ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Online - 2455-3891
Print - 0974-2441

Vol 13, Issue 7, 2020

Research Article

GAS CHROMATOGRAPHY AND MASS SPECTROMETRY ANALYSIS OF BIOACTIVE COMPOUNDS OF *DRYOPTERIS HIRTIPES* (BLUMZE) *KUNTZE*

VALARMATHI R[1]*, NATARAJAN D[2]

[1]Department of Biotechnology, Padmavani College of Arts and Science for Women, Salem, Tamil Nadu, India. [2]Department of Biotechnology, Periyar University, Salem, Tamil Nadu, India. Email: nilavalar78@gmail.com

Received: 22 March 2020, Revised and Accepted: 08 March 2020

ABSTRACT

Objective: The objective of this study was to analyze GC–MS analysis of whole plant methanolic extract of *Dryopteris hirtipes* from Dryopteridaceae family.

Methods: Gas chromatography and mass spectrometry analysis of whole plant extract was carried out with instrument GC–MS.

Results: The methanolic extract of *D. hirtipes* reveals to identify more known and unknown bioactive compounds. In this study, seven major bioactive compounds were identified such as Stigmast-5-en-3-ol(56.65%), Phytol (5.39%), Lanost -8-en-3-ol-(3 β)(3.18%), Neophytadiene(2.68%), Tri-o-trimethylsilyl N-heptaflurobutryl derivative of terbutaline(2.19%), 1H-Imidazole 2-methanol(1.28%), and 8A-(2,4-Dimethyl-1-nitrilo-pent-2-yl) dioxy)tocopherone(1.0%) and low concentrations of compounds like hexadecanoic acid(0.6%).

Conclusion: These identified compounds are having active pharmacological properties such as antimicrobial property, hypotension, anti-inflammatory, anti-tumor, anti-cancer, anti-hepatitis, analgesic, and antipyretic properties. However, *D. hirtipes* is a rare pteridophyte and used to cure many diseases, and so there need further studies to isolate and identify the specific active compounds present in it.

Keywords: Gas chromatography–mass spectrometry, *Dryopteris hirtipes*, Pteridophytes, Bioactive compounds.

© 2020 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/ajpcr.2020.v13i7.37715

INTRODUCTION

Medicinal plants are the major natural resources found in the world, in which it contains more active phytoconstituents. Among these groups, pteridophytes were found abundant to have more than 13,000 species of fern and fern-related groups distributed in all over the world [1]. Most of the pteridophytes grow vigorously in tropical, temperate regions, and eco-geographically threatened regions, and sometimes, they have adapted with varied climatic conditions [2]. More than 400 species of pteridophytes occur all over southern India [3]. Moreover, researchers analyzed that pteridophyte families are not easily infected by pathogenic organisms due to the rich content of phytoconstituents and its evolutionary aspects to survive more than 350 million years [4]. In past days, lower groups of pteridophytes screening were not explored properly and not well documented, and these present days, the priority in the usage of natural drugs has been increased in the research community, and analysis of bioactive compounds may also take in this family of pteridophytes and showed more pharmacological activities [5]. However, plants are the major reservoir of secondary metabolites with pharmacological activities to treat various ailments [6] with less side effects. Many species of pteridophytes are yet to be explored for their bioactive compounds and to isolate specific chemical compounds to treat various disorders.

Dryopteris hirtipes (Blumze) *kuntze* belongs to the family Dryopteridaceae which occurs in temperate and mountain areas in tropical regions [7], as shown in Fig. 1. In *Dryopteris* species, the rhizome is used for rheumatism, epilepsy, and leprosy [8], leaf juice used to cure epilepsy, act as an antibiotic [9], and paste of the plant used to cure a bacterial infection, act as antifungal properties, and insecticide [10,11].

Metabolic profiling of various plant extracts provides information on their phytochemical composition by qualitatively, which allows the detection of chemically active known and unknown bioactive compounds by hyphenate technique. GC–MS studies proved to be a reliable method for identifying the volatile and semi-volatile compounds [12,13] fatty acids, lipids, and hydrocarbons [14]. The aim of the present study is to identify the active compounds present in *D. hirtipes* using GC–MS.

METHODS

Collection of the plant

The leaves of *D. hirtipes* were collected from Yercaud hills, Salem District, Tamil Nadu. The plant identification was confirmed with the help of herbarium specimens in the Indian Botanical Survey of India, Coimbatore. The leaves were carefully separated, washed with 2–3 times in tap water, and then dried under shade for more than two weeks. The shade dried fronds with spores of *D. hirtipes* were powdered by electric blender. The powdered plant materials were stored in a closed glass container until their use in extract preparation. About 100 g of powdered leaves were extracted with various organic solvents such as hexane, ethyl acetate, and methanol using Soxhlet apparatus and then concentrated using rotary evaporator.

GC–MS analysis

GC–MS analysis of the sample was carried out using Shimadzu QP2020.

Identification of compounds

Gas chromatography can separate volatile components in a given sample and mass spectroscopy helps to fragment the components and identify them on the basis of their mass. The identification of compounds was based on the molecular structure, molecular mass, and calculated fragments. Interpretation on mass spectrum GC–MS was conducted using the database of National Institute Standard and Technology (NIST) and WILEY Library having more than 62,000 patterns. The relative percentage of each compound was calculated by comparing its average peak area to the total areas. The spectrum of the unknown compound was compared with the spectrum of the known compound stored in the NIST and WILEY library.

Fig. 1: *Dryopteris hirtipes*

RESULTS AND DISCUSSION

Chromatogram of GC–MS studies on bioactive components in methanolic extract of *D. hirtipes* showed the presence of major seven compounds, and the other complex mixture components related to the peaks were determined. The active principles with their retention time (RT), molecular weight (MW), molecular formula, and concentration (Peak area %) in Table 1 and Figure 2. The most prevailing compounds found to be Stigmast -5-en-3-ol (56.65%), Phytol(5.39%), Lanost-8-en-3-ol-3β (3.18%), Neophytadiene(2.68%), Tri-otrimethylsilyl N-Heptaflurobutryl derivative of terbutaline (2.19%), 1H-Imidazole-methanol(1.8%), and 8A(2,4-Dimethyl 1-nitrilo-pent –yl)dioxy) tocopherone (1.0%), bioactive compounds represented in Figure 3.

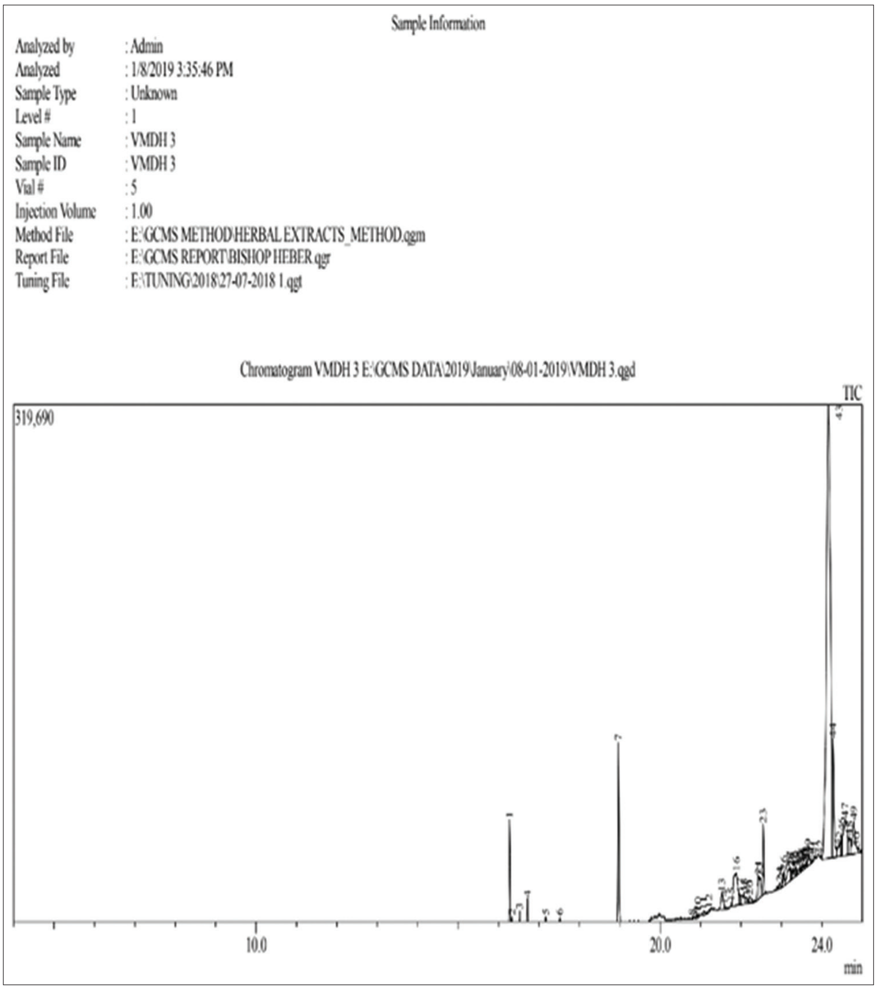
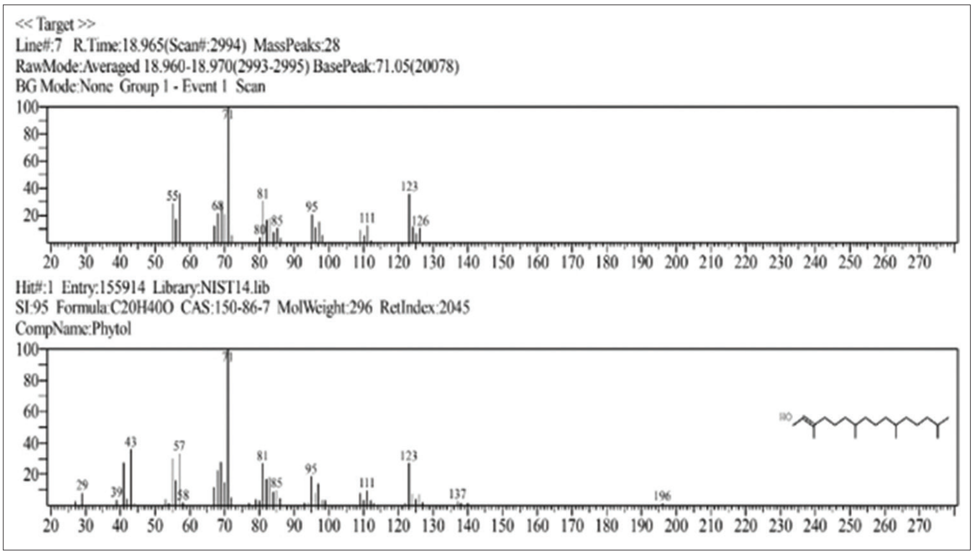


Fig. 2: GC–MS Chromatogram of methanolic extract in *Dryopteris hirtipes*

Table 1: GC–MS Analysis in methanolic extract of *D. hirtipes*

S. No.	RT	Name of the compound	Molecular formula	Molecular weight	Area %	Biological reports
1	16.271	Neophytadiene	$C_{20}H_{38}$	278.524	2.68	Analgesic, antipyretic, anti-inflammatory, antioxidant, and antimicrobial activity
2	18.965	Phytol	$C_{20}H_{40}O$	128.1705	5.39	Antimicrobial, anticancer, anti-inflammatory activity
3.	22.433	1H-Imidazole-2-methanol	$C_4H_6N_2O$	98.10	1.28	Antihypertensive, anti-inflammatory
4	24.161	Stigmast-5-en-3-ol	$C_{29}H_{50}O$	414.718	56.65	Act as hypotension, reduce blood glucose level, antiarthritics, antiulcer activity
5	24.679	8A-(2,4-dimethyl-1-nitrilopent-2-yl) dioxy) tocopherone	$C_{40}H_{67}NO_4$	625.9723	1.0	Antioxidant property
6	24.791	Lanost-8-en-3-ol(3 beta)	$C_{30}H_{52}O$	428.733	3.18	Anti-inflammatory, antitumor, anti-cancer, antihyper, lipidemia, antihepatitis
7	26.915	Tri-o-trimethylsilyl N-heptaflurobutryl derivative of terbutaline	$C_{12}H_{19}NO_3$	225.288	2.19	Anti-inflammatory, antiasthma drug



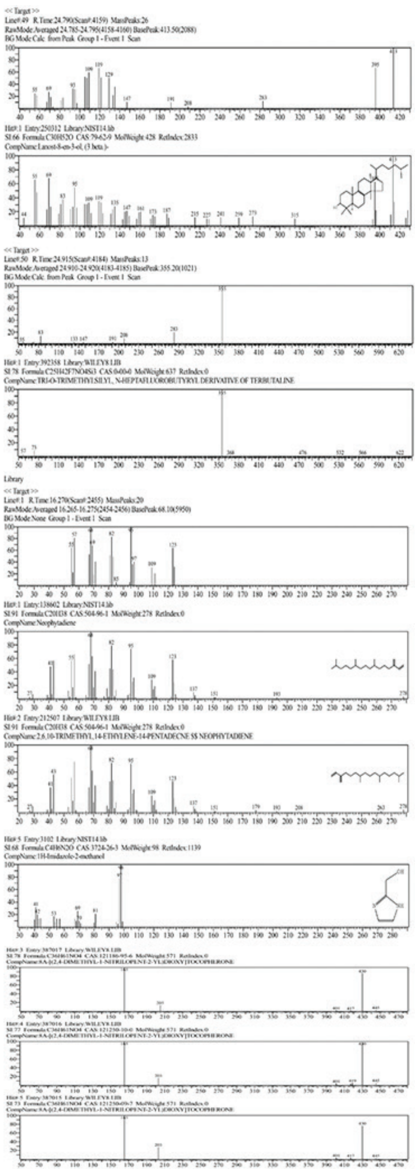


Fig. 3: GC chromatogram of chemical compounds Stigmast-5-en-3-ol, Phytol, Lanost-8-en-3-ol-3β, Neophyadiene, terbutaline derivatives, 1H-imidazole-2-methanol, Tocopherone

The diverse active components have been considered to have a wide range of activities which may be used to cure various diseases.

Stigmast-5-en-3-ol(56.65%) is a derivative of phytosterol and it has the tendency to reduces blood level of glucose, acts as anti-inflammatory, anti-pyretic, anti-arthritic, and anti-ulcer activity were reported in their findings [15-19]. Phytol (5.39%) is a diterpene with antimicrobial properties against many bacterial strains and also possesses antioxidant, anti-inflammatory properties in the methanolic extract of *A. capillus-veneris* [20,21] reported in ethanolic extract of *Jatropha gossypifolia* and also reported the bioactive compound in ethanolic extracts of *christella dentata* [22]. Lanost-8-en-3-ol-3β, a steroid family, possess that anti-inflammatory, anti-tumor, anticancer, and anti-hepatitis activity were reported [23,24]. The presence of bioactive compound neophytadiene (2.68%) a hydrocarbons possess anti-inflammatory, antioxidant, and disinfectant activity which were reported [22,25,26] in their research findings. 1H-imidazole-2-methanol contains a special pharmacological properties such as antidepressants and anti-inflammatory properties which were identified and suggested their findings performed in benzene/ethanol extracts in oil tea cake [27]. 8A-(2,4-Dimethyl -1-nitilo-pent-2-yl)-dioxy)-tocopherone components that it possess antioxidant property reported [28]. The phytocomponents present in *D. hirtipes* may contribute the major proportion and trace amounts of compounds like hexadecanoic acid that possesses such as an analgesic, anti-inflammatory, antioxidant, anticancer, and antidepressants. These natural components should be explored for the beneficiary in the fields of medical and pharmacy.

CONCLUSION

In the present study, seven major known chemical constituents and some unknown chemical constituents have been identified from the whole plant in the methanolic extract of *D. hirtipes* Linn. In those, seven bioactive compounds show the medicinal properties to treat various ailments. Further investigation is required for the analysis of specified compounds in *D. hirtipes* which may lead to explore the development of the new drug to the society.

ACKNOWLEDGMENTS

The authors must be thankful to Dr. D. Natarajan, Assistant Professor, Department of Biotechnology, Periyar University, Salem, for his support and encouragement and for providing laboratory facilities.

AUTHORS' CONTRIBUTIONS

The author processed the main concepts of this work, experimental data design, drafted the manuscript, interpreting results, and discussion and submit the corrected version to be published.

CONFLICTS OF INTEREST

The author declares that there are no conflicts of interest regarding the publication of this site.

AUTHOR FUNDING

The author declared no financial support.

REFERENCES

1. Moran RC. Biogeography of ferns and lycophytes. In: Haufler C, Ranker TA, editors. The Biology and Evolution of Ferns and Lycophytes. Cambridge: Cambridge University Press; 2006. p. 369-96.
2. Wallace RA, Sander GP, Ferl RJ. Biology: The Science of Life. New York: Harper Collins; 1991. p. 547-55.
3. Singh BP, Upadhyay R. Observations on some ferns of Pachmarhi biosphere reserve in traditional veterinary uses. Indian Fern J 2010;27:94-100.
4. Sharma BD, Vyas MS. Ethnobotonical studies on the fern and fern allies of Rajasthan. Bull Bot Surv India 1985;27:90-1.
5. Chandra S. The Ferns of India (Enumerations, Synonyms and Distributions). Dehradun, New Delhi: International Book Distributors; 2000. p. 454.
6. Vyas GD. Soil fertility Deterioration in cropland due to pesticide. J Indian Bot Soc 1999;78:177-8.
7. Hoshizaki BJ, Wilson KA. The cultivated species of the fern genus *Dryopteris* in the United States. Am Fern J 1999;89:1-98.
8. Shah NC, Singh SC. Hitherto unreported phytotherapeutical uses from tribal pockets of Madhyapradesh (India). Ethnobotany 1990;2:91-5.
9. Vasudeva SM. Economic importance of pteridophytes. Indian Fern J 1990;16:130-52.
10. Verma P, Khan AA, Singh KK. Traditionalphytotheraphy among the Baiga tribe of Shadol district of Madhyapradesh, India. Ethnobotany 1995;7:69-73.
11. Asolkar LV, Kakkar KK, Chakre OJ. Glossary of Indian Medicinal Plants. New Delhi: CSIR; 1995. p. 65.
12. Jie MS, Choi CY. MS characterization of picolinyl and methyl ester derivatives of isomeric thia fatty acids. J Int Fed Clin Chem 1991;3:122.
13. Betz JM, Gay ML, Mossoba MM, Adamus S, Portz BS. Chiral gas chromatographic determination of ephedrine-type alkaloids in dietary supplements containing ma huang. J AOAC Int 1997;80:303-15.
14. Sridharan S, Meena V, Kavitha V, Nayagam AA. GC-MS study and Phytochemical profiling of *Mimosa pudica* Linn. J Pharm Res 2011;4:741-2.
15. Poudyali B, Singh B. Potential antibacterial and antioxidant properties of aqueous, ethanol and methanol extracts of *Tectariamacrodonta* C.CHR. Int J Pharm Sci Res 2019;10:3785-94.
16. Bihana S, Dhimin A, Singh G, Satija S. Gas chromatography-mass spectroscopy analysis of bioactive compounds in the whole plant parts of ethanolic extract of *Asclepias curassavica* L. Int J Green Pharm 2018;12:107.
17. Yamuna P, Abirami P, Vijayashalini P, Sharmila M. GC-MS analysis of bioactive compounds in the entire plant parts of ethanolic extract of *Gomphrena decumbens* Jacq. J Med Plants Stud 2017;5:31-7.
18. Ankita S, Tribhuvan S, Rekha V. GC-MS analysis of bioactive phytoconstituents from *Rumex vesicarius* L. Int Res J Pharm 2015;6:269-72.
19. Socolsky C, Salvatore A, Asakawa Y, Bardon A. Bioactive new bitter tasting p-hydroxy styrene glycoside and other constituents from the fern *Elaphaglossum spathulatum*. Arkivoc 2003;10:347-55.
20. Kumar SS, Samydurai P, Ramakrishnan R, Nagarajan N. Gas chromatography and mass spectrometry analysis of bioactive constituents of *Adiantum capillus-veneris* L. Int J Pharm Pharm Sci 2014;6:60-3.
21. Bharathy V, Mariasumathy B, Uthayakumari F. Determination of phytocomponents by GC-MS in leaves of *Jatropha gossypifolia*. Sci Res Rep 2012;2:286-90.
22. Rekha K, Jose NM. Metabolic profiling of rhizome, petiole and leaves of C*hristella dendate* (Forssk) Brownsey and Jermy using GC-MS analysis. Int J Curr Adv Res 2018;7:16238-240.
23. Okeleye BI, Mkwetshana NT, Ndip RN. Evaluation of the Antibacterial and antifungal potential of *Peltaphorum africanum*: Toxicological effect on human changliverline. Sci World J 2013;2013:878735.
24. Jimenez-Allanes MA, Gamboa A, Zambranovazquez O, Fischer MM, Hernandez-Portilla LB, Zamilpa A. Phytochemistry of *Cnidoscolus tehuacanensis* Breckon (*Euphorbiaceae*), an endemic Mexican plant with potent therapeutic benefits. Am J Ethnomed 2018;5:6.
25. Sharmila M, Rajeswari M, Jayashree I, Geetha DH. GC-MS analysis of bioactive compounds of *Amarantus polygonoides* Linn. (*Amaranthaceae*). Int J Appl Adv Sci Res 2016;1:2456-3080.
26. Sreenath KB, Sowmiya S, Gopalakrishnan VK, Poornima K. Quantitative phytochemical analysis, *in vitro* antioxidant potential and GC-MS studies in ethanol extracts of *Azolla microphylla.* Asian J Pharm Clin Res 2018;9:318-23.
27. He GX, Zhang DQ, Liu QM, Peng K. 450°C-based pyrolysis GC/MS analysis of utilization of benzene/ethanol-extracted residue from oil-tea cake. Key Eng Mater 2011;480-481:472-7.
28. Liebler DC, Baker PF, Kayseen KL. Oxidation of Vitamin E. Evidence for competing autooxidation and peroxyl radical trapping reactions of the tocopheroxyl radical. J Am Chem Soc 1990;112:6995-7000.