Original Article

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

TULIKA TYAGI*†, MALA AGARWAL*‡

*†Faculty of Biotechnology, B. B. D. Government P. G. College, Chimpumpura, Jaipur, University of Rajasthan, Jaipur Rajasthan State India
Email: tulikatyagi_062@yahoo.co.in

Received: 02 Jan 2017, Revised and Accepted: 31 Apr 2017

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, Octadecanoic acid, ethyl ester, 2-Cyclopenten-1-one, 5-hydroxy-2,3-dimethyl, 1-Glutamine, 2-Pentadecanone, 6,10,14-trimethyl, Linoleic 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, α-Glyceryl linolenate, 1-Hexadecanoic acid, E-11-Hexadecenoic acid, ethyl ester, Stearic acid, ethyl ester, Octadecanoic acid, ethyl ester, 2-Cyclopenten-1-one, 5-hydroxy-2,3-dimethyl, 1-Monolinoleoylglycerol trimethylsilyl ether, Ethyl iso-allocholate are the major compounds.

The results indicates Pistia stratiotes L. and Eichhornia crassipes (Mart.) Solms possess potent antioxidant, anti-inflammatory, anticancer, anti-tumour, 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

© 2017 The Authors. Published by Innovare Academic Sciences Pvt Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/)
DOI: http://dx.doi.org/10.22159/ijcpr.2017v9i3.19970

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 sub-tropical 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 eye wash. 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 affections, 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. 1 μl 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 1 μm 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.

![GC-MS Spectra of ethanolic extract of Leaf of *P. stratiotes*](image)

**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                              | C₄H₈O  | 74   | 5.42        | Alcohol           | Biofuel                                       |
| 3.48 | Formic acid,1-methylethyl ester               | C₄H₈O₂ | 88   | 0.93        | Carboxylic acid   | Preservative, antibacterial agent, treatment for warts. |
| 7.08 | Propane,1,1-diethoxy-2-methyl                 | C₄H₈O₂ | 146  | 2.05        | Ether             | No activity reported.                         |
| 11.81| L-Glutamine                                   | C₅H₁₀N₃O | 146 | 0.38      | Amino acid        | Building block of Protein                     |
| 17.93| n-Hexadecanoic acid                           | C₁₆H₃₂O₂ | 256 | 7.18       | Palmitic acid (saturated fatty acid)         | Antioxidant, Hypcholesterolemic, Nematocide, Pesticide, Lubricant, Antianandrogenic, Hemolytic, 5-alpha reductase inhibitor, antipsychotic |
| 18.33| Hexadecanoic acid, ethyl ester                | C₁₆H₃₂O₂ | 284  | 13.29      | Palmitic acid ester | Antioxidant, Hemolytic, Hypcholesterolemic, Flavor, Nematocide, Antianandrogenic |
| 21.53| Linolelaidic acid, methyl ester               | C₂₀H₃₂O₂ | 294 | 2.41       | Fatty acid        | No activity reported.                         |
| 21.64| 9,12,15-Octadecacatrienioic                   | C₂₀H₃₂O₂ | 292  | 2.7        | Steroid           | Antiarthritic, Anticancer, Hepatoprotective,   |

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

Int J Curr Pharm Res, Vol 9, Issue 3, 111-117

23.92 12,15-Octadecadiynoic acid, methyl ester \((Z,Z,Z)\)  C_{19}H_{30}O_{2} 290 0.50 Unsaturated fatty acid ester  Antimicrobial, Antiasthma, Diuretic.

24.64 Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester  C_{19}H_{30}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_{40}O_{2} 368 0.69 Fatty ester  No Activity reported.

28.59 Stigmasterol  C_{29}H_{48}O_{4} 412 2.57 Steroid  Antioxidant, hypoglycemic and thyroid inhibiting properties, precursor of progesterone, antimicrobial, anticancer, antiarthritic, antiasthma, anti-inflammatory, diuretic

**Activity Source:** Dr. Duke’s Phytochemical and Ethnobotanical Databases

![Fig. 2: GC-MS spectra of ethanolic extract of Root P. stratiotes](image)

| 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_{4}C_{13}O_{3} | 118 | 1.79 | Ether | Flavoring agent |
| 7.08 | Propane, 1,1-diethoxy-2-methyl | C_{4}H_{16}O_{2} | 146 | 1.61 | Ether | No activity reported. |
| 15.66 | Octadecanoic acid, ethyl ester | C_{18}H_{34}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, Hypcholesterolemic, Nematicide, Pesticide, Lubricant, Antiandrogenic, Hemolytic, 5-alpha reductase Inhibitor |
| 17.98 | E-11-Hexadecanoic acid, ethyl ester | C_{18}H_{36}O_{6} | 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, Hypcholesterolemic, Flavor, Nematicide, Antiandrogenic |
| 24.92 | Bis (2-ethylhexyl) phthalate | C_{8}(C_{6}H_{13}COO)_{2} | 390 | 91.49 | Plasticizer compound | Solvent in glowstick |
| 27.27 | 1-Monomolinoyleglycerol trimethylsilyl ether | C_{29}H_{42}O_{4}Si | 498 | 0.22 | Steroid | Antiarthritic, Anticancer Hepatoprotective, Antimicrobial, Antiasthma, Diuretic |
| 28.59 | Ethyl iso-allocholate | C_{26}H_{44}O_{5} | 436 | 0.92 | Steroid | Antioxidant, diuretic, Anti-inflammatory, Antiasthma |

**Activity Source:** Dr. Duke’s Phytochemical and Ethnobotanical Databases
Fig. 3: GC-MS spectra of ethanolic extract of Leaf E. crassipes

| RT  | Name of compound                                      | MF           | MW  | Peak area % | Compound nature       | Activity                                                                 |
|-----|-------------------------------------------------------|--------------|-----|-------------|------------------------|--------------------------------------------------------------------------|
| 2.59| Ethane, 1,1-dioxy                                       | C₂H₁₀O₂      | 118 | 9.77        | Ether                   | Flavoring agent                                                         |
| 7.09| Propane,1,1-dioxy-2-methyl                              | C₃H₁₀O₂      | 146 | 7.10        | Ether                   | No activity reported.                                                    |
| 17.84| n-Hexadecanoic acid                                    | C₁₂H₂₄O₂     | 256 | 2.34        | Palmitic acid (saturated fatty acid) | Antioxidant, Hypocholesteremic, Nematicide, Pesticide, Lubricant, Antiandrogenic, Hemolytic, 5-alpha reductase inhibitor, antipsychotic |
| 18.20| E-11-Hexadecanoic acid, ethyl ester                    | C₁₃H₂₆O₂     | 282 | 1.04        | Stearic acid            | Antifungal, Antitumour, Antibacterial                                    |
| 18.30| Palmitic acid, ethyl ester                             | C₁₃H₂₆O₂     | 284 | 12.09       | Stearic acid            | Antifungal, Antitumour, Antibacterial                                    |
| 20.66| Phytol                                                | C₁₅H₃₀O₂     | 296 | 2.12        | Diterpene               | Antimicrobial, Anti-inflammatory, Anticancer, Diuretic, Antifungal against S. typhi, resistant gonorrhea, joint dislocation, headache, hernia, stimulant and antimalarial |
| 21.27| 9,12,15-Octadecatrienal                                | C₁₅H₂₆O2     | 262 | 2.10        | Steroid                 | Antiarthritis, Anticancer, Hepato protective, Antimicrobial, Antiasthma, Diuretic |
| 21.53| 9,12-Octadecadienoic acid, ethyl ester                | C₁₅H₂₆O₂     | 308 | 3.79        | Polyenoic fatty acid    | Hepatoprotective, anti-histaminic, Hypcholesterolemic, antieczemic, Hypcholesterolemic, antieczemic, Hypcholesterolemic, Antiarthritis, Hepatoprotective Antiandrogenic, 5-Alpha reductaseinhibitor, Antihistaminic, Anticorony, Insectifuge, Antieczemic, Antiacne |
| 21.65| Linolenic acid, ethyl ester                            | C₁₅H₂₆O₂     | 306 | 26.26       | Linoleic acid ethyl ester | Antiarthritis, Anticancer, Hepato protective, Antimicrobial, Antiasthma, Diuretic |
| 21.94| Stearic acid, ethyl ester                              | C₁₅H₃₀O₂     | 312 | 0.98        | Fatty ester             | No activity reported.                                                    |
| 24.63| Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester | C₁₆H₃₂O₄     | 330 | 0.87        | Amino compound          | Antimicrobial                                                           |
| 25.64| α-Glyceryl linolenate                                   | C₁₆H₃₀O₄     | 352 | 1.35        | Fatty acid              | Cosmetic, Colouring agent.                                              |
| 26.43| 1-Monolinoleoylglycerol trimethylsilyl ether           | C₁₇H₃₂O₂Si₂  | 498 | 1.52        | Steroid                 | Antiarthritis, Anticancer, Hepato protective, Antimicrobial, Antiasthma, Diuretic |
| 27.68| Linoleic acid, 2,3-bis-(O-TMS)-propyl ester            | C₁₇H₃₂O₂Si₂  | 498 | 1.98        | Steroid                 | Antiarthritis, Anticancer, Hepato protective, Antimicrobial, Antiasthma, Diuretic |
| 28.59| Stigmasterol                                          | C₂₀H₃₂O₂     | 412 | 11.39       | Steroid                 | Antioxidant, hypoglycemic and thyroid inhibiting properties, precursor of progesterone, antimicrobial, anticancer, antiarthritis, antiasthma, anti inflammatory, diuretic |

**Activity Source:** Dr. Duke's Phytochemical and Ethnobotanical Database
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                          | C₇H₁₄O            | 118              | 28.82       | Alcohol                  | Biofuel                                       |
| 2.58 | Ethane, 1,1-diethoxy                      | C₆H₁₂O₂           | 88               | 7.6         | Carboxylic acid          | Flavoring agent                               |
| 3.48 | Formic acid, 1-methylmethyl ester         | C₆H₁₂O₂           | 104              | 0.97        | Ether                    | Preservative, an antibacterial agent, treatment for warts. |
| 4.24 | Ethanol, 2-propoxy                        | C₆H₁₂O₂           | 146              | 16.84       | Ether                    | Solvent, Paints and Coating.                  |
| 7.09 | Propane, 1,1-diethoxy-2-methyl            | C₆H₁₄O₂           | 178              | 16.9        | Ether                    | No activity reported.                         |
| 17.86| n-Hexadecanoic acid                       | C₁₉H₃₈O₂          | 256              | 3.82        | Palmitic acid (saturated fatty acid) | Antioxidant, Pesticide, Hypocholesterolemic, Nematicide, Lubricant, Antianidrogenic, Hemolytic, 5-alpha reductase inhibitor, antipsychotic |
| 18.31| Hexadecanoic acid, ethyl ester            | C₂₀H₃₄O₂          | 284              | 23.7        | Palmitic acid ethyl ester | Antioxidant, Nematicide, Hypocholesterolemic, Pesticide, Antianidrogenic, flavor, Hemolytic, Alpha reductase inhibitor |
| 21.52| Linolelaic acid, methyl ester             | C₂₀H₃₄O₂          | 294              | 1.62        | Fatty acid               | No activity reported.                         |
| 21.63| 9,12,15-Octadecatrienoic acid, ethyl ester (Z,Z,Z)- | C₂₀H₃₄O₂ | 306              | 5.50        | Linolenic acid ester compound | Anti-inflammatory, Cancer preventive, Hepatoprotective |
| 21.94| Octadecanoic acid, ethyl ester            | C₂₀H₃₄O₂          | 312              | 1.32        | Fatty ester              | No activity reported.                         |
| 24.63| Hexadecanoic acid, 2-hydroxy-1- (hydroxymethyl) ethyl ester | C₂₀H₄₀O₄ | 330              | 0.94        | Amino compound           | Antimicrobial                                 |
| 28.59| Ethyl iso-allocholate                     | C₂₂H₃₄O₅          | 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].
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                                        | C₃H₇O   | 60   | 5.53        | Alcohol            | Engine fuel                                                             |
| 2.12| 1-Propanol, 2-methyl                                   | C₃H₇O   | 74   | 4.85        | Alcohol            | Industrial Solvent                                                      |
| 2.57| Ethane, 1,1-diethoxy                                   | C₂H₆O₂  | 118  | 5.14        | Ether              | Flavoring agent                                                         |
| 3.46| Formic acid, 1-methyl ethyl ester                      | C₂H₂O₂  | 88   | 2.95        | carboxylic acid    | Preservative, antibacterial agent, treatment for warts.                  |
| 17.87| n-Hexadecanoic acid                                   | C₁₅H₃₂O₂| 256  | 7.98        | Palmitic acid      | Antioxidant, Hypcholesteremic, Nematicide, Pesticide, Lubricant, Antiandrogenic, Hemolytic, 5-alpha reduce inhibitor, antipsychotic |
| 18.31| Hexadecanoic acid, ethyl ester                       | C₁₆H₃₂O₂| 284  | 28.33       | Palmitic acid      | Antioxidant, Hemolytic Hypcholesteremic, Flavor, Nematicide, Antiandrogenic, Cancer preventive |
| 21.53| 9,12-Octadecadienoic acid, ethyl ester               | C₁₈H₃₄O₂| 308  | 9.99        | Unsaturated fatty acid ester  | Anti-inflammatory, Cancer preventive                                   |
| 21.64| Linolenic acid, ethyl ester                          | C₁₈H₃₄O₂| 306  | 17.65       | Unsaturated fatty acid ester  | Anti-inflammatory, Cancer preventive                                   |
| 21.94| Octadecanoic acid, ethyl ester                       | C₂₀H₄₂O₂| 312  | 2.27        | Fatty ester        | No Activity reported.                                                   |
| 23.03| Octadecane, 6-methyl                                 | C₁₅H₃₀  | 268  | 1.66        | Alkane             | Absorbant                                                               |
| 24.64| Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester | C₂₀H₃₇O₄| 330  | 2.51        | Amino compound      | Antimicrobial                                                           |
| 28.59| Octadecatrienoic acid, methyl ester                   | C₂₀H₃₂O₄| 412  | 8.39        | Steroid            | Antibacterial, trypanocidal activity                                   |
| 28.98| 1-Monolinoleoylglycerol trimethylsilyl ether          | C₁₇H₃₄O₄Si₂| 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, hypcholesteromic and antieczelem [9]. 9,12,15-Octadecatrienoic acid, methyl ester, (ZZZ)-is a polyenoic fatty acid compound and it may be acts as an anti-inflammatory, hepatoproective, cancer preventive, hepatoprotective, nematicide, insectifuge, anti-histaminic, anti arthritic, anti-coronary, anti eczecmic, anti-acne, 5-alpha reductase inhibitor and anti-androgenic [10]. Disoioctyl 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, antianduruff, 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.

ACKNOWLEDGEMENT

The authors are grateful to Kishor Potekar and K. P Jain, Padmaja Aerobiologicals (P) Ltd. Plot no. 36, Sector-24, Near Bank of India, Turbhe, Navi Mumbai 400705. Maharashtra. India for providing the laboratory facilities (GC-MS) and support to carry out the work.

CONFLICT OF INTERESTS

Declare none

REFERENCES

1. Bigoniya P, Singh CS, Shukla A. Pharmacognostical and physicochemical standardization of ethnomedicinally important seeds of *Lepidium sativum* Linn. and *Wrightia tinctoria* R. Br. Indian J Nat Prod Resour 2011;2 Suppl 4:464-71.
2. Kirtikar KR, Basu BD. Indian Medicinal Plants. Delhi: Sri Satguru Publications; 2000.
3. Kirtikar KK, BD Basu. The Indian medicinal plants. Dehradun: Oriental Enterprises; 2001. p. 3576-9.
4. 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.
5. 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.
6. Ogunlesi M, Okei 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.
7. Kametani T, Furuyama H. Synthesis of Vitamin D3 and related compounds Med Res Rev 1987;7 Suppl 2:147-71.
8. Senthil J, Rameshkkannan MV, Mani P. Phytochemical profiling of ethanolic leaves extract of *Ipomoea sepia* (Koenig Ex. Roxb). Int J Innovative Res Sci Eng Technol 2016;5 Suppl 3:3140-7.
9. 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.
10. Vobra A, Kaur H. Chemical investigation of medicinal plant *Ajuga bactreosa*. J Nat Prod Plant Resour 2011;1 Suppl 1:37-45.
11. 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.
12. 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]