ | Antioxidant, Cardio protective, Anticancer, Anti-inflammatory |
| 32 | 32.784 | Vitamin E | 430 | $C_{29}H_{50}O_2$ | Antiaging, Analgesic, antidiabetic**,** Antidermatitic, Antileukemia, Anticancer, Vasodilator, Hepatoprotective, Hypocholesterolemic, Antibronchitic, Anticoronary |
| 33 | 35.513 | Ergost-5-en-3-ol, (3.beta.,24r)- | 400 | $C_{28}H_{48}O$ | Liver disease, Jaundice, Arthrosclerosis |
| 34 | 36.475 | Stigmasta-5,22-dien-3-ol | 412 | $C_{29}H_{48}O$ | Synthetic Progesterone |
| 35 | 38.337 | Stigmast-5-en-3-ol, (3.beta.)- | 414 | $C_{29}H_{50}O$ | Anti Inflammatory, Antipyretic, Anti ulcer, Antiarthritic |

**Table 4: Structure and nature of compounds identified in the methanolic extract of whole plant**

| S. No. | Compound | Nature | Structure |
|---|---|---|---|
| 1 | Naphthalene | Polycyclic aromatic hydrocarbon |  |
| 2 | 2-Undecanone | Ketone |  |
| 3 | 9-Eicosene, (E)- | Alkene |  |
| 4 | 1-Tetradecene | Olefins |  |

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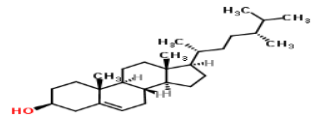
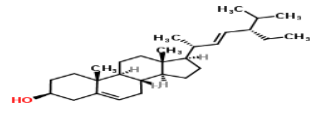
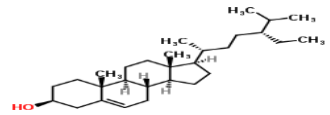
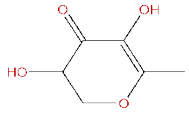
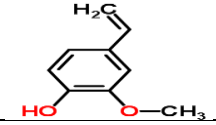
|---|---|---|---|
| 5 | 8-Pentadecanone | Ketone |  |
| 6 | 2-Pentadecanone, 6,10,14-Trimethyl- | Sesquiterpenoids |  |
| 7 | cis-13-Octadecenoic acid | Elaidic acid |  |
| 8 | Pentadecanoic acid | Fatty acid |  |
| 9 | n-Nonadecanol-1 | Fatty alcohol |  |
| 10 | 9-octadecenoic acid | Oleic acid |  |
| 11 | Octadecanal | Fatty Aldehyde |  |
| 12 | Ocadecanoic acid | Stearic acid |  |
| 13 | γ-Tocopherol | Vitamin E compound |  |
| 14 | Ergost-5-en-3-ol, (3.beta.,24r)- | Campesterol |  |
| 15 | Stigmasta-5,22-dien-3-ol | Stigmasterol |  |
| 16 | Stigmast-5-en-3-ol, (3.beta.)- | β-Sitosterol |  |
| 17 | 2,3-Dihydro-3,5-dihydroxy-6-methyl-4h-pyran | Pyranone |  |
| 18 | 2-Methoxy-4-vinylphenol | Phenolic compound |  |

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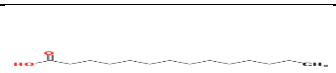
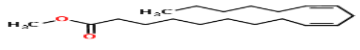
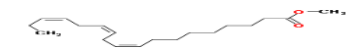
|---|---|---|---|
| 19 | Tetradecanoic acid | Myristic acid |  |
| 20 | Hexadecanoic acid, methyl ester | Fatty acid methyl ester |  |
| 21 | 9,12-Octadecadienoic acid (z,z,)-, methyl ester | Fatty acid methyl ester |  |
| 22 | 9,12,15-Octadecatrienoic acid, methyl ester, (z,z,z)- | Fatty acid methyl ester |  |

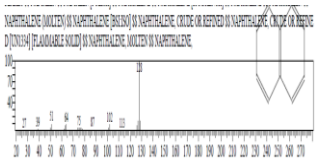


**Figure 4: Mass spectrum of Naphthalene**

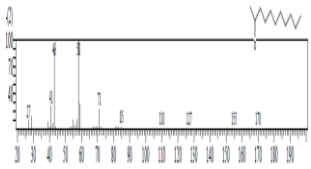


**Figure 5: Mass spectrum of 2-Undecanone**

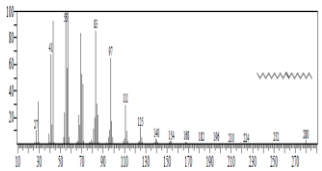


**Figure 6: Mass spectrum of 9-Eicosene, (E)-**

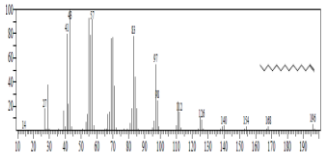


**Figure 7: Mass spectrum of 1-Tetradecene**

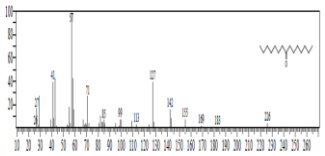


**Figure 8: Mass spectrum of 8-Pentadecanone**

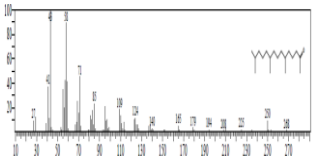


**Figure 9: Mass spectrum of 2-Pentadecanone, 6, 10, 14-trimethyl-**

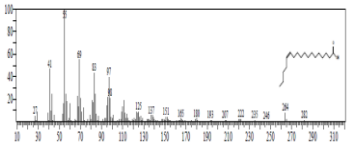


**Figure 10: Mass spectrum of cis-13-Octadecenoic acid**

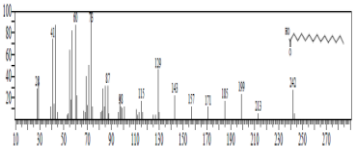


**Figure 11: Mass spectrum of Pentadecanoic acid**

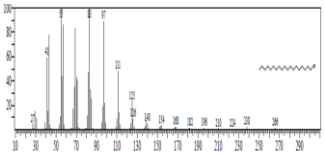


**Figure 12: Mass spectrum of n-Nonadecanol-1**

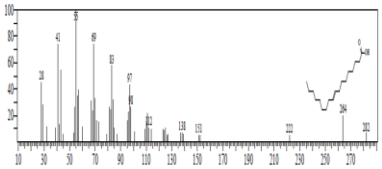


**Figure 13: Mass spectrum of 9-octadecenoic acid**

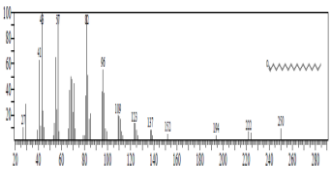


**Figure 14: Mass spectrum of Octadecanal**

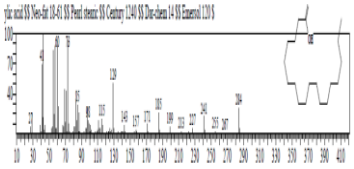


**Figure 15: Mass spectrum of Ocadecanoic acid**

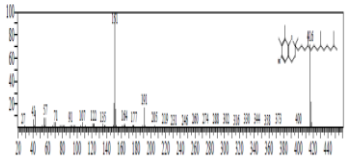


**Figure 16: Mass spectrum of γ-Tocopherol**

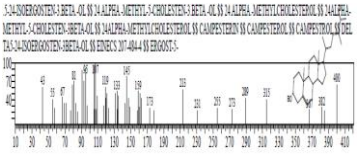


**Figure 17: Mass spectrum of ERGOST-5-EN-3-OL, (3. BETA ., 24R)-**

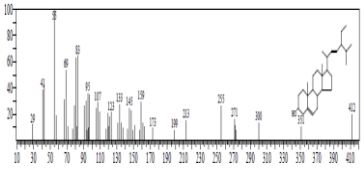


**Figure 18: Mass spectrum of Stigmasta-5, 22-dien-3-ol**

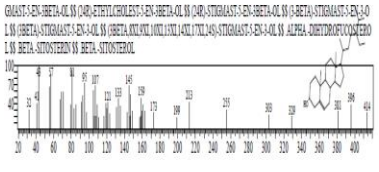


**Figure 19: Mass spectrum of Stigmast-5-en-3-ol, (3.beta.)-**

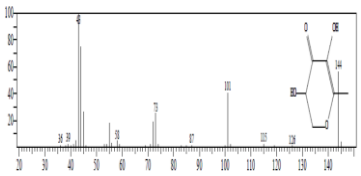


**Figure 20: Mass spectrum of 2, 3-Dihydro-3, 5-dihydroxy-6-methyl-4h-pyran**

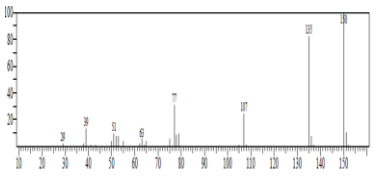


**Figure 21: Mass spectrum of 2-Methoxy-4-vinylphenol**

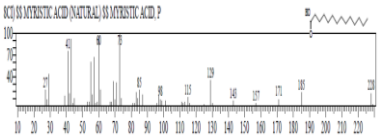


**Figure 22: Mass spectrum of Tetradecanoic acid**

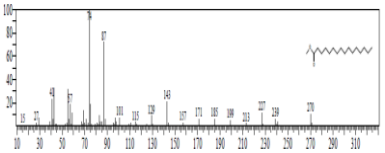


**Figure 23: Mass spectrum of Hexadecanoic acid, methyl ester**

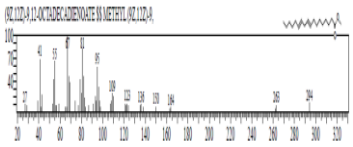


**Figure 24: Mass spectrum of 9, 12-Octadecadienoic acid (z, z,)-, methyl ester**

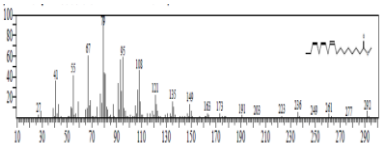


**Figure 25: Mass spectrum of 9, 12, 15-Octadecatrienoic acid, methyl ester, (z, z, z)-**

## CONCLUSION

22 bioactive compounds were identified in methanol extract of whole plant of *C. ciliaris* by GC-MS analysis. The results revealed presence of higher no. of compounds in methanol extract of leaf followed by root and stem. GC-MS study has exploited the potential of *C. ciliaris*. This plant can be a good source of phytoconstituents like alkane, carboxylic acid, phytosterol, aldehyde, ketone, fatty acid ester, fatty alcohol, terpenes and Vitamin E. Ergost-5-en-3-ol, (3.beta., 24r)-(Campesterol) and Stigmasta-5, 22-dien-3-ol (Stigmasterol) both are anti-cancerous phytosterols. Stigmast-5-en-3β-ol (β-Sitosterol), a phytosterol shows anti-inflammatory, anti-pyretic, anti-arthritic, anti-ulcer, insulin releasing and estrogenic effects. In future, the isolation and purification of above mentioned compounds analyzed from various parts of this plant would be fruitful for the pharmaceutical companies to formulate novel drugs and herbal medications for treating various ailments. It could be concluded that *C. ciliaris* L. contains numerous bioactive compounds. So it's recommended as a plant of pharmaceutical importance. However further studies are needed to undertake its bioactivity and toxicity profile.

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