

Original Article

GC-MS ANALYSIS OF INVASIVE AQUATIC WEED, *PISTIA STRATIOTES* L. AND *EICHHORNIA CRASSIPES* (MART.) SOLMS

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ABSTRACT

Objective: To investigate the bioactive components of an invasive aquatic weed, *Pistia stratiotes* L. and *Eichhornia crassipes* (Mart.) Solms vegetative parts by using Gas Chromatography-Mass Spectrometer (GC-MS).

Methods: The chemical compositions of the ethanol extract of whole plant *Pistia stratiotes* L. and *Eichhornia crassipes* (Mart.) Solms was investigated using Agilent Technologies GC-MS (GC-7890A, MS 5975C).

Results: The results of GC-MS analysis of the ethanolic extract revealed the existence of 28 phytochemical compounds in *Pistia stratiotes* L. n-Hexadecanoic acid, 11-Hexadecenoic acid, ethyl ester, Hexadecanoic acid, ethyl ester, Octadecanoic acid, ethyl ester, 2-Cyclopenten-1-one, 5-hydroxy-2,3-dimethyl, L-Glutamine, 2-Pentadecanone, 6,10,14-trimethyl, Linolelaidic acid, methyl ester, 9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z), Nonadecane, 12,15-Octadecadiynoic acid, methyl ester, Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester, Diisooctyl phthalate, Docosanoic acid, ethyl ester, Stigmasterol, Bis(2-ethylhexyl) phthalate, 1-Monolinoleoylglycerol trimethylsilyl ether, Ethyl iso-allocholate are the major compound.

The ethanolic extract of *Eichhornia crassipes* (Mart.) Solms contains 43 phytochemical compounds of high and low molecular weight n-Hexadecanoic acid, E-11-Hexadecenoic acid, ethyl ester, Palmitic acid, Phytol, 9,12,15-Octadecatrienal, 9,12-Octadecadienoic acid, ethyl ester, Linolenic acid, ethyl ester, Stearic acid, ethyl ester, Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester, α -Glyceryl linolenate, 1-Monolinoleoylglycerol trimethylsilyl ether, Linoleic acid, 2,3-bis-(O-TMS)-propyl ester, Stigmasterol, Linolelaidic acid, methyl ester, 9,12,15-Octadecatrienoic acid, ethyl ester, (Z,Z,Z), Ethyl iso-allocholate, Cholesta-22,24-dien-5-ol, 4,4-dimethyl are the major compounds.

These results indicates *Pistia stratiotes* L. and *Eichhornia crassipes* (Mart.) Solms possess potent antioxidant, anti-inflammatory, anticancer, antitumour, antiarthritic, cancer preventive, antibacterial effects so can be recommended as a plant of phytopharmaceutical importance.

Conclusion: The ethanol extract of *Pistia stratiotes* L. and *Eichhornia crassipes* (Mart.) Solms proves as a potential source of bioactive compounds of pharmacological importance.

Keywords: Antioxidant, Anti-inflammatory, Anticancer, Antitumour, Antiarthritic

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INTRODUCTION

Plants are valuable for modern folklore medicine as they are sources of direct therapeutic agents. Herbal plants produce and contain a variety of chemical substances, of these substances certain isolated compounds serve as models for new synthetic compounds and can be used as taxonomic markers for the discovery of new compounds. However, only a fraction of the world's plants has been studied. Over the years evaluation of crude drugs has undergone many changes.

Due to advancement in the chemical knowledge of crude drugs, evaluation methods include estimating active constituents present in the crude drug, in addition to its morphological and microscopic analysis. Quality control standardisations of the various medicinal plants used in traditional medicine is now becoming more important today in view of the commercialization of formulations based on these plants [1].

Pistia stratiotes, commonly known as water cabbage or water lettuce, belongs to the family Araceae, is an edible, aquatic, floating ornamental plant with widely distributed across tropical and subtropical areas around the world. *P. stratiotes* is widely distributed and is being loathed in Asia and Africa. This plant and its extracts potentially have medicinal effects. In various parts of the world, it is also used as anodyne for eyewash. The leaves are used in eczema, leprosy, ulcers and piles [2]. The plant is bitter, pungent flavor, having cooling, laxative property. It is used in 'Tridosha' fever and diseases of the blood. Leaf infusions have been mentioned in the

folklore to be used for dropsy, bladder complaints, kidney afflictions, hematuria, dysentery and anemia [3].

The freshwater aquatic plant *E. crassipes*, commonly known as water hyacinth is a member of the family Pontederiaceae. This fast growing, free-floating, perennial plant is indigenous to Brazil Amazon basin and Ecuador region. It was introduced as an ornamental species to adorn the water bodies. Water hyacinth is a source of many compounds with radical scavenging activity, such as vitamins, terpenoids, phenolic acids, lignin, stilbens, alcaloids, sterols, and other metabolites with high antioxidant activity [4]. Phytosterols are steroidal molecules that show a similar structure to cholesterol found in many vegetables such as water hyacinth. The most common phytosterol compounds is stigma sterol. Those compounds comprise 98% of all the vegetable sterols identified in plants [5].

The aim of this study was to analyze organic water lettuce and water hyacinth extracts through phytochemical screening and gas chromatography-mass spectrometry (GC-MS) to elucidate their chemical composition and to determine their potential applications.

MATERIALS AND METHODS

Collection of plant material

Leaves of *Pistia stratiotes* L. (Araceae) and *Eichhornia crassipes* (Mart.) solms, (Pontederiaceae), were collected from Kishor Sagar lake, Kota city, Rajasthan, India. It is situated between 25 °11'0"N

latitude and 75 °50'0"E longitude. Kishor Sagar lake in Kota city is one of the major water bodies enhances the groundwater level around this area.

Preparation of samples

The collected plant materials were air-dried and ground into uniform powder. Dry powder of plant sample was extracted with ethanol using soxhlet apparatus for 6 h. The extract was filtered, followed by concentrated using rotary evaporator. The concentrated extract was subjected to freeze drying in a lyophilizer till dry powder was obtained. Finally, the extracted powder was suspended with the ethanol at the concentration of 100 mg/ml (w/v) followed by filtration through Varian Bond Elute C18 solid phase extraction to remove impurities. 1µl of this solution was employed for GC-MS-MS analysis.

Gas chromatography-mass spectroscopy analysis

The GC-MS analysis was carried out using Agilent Technologies GC-MS (GC-7890A, MS 5975C) with Fused silica 15m x 0.2 mm ID x 1µm of the capillary column. The instrument was set to an initial temperature of 110 °C, and maintained at this temperature for 2 min. At the end of this period, the oven temperature was rose up to 280 °C, at the rate of an increase of 5 °C/min, and maintained for 9

min. Injection port temperature was ensured as 250 °C and Helium flow rate as 1 ml/min. The ionisation voltage was 70eV. The samples were injected in split mode as 10:1. Mass spectral scan range was set at 30-450 (m/z). Using computer searches on a NIST Ver.2.1 MS data library and comparing the spectrum obtained through GC-MS compounds present in the plant's sample were identified.

Interpretation on mass-spectrum GC-MS was conducted using the database of National Institute Standard and Technology (NIST) having more than 62,000 patterns. The spectrum of the unknown components was compared with the spectrum of known components stored in the NIST library. The name, molecular weight and structure of the components of the test materials were ascertained.

RESULTS AND OBSERVATION

Gas chromatogram and mass spectra of different plant parts of ethanol extract of *Pistia stratiotes* L. and *Eichhornia crassipes* (Mart.) solms are presented in fig. 1, 2, 3, 4 and 5 respectively. The detailed tabulation of GC-MS analysis of the extract is given in table 1, table 2, table 3, table 4 and table 5 respectively. The activity of the compounds as reported in Dr. Duke's Phytochemical and Ethno botanical Databases which are screened during GC-MS analysis justify the traditional medicinal uses.

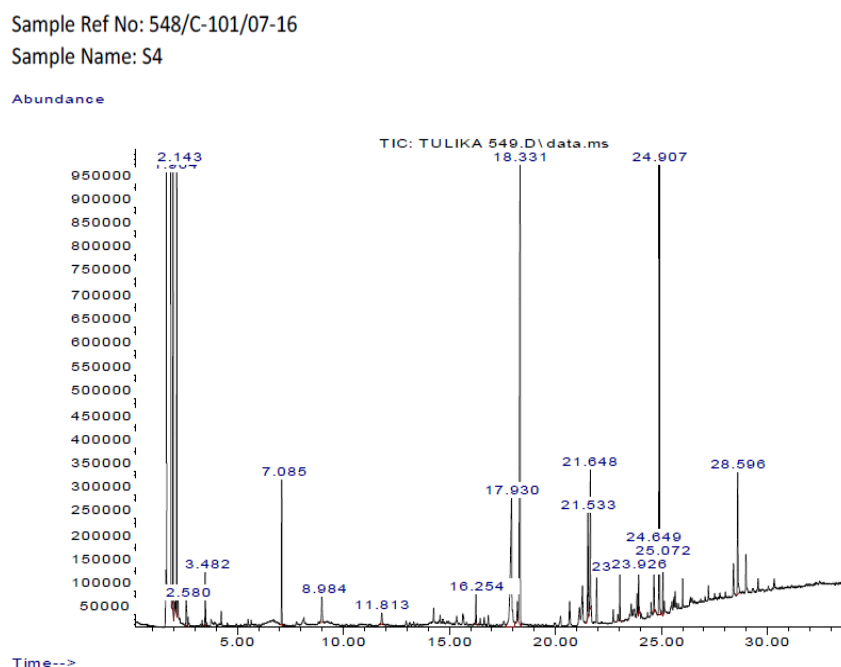


Fig. 1: GC-MS Spectra of ethanolic extract of Leaf of *P. stratiotes*

Table 1: Photo component present in the ethanolic extract of the Leaf of *Pistia stratiotes* by GC-MS

RT	Name of Compound	MF	MW	Peak area %	Compound nature	Activity
2.14	Isobutyl alcohol	C ₄ H ₁₀ O	74	5.42	Alcohol	Biofuel
3.48	Formic acid,1-methylethyl ester	C ₄ H ₈ O ₂	88	0.93	Carboxylic acid	Preservative, antibacterial agent, treatment for warts.
7.08	Propane,1,1-diethoxy-2-methyl	C ₈ H ₁₈ O ₂	146	2.05	Ether	No activity reported.
11.81	L-Glutamine	C ₅ H ₁₀ N ₂ O ₃	146	0.38	Amino acid	Building block of Protein
17.93	n-Hexadecanoic acid	C ₁₆ H ₃₂ O ₂	256	7.18	Palmitric acid (saturated fatty acid)	Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Lubricant, Antiandrogenic, Hemolytic, 5-alpha reductase inhibitor, antipsychotic
18.33	Hexadecanoic acid, ethyl ester	C ₁₈ H ₃₆ O ₂	284	13.29	Palmitic acid ester	Antioxidant, Hemolytic, Hypocholesterolemic, Flavor, Nematicide, Antiandrogenic
21.53	Linolelaidic acid, methyl ester	C ₁₉ H ₃₄ O ₂	294	2.41	Fatty acid	No activity reported.
21.64	9,12,15-Octadecacatrienoic	C ₁₉ H ₃₂ O ₂	292	2.7	Steroid	Antiarthritic, Anticancer, Hepatoprotective,

23.92	acid, methyl ester, (Z,Z,Z) 12,15-Octadecadiynoic acid, methyl ester	C ₁₉ H ₃₀ O ₂	290	0.50	Unsaturated fatty acid ester	Antimicrobial, Antiasthma, Diuretic. No Activity reported.
24.64	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester	C ₁₉ H ₃₈ O ₄	330	0.96	Amino compound	Antimicrobial
24.90	Diisooctyl phthalate	C ₈ H ₄ (C ₈ H ₁₇ COO) ₂	390	53.84	Plasticizer compound	Antimicrobial, Antifouling
25.07	Docosanoic acid, ethyl ester	C ₂₄ H ₄₈ O ₂	368	0.69	Fatty ester	No Activity reported.
28.59	Stigmasterol	C ₂₉ H ₄₈ O	412	2.57	Steroid	Antioxidant, hypoglycemic and thyroid inhibiting properties, precursor of progesterone, antimicrobial, anticancer, antiarthritic, antiasthama, anti-inflammatory, diuretic

Activity Source: -Dr. Duke's Phytochemical and Ethnobotanical Databases

Sample Ref No: 546/C-99/07-16

Sample Name: S2

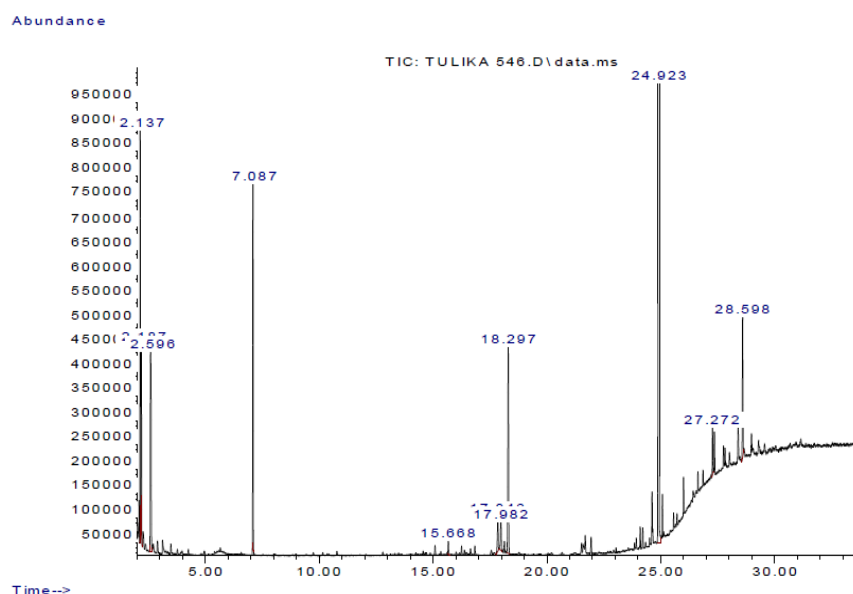


Fig. 2: GC-MS spectra of ethanolic extract of Root *P. stratiotes*

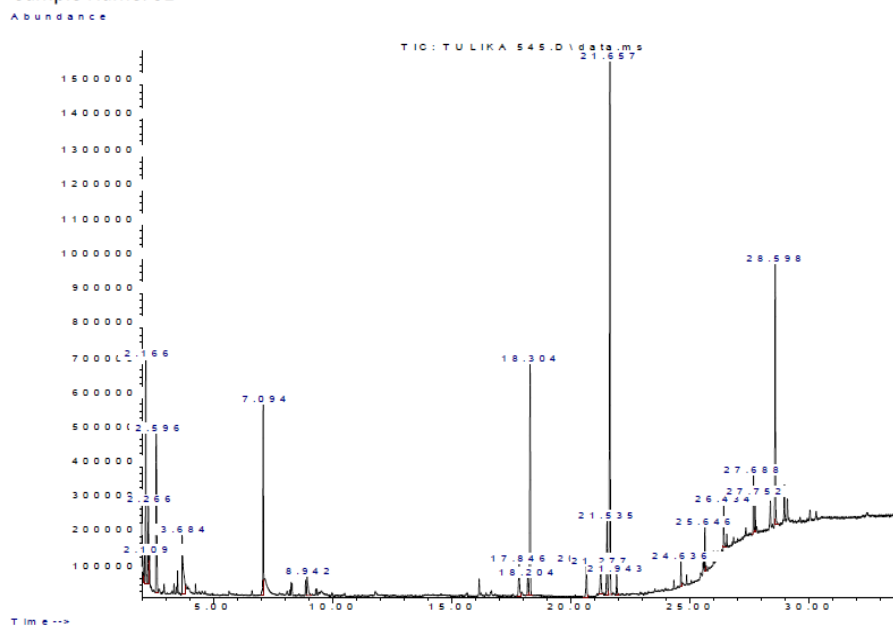
Table 2: Compound present in the ethanolic extract of the root of *Pistia stratiotes*

RT	Name of compound	MF	MW	Peak area %	Compound nature	Activity
2.13	Isobutyl alcohol	C ₄ H ₁₀ O	74	1.70	Alcohol	Biofuel
2.59	Ethane, 1,1-diethoxy	C ₆ C ₁₄ O ₂	118	1.79	Ether	Flavoring agent
7.08	Propane, 1,1-diethoxy-2-methyl	C ₈ H ₁₈ O ₂	146	1.61	Ether	No activity reported.
15.66	Octadecanoic acid, ethyl ester	C ₂₀ H ₄₀ O ₂	312	0.07	Fatty ester	No activity reported.
17.84	n-Hexadecanoic acid	C ₁₆ H ₃₂ O ₂	256	0.30	Palmitic acid (saturated fatty acid)	Antioxidant, antipsychotic, Hypocholesterolemic, Nematicide, Pesticide, Lubricant, Antiandrogenic, Hemolytic, 5-alpha reductase Inhibitor.
17.98	E-11-Hexadecanoic acid, ethyl ester	C ₁₈ H ₃₄ O ₂	282	0.24	Stearic acid	Antifungal, Antitumour, Antibacterial
18.29	Hexadecanoic acid, ethyl ester	C ₁₈ H ₃₆ O ₂	284	1.63	Palmitic acid ester	Antioxidant, Hemolytic, Hypocholesterolemic, Flavor, Nematicide, Antiandrogenic
24.92	Bis (2-ethylhexyl) phthalate	C ₈ H ₄ (C ₈ H ₁₇ COO) ₂	390	91.49	Plasticizer compound	Solvent in glowstick.
27.27	1-Monolinoleoylglycerol trimethylsilyl ether	C ₂₇ H ₅₄ O ₄ Si ₂	498	0.22	Steroid	Antiarthritic, Anticancer Hepatoprotective, Antimicrobial,
28.59	Ethyl iso-allochololate	C ₂₆ H ₄₄ O ₅	436	0.92	Steroid	Antiasthma, Diuretic, Antimicrobial, Diuretic, Anti-inflammatory, Antiasthma

Activity Source: -Dr. Duke's Phytochemical and Ethnobotanical Databases

Sample Ref No: 545/C-98/07-16

Sample Name: S1

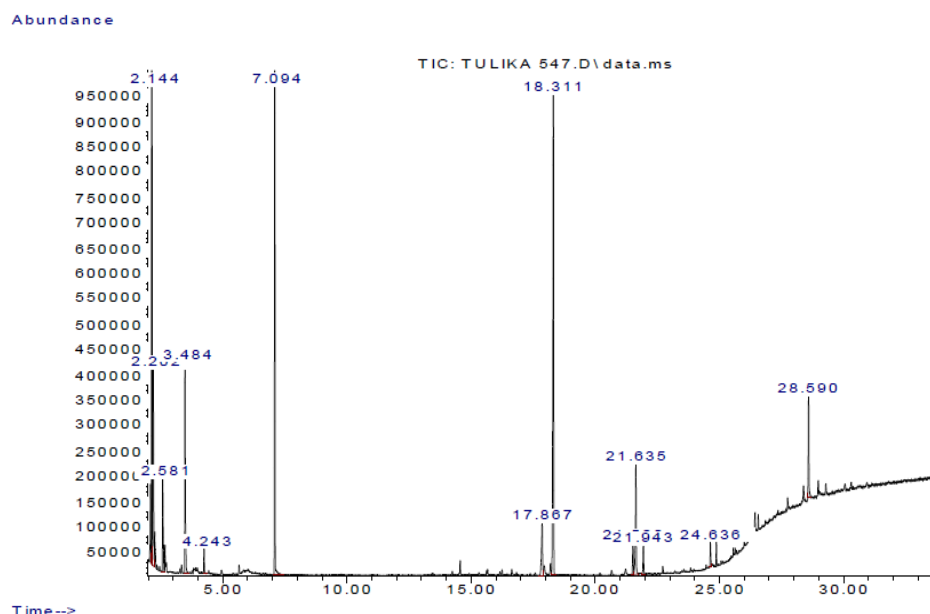
Fig. 3: GC-MS spectra of ethanolic extract of Leaf *E. crassipes*Table 3: Compound present in the ethanolic extract of Leaf of *Eichhornia crassipes*

RT	Name of compound	MF	MW	Peak area %	Compound nature	Activity
2.59	Ethane, 1,1-diethoxy	C ₆ H ₁₄ O ₂	118	9.77	Ether	Flavoring agent
7.09	Propane,1,1-diethoxy-2-methyl	C ₈ H ₁₈ O ₂	146	7.10	Ether	No activity reported.
17.84	n-Hexadecanoic acid	C ₁₆ H ₃₂ O ₂	256	2.34	Palmitic acid (saturated fatty acid)	Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Lubricant, Antiandrogenic, Hemolytic, 5-alpha reductase inhibitor, antipsychotic
18.20	E-11-Hexadecanoic acid, ethyl ester	C ₁₈ H ₃₄ O ₂	282	1.04	Stearic acid	Antifungal, Antitumour, Antibacterial
18.30	Palmitic acid, ethyl ester	C ₁₈ H ₃₆ O ₂	284	12.09	Stearic acid	Antifungal, Antitumour, Antibacterial
20.66	Phytol	C ₂₀ H ₄₄ O	296	2.12	Diterpene	Antimicrobial, Anti-inflammatory, Anticancer, Diuretic, Antifungal against <i>S. typhi</i> , resistant gonorrhoea, joint dislocation, headache, hernia, stimulant and antimalarial
21.27	9,12,15-Octadecatrienal	C ₁₈ H ₃₀ O	262	2.10	Steroid	Antiarthritic, Anticancer, Hepatoprotective, Antimicrobial, Asthma, Diuretic
21.53	9,12-Octadecadienoic acid, ethyl ester	C ₂₀ H ₃₆ O ₂	308	3.79	Polyenoic fatty acid	Hepatoprotective, antihistaminic, hypocholesterolemic, antieczemic
21.65	Linolenic acid, ethyl ester	C ₂₀ H ₃₄ O ₂	306	26.26	Linoleic acid ethyl ester	Hypocholesterolemic, Nematicide, Antiarthritic, Hepatoprotective Antiandrogenic, Hypocholesterolemic, 5-Alpha reductaseinhibitor, Antihistaminic, Anticoronary, Insectifuge, Antieczemic, Antiacne
21.94	Stearic acid, ethyl ester	C ₂₀ H ₄₀ O ₂	312	0.98	Fatty ester	No activity reported.
24.63	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester	C ₁₉ H ₃₈ O ₄	330	0.87	Amino compound	Antimicrobial
25.64	α-Glyceryl linolenate	C ₂₁ H ₃₆ O ₄	352	1.35	Fatty acid Ester	Cosmetic, Colouring agent.
26.43	1-Monolinoleoylglycerol trimethylsilyl ether	C ₂₇ H ₅₄ O ₄ Si ₂	498	1.52	Steroid	Antiarthritic, Anticancer, Hepatoprotective, Antimicrobial, Asthma, Diuretic.
27.68	Linoleic acid, 2,3-bis-(O-TMS)-propyl ester	C ₂₇ H ₅₄ O ₄ Si ₂	498	1.98	Steroid	Antiarthritic, Anticancer, Hepatoprotective, Antimicrobial, Asthma, Diuretic
28.59	Stigmasterol	C ₂₉ H ₄₈ O	412	11.39	Steroid	Antioxidant, hypoglycemic and thyroid inhibiting properties, precursor of progesterone, antimicrobial, anticancer, antiarthritic, asthma, anti-inflammatory, diuretic

Activity Source: -Dr. Duke's Phytochemical and Ethnobotanical Database

Sample Ref No: 547/C-100/07-16

Sample Name: S3

Fig. 4: GC-MS spectra of ethanolic extract of petiole of *E. crassipes*Table 4: Compound present in the ethanolic extract of the petiole of *Eichhornia crassipes*

RT	Name of compound	Molecular formula	Molecular weight	Peak area %	Compound nature	Activity
2.14	Isobutyl alcohol	C ₄ H ₁₀ O	74	28.82	Alcohol	Biofuel
2.58	Ethane, 1,1-diethoxy	C ₆ H ₁₄ O ₂	118	4.15	Ether	Flavoring agent
3.48	Formic acid,1-methylethyl ester	C ₄ H ₈ O ₂	88	7.6	carboxylic acid	Preservative, an antibacterial agent, treatment for warts.
4.24	Ethanal, 2-propoxy	C ₅ H ₁₂ O ₂	104	0.97	Ether	Solvent, Paints and Coating.
7.09	Propane,1,1-diethoxy-2-methyl	C ₈ H ₁₈ O ₂	146	16.84	Ether	No activity reported.
17.86	n-Hexadecanoic acid	C ₁₆ H ₃₂ O ₂	256	3.82	Palmitic acid (saturated fatty acid)	Antioxidant, Pesticide, Hypocholesterolemic, Nematicide, Lubricant, Antiandrogenic, Hemolytic, 5-alpha reductase inhibitor, antipsychotic
18.31	Hexadecanoic acid, ethyl ester	C ₁₈ H ₃₆ O ₂	284	23.7	Palmitic acid ethyl ester	Antioxidant, Nematicide, Hypocholesterolemic, Pesticide, Antiandrogenic, flavor, Hemolytic, Alpha reductase inhibitor
21.52	Linolelaidic acid, methyl ester	C ₁₉ H ₃₄ O ₂	294	1.62	Fatty acid	No activity reported.
21.63	9,12,15-Octadecatrienoic acid, ethyl ester,(Z,Z,Z)-	C ₂₀ H ₃₄ O ₂	306	5.50	Linolenic acid ester compound	Anti-inflammatory, Cancer preventive, Hepatoprotective
21.94	Octadecanoic acid, ethyl ester	C ₂₀ H ₄₀ O ₂	312	1.32	Fatty ester	No activity reported.
24.63	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester	C ₁₉ H ₃₈ O ₄	330	0.94	Amino compound	Antimicrobial
28.59	Ethyl iso-allochololate	C ₂₆ H ₄₄ O ₅	436	4.65	Steroid	Antimicrobial, Diuretic, Anti-inflammatory, Antiasthma

Activity Source: -Dr. Duke's Phytochemical and Ethnobotanical Databases

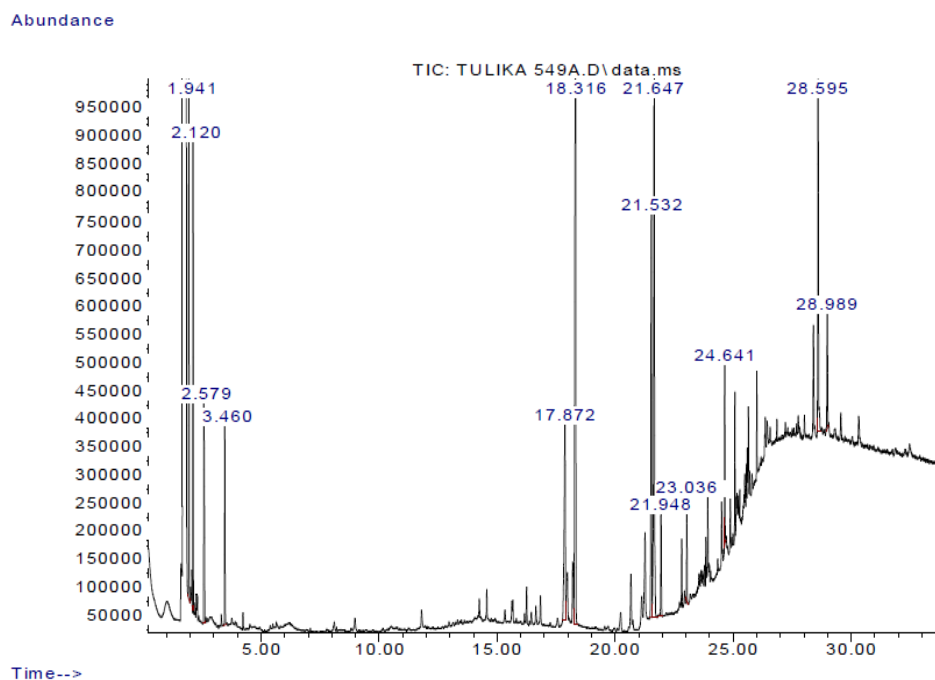
DISCUSSION

The ethanol extract contains various useful compounds having pharmacological activity. Phytol is a diterpene compound and it may be act as an antimicrobial, anti-inflammatory, anti-cancer and diuretic. Phytol gives good preventive and therapeutic results against arthritis and shows that reactive oxygen species constitute a promising novel class of pharmaceuticals for the treatment of

rheumatoid arthritis and other chronic inflammatory diseases [6]. Stigmasterol is an unsaturated plant sterol and act as a precursor in the manufacture of semi-synthetic progesterone, a valuable human hormone that plays an important physiological role in the regulatory and tissue rebuilding mechanisms related to oestrogen effects, as well as acting as an intermediate in the biosynthesis of androgens, oestrogens and corticoids. It is also used as the precursor of Vitamin D₃ [7].

Sample Ref No: 549/C-102/07-16

Sample Name: S5

Fig. 5: GC-MS Spectra of ethanolic extract of Root of *E. crassipes*Table 5: Compound present in the ethanolic extract of the Root of *Eichhornia crassipes*

RT	Name of compound	MF	MW	Peak area %	Compound nature	Activity
1.94	Propyl alcohol	C ₃ H ₈ O	60	5.53	Alcohol	Engine fuel
2.12	1-Propanol, 2-methyl	C ₄ H ₁₀ O	74	4.85	Alcohol	Industrial Solvent
2.57	Ethane, 1,1-diethoxy	C ₆ H ₁₄ O ₂	118	5.14	Ether	Flavoring agent
3.46	Formic acid, 1-methyl ethyl ester	C ₄ H ₈ O ₂	88	2.95	carboxylic acid	Preservative, an antibacterial agent, treatment for warts.
17.87	n-Hexadecanoic acid	C ₁₆ H ₃₂ O ₂	256	7.98	Palmitic acid (saturated fatty acid)	Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Lubricant, Antiandrogenic, Hemolytic, 5-alpha reductase inhibitor, antipsychotic
18.31	Hexadecanoic acid, ethyl ester	C ₁₈ H ₃₆ O ₂	284	28.33	Palmitic acid ester	Antioxidant, Hemolytic Hypocholesterolemic, Flavor, Nematicide, Antiandrogenic,
21.53	9,12-Octadecadienoic acid, ethyl ester	C ₂₀ H ₃₆ O ₂	308	9.99	Unsaturated fatty acid ester	Anti-inflammatory, Cancer preventive
21.64	Linolenic acid, ethyl ester	C ₂₀ H ₃₄ O ₂	306	17.65	Unsaturated fatty acid ester	Anti-inflammatory, Cancer preventive
21.94	Octadecanoic acid, ethyl ester	C ₂₀ H ₄₀ O ₂	312	2.27	Fatty ester	No Activity reported.
23.03	Octadecane, 6-methyl	C ₁₉ H ₄₀	268	1.66	Alkane	Absorbant
24.64	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester	C ₁₉ H ₃₈ O ₄	330	2.51	Amino compound	Antimicrobial
28.59	Cholesta-22,24-diene-5-ol, 4,4-dimethyl	C ₂₉ H ₄₈ O	412	8.39	Steroid	Antibacterial, trypanocidal activity
28.98	1-Monolinoleoylglycerol trimethylsilyl ether	C ₂₇ H ₅₄ O ₄ Si ₂	498	2.71	Steroid	Antiarthritic, Anticancer, Hepatoprotective, Antimicrobial, Antiasthma, Diuretic

Activity Source: -Dr. Duke's Phytochemical and Ethnobotanical Databases

1-Monolinoleoylglycerol trimethylsilyl ether is the common compound in the roots of both the plant show many biological activities such as Antiarthritic, Anticancer, Hepatoprotective, Antimicrobial, Antiasthma, Diuretic, antioxidant, anti-inflammatory and anti-diabetic [8]. 9, 12-Octadecadienoic acid, ethyl ester, is a polyenoic fatty acid compound and it acts as an antihistaminic, hepatoprotective, hypocholesterolemic and antieczemic [9]. 9,12,15-

Octadecatrienoic acid, methyl ester, (Z,Z,Z)-is a polyenoic fatty acid compound and it may be acts as an anti-inflammatory, hypocholesterolemic, cancer preventive, hepatoprotective, nematicide, insectifuge, anti-histaminic, anti arthritic, anti-coronary, anti eczemic, anti-acne, 5-alpha reductase inhibitor and anti-androgenic [10]. Diisooctyl phthalate is a plasticizer compound; it may be acts as an antimicrobial and antifouling [11]. Ethyl iso-

allocholate is a sterol compound and it uses as an antibacterial, antioxidant, antitumor, cancer preventive, pesticide and chemopreventive agent. Cholesta-22, 24-dien-5-ol, 4,4-dimethyl-is a steroid compound possess Antimicrobial, anti-inflammatory, anticancer, diuretic, antiarthritic, antiasthma and trypanocidal activity. Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester found in the leaves of both plant extract act as Hemolytic, pesticide, flavour, antioxidant [12].

CONCLUSION

GC-MS analysis of ethanol extract of leaf of *P. stratiotes* and *E. crassipes* revealed the presence of secondary metabolites of anticancerous, antimicrobial, antioxidant, antidandruff, anti-proliferative activities and provides a potential source of the industrial application. We concluded that the biological values of *P. stratiotes* and *E. crassipes* contain pharmacologically active compounds that may enhance its use as a traditional drug.

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CONFLICT OF INTERESTS

Declare none

REFERENCES

- Bigoniya P, Singh CS, Shukla A. Pharmacognostical and physicochemical standardization of ethnopharmacologically important seeds of *Lepidium sativum* Linn. and *Wrightia tinctoria* R. Br. Indian J Nat Prod Resour 2011;2 Suppl 4:464-71.
- Kirtikar KR, Basu BD. Indian Medicinal Plants. Delhi: Sri Satguru Publications; 2000.
- Kirtikar KK, Basu BD. The Indian medicinal plants. Dehradun: Oriental Enterprises; 2001. p. 3576-9.
- Jayanthi P, Lalitha P. Reducing the power of the solvent extracts of *Eichhornia crassipes* (Mart.) Solms. Int J Pharm Pharm Sci 2011;3 Suppl 3:126-8.
- Nair V, Kanfer I, Hoogmartens J. Determination of β -sitosterol and stigmasterol in oral dosage forms using high-performance liquid chromatography with evaporative light scattering detection. J Pharm Biomed Anal 2006;41 Suppl 3:731-7.
- Ogunlesi M, Okiei W, Ofor E, Osibote AE. Analysis of the essential oil from the dried leaves of *Euphorbia hirta* Linn (Euphorbiaceae), a potential medication for asthma. Afr J Biotech 2009;8:7042-50.
- Kametani T, Furuyama H. Synthesis of Vitamin D3 and related compounds Med Res Rev 1987;7 Suppl 2:147-71.
- Senthil J, Rameashkannan MV, Mani P. Phytochemical profiling of ethonolic leaves extract of ipomoea sepiaria (Koenig Ex. Roxb). Int J Innovative Res Sci Eng Technol 2016;5 Suppl 3:3140-7.
- Wu L, Gao H, Wang X, Ye J, Lu J. Analysis of the chemical composition of *Chrysanthemum indicum* flowers by GC/MS and HPTLC. J Med Plants Res 2010;4 Suppl 5:421-6.
- Vohra A, Kaur H. Chemical investigation of medicinal plant *Ajuga bracteosa*. J Nat Prod Plant Resour 2011;1 Suppl 1:37-45.
- Sangeetha J, Vijayalakshmi K. Determination of bioactive components of ethyl acetate fraction of *Punica granatum* Rind extract. Int J Pharm Sci Drug Res 2011;3 Suppl 2:116-22.
- Duke's Phytochemical and Ethnobotanical Databases (1992-1996). U. S. Department of Agriculture, Agricultural Research Service. Available from: <http://phytochem.nal.usda.gov>. [Last accessed on 20 Mar 2017]

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