International Journal of Applied Pharmaceutics

ISSN- 0975-7058 Thematic Special Issue 2022

Original Article

PHYTOCHEMICAL AND PHARMACOLOGICAL ACTIVITIES OF *MUKIA MADERASPATANA*

VASANTHA KUMAR S., B. USHARANI*

Department of Biochemistry, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai 600117, Tamil Nadu, India
***Email: raniushab1@gmail.com**

Received: 17 Apr 2021, Revised and Accepted: 31 May 2022

ABSTRACT

Objective: The study aimed to evaluate the bioactive compounds of *Mukia maderaspatana* and its properties. In addition, the preliminary phytochemical analysis and antioxidant potential of *Mukia maderaspatana* were performed.

Methods: Extraction of leaves of *Mukia maderaspatana* made using Soxhlet apparatus, followed by evaluation of phytochemicals such as alkaloids, flavonoids, coumarin, glycosides, terpenoids, tannin, steroid, saponin, phenol, anthraquinone by the standard methodology of Sofowara, Trease and Evans, Harborne. Quantification of phytochemicals were performed accordingly to standard methodology. Antioxidant activity were performed accordingly to methodology of Shimada, Prieto, Zhang and Benzie. Methodology of Hema *et al.* is followed for detection of bioactive compounds by GC-MS analysis.

Results: The Qualitative analysis revealed the presence of higher concentration of phytocompounds in Hydroalcoholic extract. The yield of alkaloid (215.8±4.78 mg AE), flavonoid (307.10±8.73 mg QE), phenol (374.50±6.41 mg GAE), tannin (129.98±5.32 mg TAE) and terpenoids (119.23±4.17 mg LE) are higher in hydroalcoholic extract than aqueous and methanolic extract. IC_{50} value for DPPH radical scavenging activity, Total antioxidant activity, Hydrogen peroxide scavenging activity and Ferric reducing antioxidant power activity are (61.43µg/ml), (59.68µg/ml), (55.69µg/ml), (64.60µg/ml). GC-MS analysis revealed the presence of about thirty compounds in hydroalcoholic extract of *Mukia maderaspatana.*

Conclusion: The present study reveals that *Mukia maderaspatana* is an important medicinal plant. We can conclude that Leaves of *Mukia maderaspatana* are good source of antioxidants, which might cure the disease related to oxidative stress.

Keywords: *Mukia maderaspatana,* Qualitative analysis, Quantitative analysis, *In vitro* antioxidant assay, GC-MS, Ascorbic acid

DOI: https://dx.doi.org/10.22159/ijap.2022.v14ti.8 Journal homepage: https://innovareacademics.in/journals/index.php/ijap

INTRODUCTION

Plants have always been man's ally in survival, providing him with food, fire, and medicine since the dawn of civilization. Plant is still a viable option as they have done throughout human history; they are an important source of medicine [1]. Plant kingdom possess enormous amount of biologically active compounds [2]. Plants, its parts and isolated phytochemicals have been used for the prevention and treatment of numerous health problems since the dawn of time [3]. It possesses natural products and by-products that helps in maintaining good health of human being. Green leafy vegetables are an important part of any well-balanced diet and are high in nutrients and vitamins. In India and other parts of the world, leafy and green vegetables are the most popular for their medicinal value [4]. Medicinal herbs play vital role in curing various diseases in India and developing countries [5]. In indigenous communities' medicinal plants have been used to treat various disease. Traditional medical methods are built on hundreds of years of observation and belief [6]. The world health organization (WHO) estimates that about 80% of the population in underdeveloped nations is dependent on food aid and almost entirely based on conventional medicine for their basic health care. Plants play a significant function and make up the majority of the environment by traditional medicine's backbone. In traditional systems of medicine, herbal drugs plays a major role in curing various disorders [7]. Traditional medical systems such as Ayurveda, Unani, Kampo and traditional Korean medicine are dependent on plants possessing medical property. Invention of drugs is based on a novel mechanism of action and the chemical diversity of natural products. It also involved in preventing and treatment of physical and mental disorders. Modern medications have benefited from the use of traditional medicine [8]. Many people are turning to natural cures as a result of the harmful effects of contemporary medications [9]. Around 80% of India's rural population uses medicinal herbs or traditional medical methods [3]. Natural sources are used to isolate modern medications, which are based on their usage in traditional medicine [10]. Drugs derived from herbal plants due to its medicinal value have been used from ancient time, in herbal drugs, whole plant or parts of plants is used [11]. Antioxidants are derived from natural sources for preventing various disease. Volatile free radicals and toxic radicals are neutralizing by the Antioxidants [12]. During metabolic process free radicals are produced in living system [13]. Oxygen gives rise to enormous reactive species and free radicals in the biological system collectively termed as "reactive oxygen species" and also another group known as "reactive nitrogen species". Intracellular antioxidant enzymes, vitamin C, vitamin E, zinc and beta-carotene prevents from cellular damage induced by oxidative stress in human [12]. Vitamin C and E, beta-carotene, possess antioxidant activity and scavenge free radicals from body [13]. Quercetin belonging to bioflavonoids possess free radical scavenging activity [14].

Cancer is a significant public health issue that affects both developing and industrialised countries, nearly 50% of cancer patients die from the disease [15]. Enormous number of anticancer drugs are available in the market but are associated with side effects so the patient requires secondary palliative care treatment as a result of the chemotherapy treatment's negative effects. Plant-derived medicines are non-toxic, the objective of the study is to develop a drug from a medicinal plant [16]. Phytoconstituents are natural bioactive compounds found in various portions of plants that operate in conjunction with nutrients and fibres to combat illness [17]. Phytochemicals such as taxols, steroids and polyphenols present in plants are possessing anticancer properties [18]. *Mukia maderaspatana* is a climber that belongs to Cucurbitaceae family, generally known as gourd family and is widely spread in tropical and subtropical regions. The leaves, roots and fruits of *Mukia maderaspatana* possess anti-ulcer, anti-inflammatory, anti-hyperglycemic antioxidant and anticancer activities [19]. Chronic respiratory disease is treated by a drug from *Mukia maderaspatana* [20]. Hence the present study is to investigate the phytochemical constituents of leaves of *Mukia maderaspatana* by Qualitative analysis, Quantitative analysis, Gas Chromatography-Mass Spectrometry and Anti-oxidant potential.

MATERIALS AND METHODS

Collection and authentication of plant material

The leaves of *Mukia maderaspatana* has been collected from Koyambedu market in Chennai, India. The fresh leaves of *Mukia maderaspatana* were authenticated in Plant Anatomy Research

Centre by Dr. P. Jeyaraman, Ph. D., Director, Retd Professor, Presidency College. The fresh leaves were washed in tap water and allowed to shade dry at room temperature. Dried leaves were powdered by using an electrical blender.

Preparation of plant extracts

About 20 grams of powdered leaves of *Mukia maderaspatana* were taken for Soxhlet extraction. Powdered leaves were packed in thimble with Whatman No. 1 filter paper and allowed for extraction. Extraction process proceeded with three different solvents–Aqueous (100%), Methanol (100%) and Hydro-alcohol (60%) for 24 h. Solvent flowing through syphon tube became colorless indicates the extraction was complete. The obtained extracts were filtered by using Whatman No.1 filter paper and allowed to dry at room temperature and the total yield of the extract is calculated. Dried extracts were stored at the refrigerator at 4 ºC.

Preliminary Qualitative analysis of phytochemicals

Phytochemical analysis is the qualitative and quantitative examination of herbal plants. Qualitative testing on *Mukia maderaspatana* leaves were undertaken to find out the presence or absence of bioactive compounds. Tests were carried out in Aqueous, Methanol and Hydro-alcoholic extracts of leaves of *Mukia maderaspatana* using standard methodology of Sofowara (1993) [21], Trease and Evans (1989) [22] and Harborne (1973) [23].

Quantitative analysis of phytochemicals

The phytochemicals present in the Aqueous, Methanol and Hydro-alcoholic extracts of leaves of *Mukia maderaspatana* were determined and quantified by standard procedures. Total alkaloid content of plant is calculated by UV-vis spectrophotometric method of Bromocresol green solution by (Biju John *et al.*, 2014) [24]. Total Flavonoid content is estimated by Aluminium chloride colorimetric method of (Lin and Tang., 2007) [25]. Total Phenol content is estimated by Folin-Ciocalteau Colorimetric method of (Singleton and Rossi., 1965) [26]. Total Tannin content is estimated by UV-vis spectrophotometric method proposed by (Bajaj and Devsharma 1977) [27]. Total Terpenoids were determined by the colorimetric method proposed by (Indhumathi C *et al.*, 2014) [28].

***In vitro* antioxidant activity**

Antioxidants are free radical scavengers that protect the human body from pathological diseases caused by free radicals. Free radicals are produced as part of the body's regular metabolic process in living systems. The primary mechanism behind a lot of human neurological and other illnesses today appears to be free radicals or oxidative damage [13]. Ascorbic acid, vitamin E and phenolic compounds are natural antioxidants; it possesses the potentiality to decrease oxidative damage in various disease [29]. *In vitro* antioxidant assays such as DPPH radical scavenging activity, Total antioxidant activity, Hydrogen peroxide scavenging activity and Ferric reducing antioxidant power assay were performed. DPPH radical scavenging activity was determined by methodology of Shimada *et al.*, (1992) [30]. Phosphomolybdenum method, according to Prieto *et al.*, (1999) [31] was performed for total antioxidant activity. Hydrogen peroxide scavenging activity was estimated by method of Zhang (2000) [32]. Ferric reducing antioxidant power assay was performed by the method of Benzie and Strain (1999) [33].

Gas Chromatography-Mass Spectroscopy (GCMS) analysis

GC-MS analysis was carried out by the method of Hema *et al.* [34]. By using Perkin-Elmer GC clauses 500 system and Gas Chromatograph collaborated to a mass spectrometer (GC-MS) equipped with a Elite-1, fused silica capillary column (30m × 0.25 mm ID × 1 × df, composed of 100% Dimethylpolysiloxane) GC-MS analysis were performed. An electron ionization system including ionizing energy of 70 eV was used for GC-MS detection. At a constant flow rate of 1 ml/min helium gas (99.999%) was used as carrier gas and an injection volume of 2µl was employed with injector temperature at 250 °C and ion source temperature at 280 °C. Mass spectra were detailed at 70eV; at a scan-interval of 0.5 seconds and fragments from 45 to 450 Da. Total GC running time was 36 min. The relative % amount of each component was calculated by comparing its average peak area to total area. Turbo Mass Ver 5.2.0 software was adopted to handle mass spectra and chromatograms.

Identification of compounds

The phytocompounds present in the hydro alcoholic extract of *mukia maderaspatana* were identified by comparing the spectrum with the database of National Institute Standard and Technology (NIST), having more than 62,000 patterns. Compound name, retention time and molecular formula were determined.

RESULTS AND DISCUSSION

Phytochemical analysis of leaves extract of *Mukia maderaspatana*

Qualitative analysis

Phytocompounds such as alkaloids, flavonoids, coumarin, glycosides, terpenoids, tannin, steroid, saponin, phenol, and anthraquinone are present in higher concentrations in the hydroalcoholic extract of *Mukia maderaspatana* shown in table 1. The yield of phytocompounds is low in methanolic and aqueous extract of *Mukia maderaspatana.* Among all three extracts, hydroalcoholic extract yields a higher concentration of phytocompounds. Compounds such as coumarin, terpenoids, steroid, saponin and anthraquinone are absent in aqueous extract and also an absence of anthraquinone in methanolic extract of *Mukia maderaspatana.* Phenols possess biological activities such as antiaging, anticarcinogen, antiinflammation and also cardiovascular protection, antioxidant properties depend on phenolic compounds of plants. Flavonoids possess antimicrobial activity and effective anticancer property. Inflammation is inhibited by saponin. The property of coagulation and precipitation of red blood cells is revealed by saponin. Steroids have been shown to have antibacterial effects and also plays a vital role in sex hormones. Alkaloids are reported to possess cytotoxicity effects and also an analgesic and antibacterial properties. According to many reports Glycosides lowers blood pressure [35]. Pharmacological potential of coumarin is anticancer, anemia, and antioxidant [36]. Tannin possesses medicinal properties such as haemostatic, antidiarrheal and also for the treatment of bowel disorders [31].

Table 1: Qualitative phytochemical analysis of leaves extract of *Mukia maderaspatana*

S. No.	Phytochemicals	Aqueous extract (100%)	Methanol extract (100%)	Hydro-alcoholic extract (60%)
1	Alkaloids	+	+	++
2	Flavonoids	+	++	++
3	Coumarin	-	+	++
4	Glycosides	+	+	++
5	Terpenoids	-	+	++
6	Tannin	+	+	++
7	Steroid	-	+	++
8	Saponin	-	+	+
9	Phenol	+	+	++
10	Anthraquinone	-	-	+

("+" indicates the presence of compounds, "-" indicates the absence of compounds, "++" indicates the high concentration of compounds)

Quantitative analysis of phytochemicals

Quantitative analysis of total alkaloid, flavonoid, phenol, tannin and terpenoids of Aqueous, Methanol and Hydroalcoholic extract of leaves of *Mukia maderaspatana* are detailed in table 2.

Quantitative analysis of alkaloids, flavonoids, phenols, tannins and terpenoids shows good results in Hydroalcoholic extract of leaves of *Mukia maderaspatana.* Comparatively, the methanolic and aqueous extract of *Mukia maderaspatana* shows a lower value in quantitative analysis of alkaloids, flavonoids, phenols, tannins and terpenoids (fig. 1). The presence of phytoconstituents in *Mukia maderaspatana* proved to have a positive effect in various studies. Flavonoids possess antibacterial, anti-inflammatory, and anti-viral activity. Alkaloids reveal pharmacological effects. Polyphenolic groups, including tannin and phenols, have anticancer activity and antimicrobial activity [37].

Table 2: Quantitative analysis of alkaloid, flavonoid, phenol, tannin and terpenoids of aqueous, methanol and hydroalcoholic extracts of leaves of *Mukia maderaspatana*

Name of sample	Total alkaloids (Milligrams of atropin equivalents per gram)	Total flavonoids (Milligrams of quercetin equivalents per gram)	Total phenols (Milligrams of gallic acid equivalents per gram)	Total tannins (Milligrams of tannic acid equivalents per gram)	Total terpenoids (Milligrams of linalool equivalents per gram)
Aqueous extract of leaves of *Mukia maderaspatana*	53.3±3.63	31.4±2.45	82.0±5.68	54.01±9.86	76.01±7.43
Methanolic extract of leaves of *Mukia maderaspatana*	185±9.23	216.5±6.25	222.52±4.85	71.54±5.42	52.08±3.64
Hydro-alcoholic extract of leaves of *Mukia maderaspatana*	215.8±4.78	307.10±8.73	374.50±6.41	129.98±5.32	119.23±4.17

Values were expressed as mean±Standard deviation for triplicates

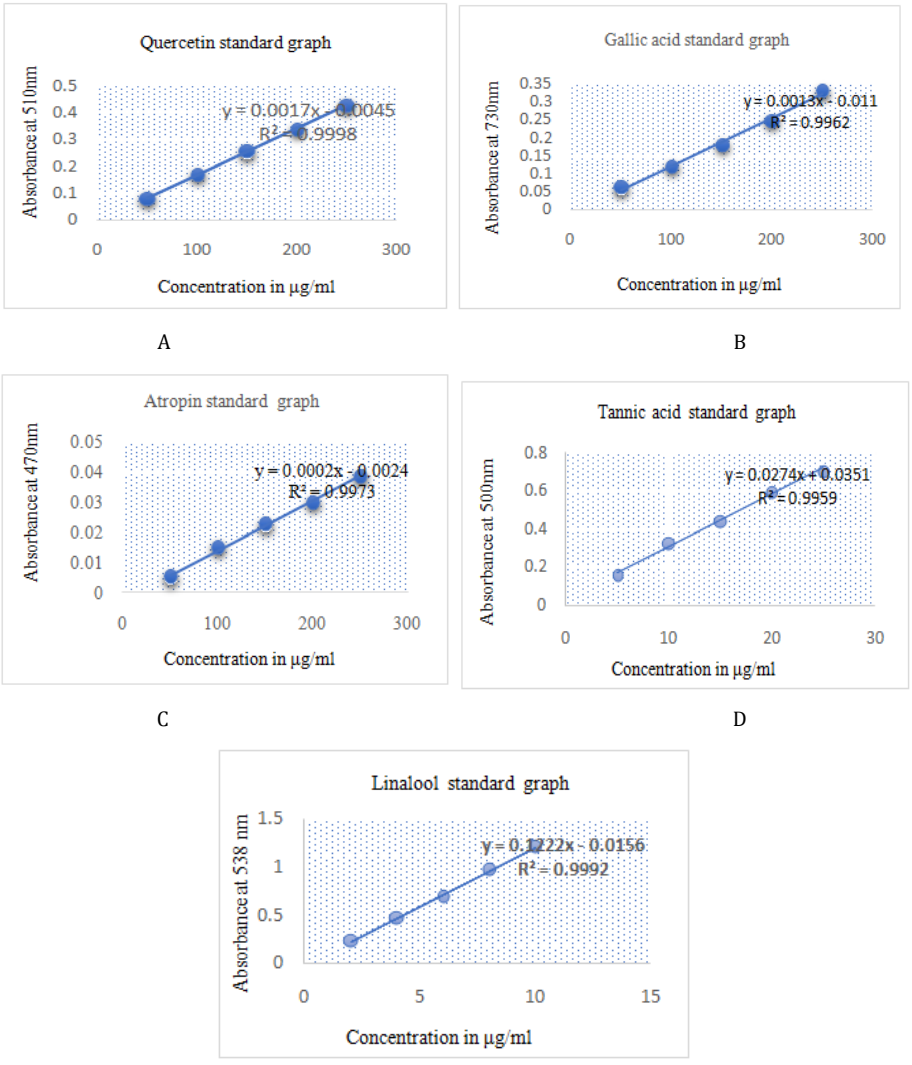

Fig. 1: Standard curve for flavonoids, phenol, alkaloids, tannin and terpenoids, A. Standard curve for flavonoids using Quercetin, B. Standard curve for phenol using Gallic acid, C. Standard curve for alkaloids using Atropin, D. Standard curve for tannin using tannic acid, E. Standard curve for terpenoids using Linalool

***In vitro* antioxidant activity**

Free radical reactions in the body have been related to a wide range of diseases and health problems, including cardiovascular, neurological, cancer, and pulmonary problems. Free radicals have a major role in the ageing process. In the event of such irregularities, antioxidants may be a potential treatment option. Various oxidative reaction generates reactive oxygen species such as superoxide radicals, hydroxyl radicals, and hydrogen peroxide. Major problem for our health is the imbalance between antioxidant enzymes and reactive oxygen species. Separate experiments for each kind of reactive oxygen species were used to examine the ability of plant extracts to scavenge various ROS species. 1, 1-diphenyl-2-picryl-hydrazol is a relatively stable radical. The ability of antioxidants to scavenge the stable radical is determined by the DPPH test. Scavenging property of plant extract of those ROS species has been evaluated for a different type of reactive oxygen species by separate assays. Ascorbic acid is an excellent DPPH scavenger. The lowest IC_{50} value has the greatest antioxidant activity. As a consequence, the test extract's phenolic compounds may be responsible for the removal of H_2O_2. Compounds like catechin and quercetin possess orthodihydroxy phenolic structure that protects bacterial cells from cytotoxicity induced by H_2O_2 [29]. Increasing the Total antioxidants have the potential to treat neurological diseases and have the ability to cure diabetes, cancer and respiratory disorder [5]. In FRAP assay the ferric tripyridyltriazine (Fe(III)-TPTZ) complex is reduced to ferrous tripyridyltriazine (Fe(II)-TPTZ) at low pH by a reductant [38]. Inhibiting the targeted material by 50% by a substance is defined as IC_{50} value. Phytoconstituents like phytol, esters and fatty acids possess antioxidant potential [39]. Hydroalcoholic extract of *Mukia maderaspatana* shows excellent antioxidant activity than Aqueous and Methanol extract (table 3).

Table 3: *In vitro* antioxidant activity of aqueous, methanol and hydroalcoholic extract of *Mukia maderaspatana*

Tests	Samples	Concentration (µg/ml)					IC_{50} value (µg/ml)
		20 µg/ml	40 µg/ml	60 µg/ml	80 µg/ml	100 µg/ml	
DPPH radical scavenging activity	Aqueous extract	13.53±0.09	24.81±0.18	36.84±0.32	56.76±0.58	67.29±0.66	74.55
	Methanol extract	15.41±0.12	28.19±0.23	41.72±0.42	61.65±0.62	70.30±0.79	69.13
	Hydroalcoholic extract	18.42±0.18	34.58±0.29	49.24±0.57	66.91±0.71	75.56±0.84	61.43
	Std. (Ascorbic acid)	21.80±0.21	39.84±0.35	59.39±0.60	75.93±0.97	92.85±1.05	51.05
Total antioxidant activity	Aqueous extract	15.36±0.11	27.40±0.27	43.97±0.53	56.62±0.75	70.78±0.87	71.28
	Methanol extract	17.46±0.18	31.92±0.32	47.59±0.57	60.84±0.73	75.00±0.95	64.77
	Hydroalcoholic extract	20.18±0.21	34.63±0.35	52.71±0.61	64.75±0.78	78.91±1.03	59.68
	Std. (Ascorbic acid)	22.59±0.23	38.25±0.41	56.62±0.64	74.69±0.74	90.06±1.07	52.48
Hydrogen peroxide scavenging activity	Aqueous extract	14.74±0.08	26.97±0.23	44.24±0.42	57.19±0.59	69.42±0.65	70.72
	Methanol extract	16.90±0.11	33.45±0.27	52.15±0.49	64.02±0.62	75.17±1.02	62.26
	Hydroalcoholic extract	19.78±0.18	39.92±0.31	56.83±0.53	69.78±0.67	79.85±1.07	55.69
	Std. (Ascorbic acid)	22.66±0.20	44.24±0.34	61.51±0.56	78.77±0.71	91.72±1.11	48.59
Ferric reducing antioxidant power activity	Aqueous extract	16.40±0.05	24.14±0.14	36.53±0.38	47.05±0.67	61.30±0.78	82.90
	Methanol extract	19.50±0.07	28.79±0.19	42.41±0.49	52.94±0.71	67.80±0.81	72.77
	Hydroalcoholic extract	20.12±0.10	33.43±0.25	47.98±0.51	59.44±0.74	73.68±0.86	64.60
	Std. (Ascorbic acid)	22.91±0.12	37.77±0.29	52.32±0.56	69.04±0.87	85.75±0.99	55.46

Values were expressed as mean±Standard deviation for triplicates

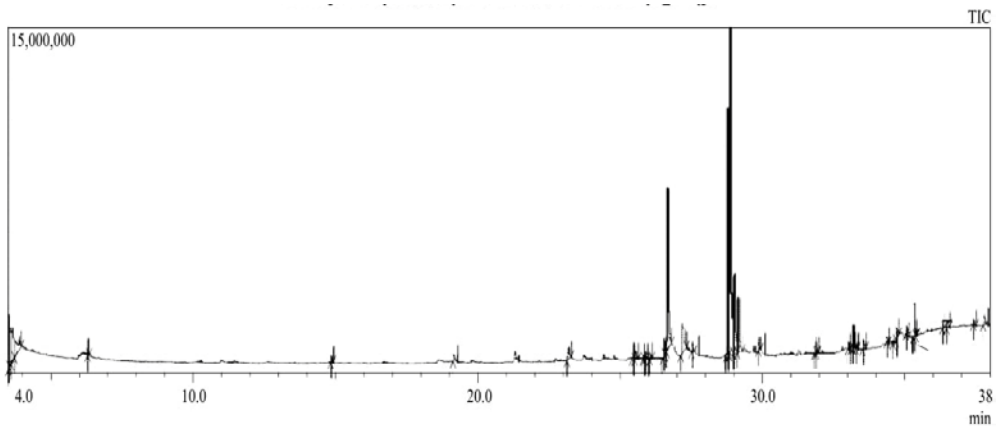

Fig. 2: GC-MS chromatogram of hydroalcoholic extract of *Mukia maderaspatana*

Gas chromatography-mass spectrometry (GCMS) analysis

Combination of Gas chromatography and Mass Spectrometry technique revealed the presence of volatile compounds [40]. Thirty compounds were identified in hydroalcoholic extract of *Mukia maderaspatana.* Compounds identified from GC-MS analysis are detailed in table 4 and chromatogram of hydroalcoholic extract of *Mukia maderaspatana* was shown in fig. 2. Compounds like Butanoic acid, 3-methyl [41], Cyclotetrasiloxane, octamethyl [42], 1,2-Benzenedicarboxylic acid [43], Silicone oil [44] possessing antimicrobial property. Cholesterol [45] and Cyclohexasiloxane, dodecamethyl-[46] have good antifungal activity. Cycloheptasiloxane, tetradecamethyl [47], 2,6,10-Trimethyl,14-Ethylene-14-pentadecene [48], Squalene are compounds exhibit anticancer property [49]. Squalene also possess Antibacetrial, immunostimulant, and lipoxygenase inhibitor activity [50]. Methyl stearate has gastrin inhibitor potential, and antihelmintic, antinociceptive properties. Compounds like Tetracosanoic acid, Methyl ester have Immunomodulatory activity [51]. Various bioactive compounds in hydroalcoholic extract of *Mukia maderaspatana* reveals its pharmacological potential in treating various disorders.

Table 4: Compounds identified at various retention time from hydroalcoholic extract of *Mukia maderaspatana*

S. No.	Retention time	Area%	Molecular formula	Molecular weight g/mol	Name of the compound
1	3.529	2.05	$C_3H_4O_3$	88	Propanoic acid, 2-oxo-
2	3.564	3.52	$C_4H_8O_2$	89	Acetic acid ethyl ester
3	3.627	4.90	$C_5H_{10}O_2$	102	Butanoic acid, 3-methyl-
4	3.909	3.41	C_8H_{10}	106	Benzene, Ethyl-
5	6.317	0.14	$C_8H_{24}O_4Si_4$	296	Cyclotetrasiloxane, octamethyl-
6	14.871	0.39	$C_{12}H_{36}O_6Si_6$	444	Cyclohexasiloxane, dodecamethyl-
7	19.171	0.43	$C_{14}H_{42}O_7Si_7$	519	Cycloheptasiloxane, tetradecamethyl-
8	23.182	1.10	$C_{16}H_{30}O_2$	254	2-Propenoic acid, tridecyl ester
9	25.548	0.71	$C_{18}H_{36}O$	268	2-Pentadecanone, 6,10,14-trimethyl-
10	25.878	0.60	$C_8H_6O_4$	166	1,2-Benzenedicarboxylic acid
11	26.070	0.29	$C_{20}H_{40}O$	296	3,7,11,15-Tetramethyl-2-hexadecen-1-ol
12	26.605	0.71	$C_{17}H_{24}O_3$	276	7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,
13	26.671	12.84	$C_{17}H_{34}O_2$	270	Hexadecanoic acid, methyl ester
14	27.183	3.98	$C_{16}H_{32}O_2$	256	n-Hexadecanoic acid
15	27.549	0.62	$C_{18}H_{36}O_2$	284	Hexadecanoic acid, ethyl ester
16	28.787	15.25	$C_{19}H_{34}O_2$	294	9,12-Octadecadienoic acid(Z,Z)-,methyl ester
17	28.858	26.73	$C_{19}H_{36}O_3$	312	10-Octadecenoic acid, methyl ester
18	29.014	6.84	$C_{20}H_{40}O$	296	Phytol
19	29.167	4.64	$C_{19}H_{38}O_2$	298	Methyl stearate
20	29.895	0.62	$C_{19}H_{35}F_3O_2$	352	Heptadecyl trifluoroacetate
21	31.905	0.31	$C_{16}H_{34}$	226	Hexadecane
22	33.032	0.31	$C_{23}H_{46}O_2$	354	Docosanoic acid, methyl ester
23	33.115	0.13	$C_{28}H_{34}N_2O_3$	446	Benzyldiethyl-(2,6-xylylcarbamoylmethyl) ammonium benzoate
24	33.204	1.13	$C_8H_6O_4$	166	1,2-Benzenedicarboxylic acid
25	33.551	0.73	$C_{25}H_{45}F_5O_2$	472	Docosyl pentafluoropropionate
26	34.600	0.09	$C_{29}H_{56}O_4S_2$	532	Tetracosanoic acid, Methyl
27	35.336	1.69	$C_{30}H_{50}$	410	Squalene
28	36.344	0.24	$C_{16}H_{22}O_2Si_2$	302	Silicone oil
29	36.501	0.52	$C_{28}H_{53}F_3O_2$	478	Hexacosyl trifluoroacetate
30	37.791	0.84	$C_{27}H_{46}O$	386	Cholesterol

CONCLUSION

The present study reveals that *Mukia maderaspatana* is an important medicinal plant. The preliminary phytochemical screening shows the presence of alkaloids, flavonoids, coumarin, glycosides, terpenoids, tannin, steroids, saponin, phenol and anthraquinone in higher concentration in Hydroalcoholic extract comparable to Aqueous and Methanolic extract of *Mukia maderaspatana*. The total alkaloids, flavonoids, phenol, tannin and terpenoids are determined. *In vitro* antioxidant activity were determined and shows that the hydroalcoholic extract of *Mukia maderaspatana* scavenges the free radical more comparable to Aqueous and Methanolic extract. Hydroalcoholic extract shows higher antioxidant activity due to the presence of phenols and flavonoids. We can conclude that the Leaves of *Mukia maderaspatana* are good source of antioxidants, which might cure the disease related to oxidative stress. GC-MS analysis detected many bioactive compounds from hydroalcoholic extract of *Mukia maderaspatana* possessing good pharmacological properties. Therefore, isolating, purifying, and characterising particular bioactive chemicals from *Mukia maderaspatana* might help researchers better understand their distinct pharmacological active principles.

ACKNOWLEDGEMENT

I am thankful to the Department of Biochemistry, School of Life Sciences (VISTAS) for providing me necessary facilities and assistance in carrying out this study.

FUNDING

Nil

AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

REFERENCES

1. Gomathy G, Vijay T, Sarumathy K, Gunasekaran S, Palani S. Phytochemical screening and GC-MS analysis of Mukia maderaspatana (L.) leavesJ. Basic J Appl Pharm Sci. 2012;2(12):104-6.
2. Mohammad AMM, Rashid MM, Kaniz FU, Rana MS. Phytochemical screening and investigation of antioxidant and cytotoxicity potential of different extracts of selected medicinal plants of Bangladesh. Res J Pharm Technol. 2013;6(9):1042-50.
3. Sahoo N, Manchikanti P, Dey S. Herbal drugs: standards and regulation. Fitoterapia. 2010;81(6):462-71. doi: 10.1016/j.fitote.2010.02.001, PMID 20156530.
4. Amirtham D, Aswini NJ, Dhivya K, Ganapathy S, Indurani C. Evaluation of dehydrated Mukia madraspatana leaves as a potent source of dietary antioxidants. Int J F Research Granthaalayah. 2019;7(6):27-36.
5. Kalaivani P, Kavitha D, Amutha P. *In vitro* antioxidant activity and phytochemical composition of syringodium isoetifoelium. Res J Pharm Technol. 2021;14(12):6201-6.
6. Jeyaprakash K, Ayyanar M, Geetha K, Sekar T. Traditional uses of medicinal plants among the tribal people in Theni District (Western Ghats), Southern India. Asian Pac J Trop Biomed. 2011;1(1):S20-5. doi: 10.1016/S2221-1691(11)60115-9.
7. Rangarajan N, Sangeetha R, Mohanasundaram S, Sampath, Porkodi K, Dass Prakash MV. Additive inhibitory effect of the peels of Citrus limon and Citrus sinensis against amylase and glucosidase activity. IJRPS 2020;11(4):6876-80. doi: 10.26452/ijrps.v11i4.3661.
8. Haidan Y, Qianqian M, Li Y, Piao G. The traditional medicine and modern medicine from Natural Products; 2016. p. 21.
9. Raja ST, Margret CR, Rajesh SC, Shunmugaperumal T, Vijayakumar CT, Venkateswarlu BS. Stability of curcumin improved in hydrophobic-based deep eutectic solvents. Res J Pharm Technol. 2021;14(12):6430-6.
10. Monika M, Krishna PK. Phytochemical analysis of commercially available Spirulina, their activities and Biosynthesis of Nanoperticles. Res J Pharm Technol. 2021;14(12):6189-93.
11. Sundar RDV, Settu S, Shankar S, Segaran G, Sathiavelu M. Potential medicinal plants to treat leprosy-a review. Res J Pharm Technol. 2018;11(2):813-21. doi: 10.5958/0974-360X.2018.00153.1.
12. Victor AD, Prasad M, Mohanasundaram S. Biological active compounds with various medicinal values of strychnos nux-

vomica–a pharmacological summary. J Glob Trends Pharm Sci. 2016;7(1):3044-7.
13. Moyeenudin HM, Vijayalakshmi S. The antihypertensive effect from aqueous extract of oxalis corniculata by *in vitro* antihypertensive activity assay. Res J Pharm Technol. 2019;12(6):2981-6. doi: 10.5958/0974-360X.2019.00504.3.
14. Mohanasundaram S, Doss VA, Haripriya G, Varsha M, Daniya S, Madhankumar. GC-MS analysis of bioactive compounds and comparative antibacterial potentials of aqueous, ethanolic and hydroethanolic extracts of Senna alata L. against enteric pathogens. Int J Res Pharm Sci. 2017;8(1):22-7.
15. Ramachandran K, Venketnarayanan R. Antioxidant potential of the extract of whole plant parts of Mukia maderaspatana (Linn.) Roem. International J Biol Pharm Res. 2019;10(1):1-15.
16. Sugashini S, Sathiavelu A. Comparison of phytochemical analysis and *in vitro* pharmacological activities of most commonly available medicinal plants belonging to the Cucurbitaceae family. Res J Pharm Technol. 2019;12(4):1541-6.
17. Karpagam T, Firdous J, Revathy, Priya S, Varalakshmi B, Gomathi S. Anti-cancer activity of aloe vera ethanolic leaves extract against *in vitro* cancer cells. Res J Pharm Technol. 2019;12(5):2167-70. doi: 10.5958/0974-360X.2019.00360.3.
18. Sujeethasai K. Medicinal uses and pharmacological activities of mukia maderaspatana (Linn.)-a review. Int J Recent Sci Res. 2020;11(4):38292-6.
19. Narendhiran S, Mohanasundaram S, Arun J, Saravanan L, Catherine L, Subathra M. Comparative study in larvicidal efficacy of medicinal plant extracts against Culex quinquefasciatus. Int J Res Plant Sci. 2014;4(1):22-5.
20. Maria JRJ, Chandramahan G, Renganathan R. Antioxidant activity, preliminary phytochemical investigation and GC-MS study of Bougain Villea glabra choicy leaves. Int J Pharm Pharm Sci. 2012;4(2):12-6.
21. Bharathi P, Elavarasi N, Mohanasundaram S. Studies on rate of Biodegradation of vegetable oil (Cocunut oil) by using Pseudomonas sp. Int J Environ Biol. 2012;2(2):12-9.
22. Trease GE, Evans WC. Phenols and phenolic glycosides. In: Textbook of pharmacognosy. 12th ed. London: Balliese, Tindall and Co Publishers; 1989. p. 343-83.
23. Harborne JB. Phytochemical methods. London: Chapman & Hall, Ltd.; 1973. p. 49-188.
24. Biju J, Sulaiman CT, Satheessh G, Reddy VRK. Spectrophotometric estimation of total alkaloids in selected Justicia species. Int J Pharm Pharm Sci. 2014;6(5):647-8.
25. Lin JY, Tang CY. Determination of total phenolic and flavonoid contents in selected fruits and vegetables, as well as their stimulatory effects on mouse splenocyte proliferation. Food Chem. 2007;101(1):140-7. doi: 10.1016/ j.foodchem.2006.01.014.
26. Singleton VL, Rossi JA. Colorimetry of total phenolics with phosphomolybdic phosphotungstic acid reagents. Am J Enol Vitic. 1965;16:144-58.
27. Mohanasundaram S, Victor AD, Prasad M, Magesh R, Sivakumar K, Subathra M. Pharmacological analysis of hydroethanolic extract of Senna alata (L.) for *in vitro* free radical scavenging and cytotoxic activities against Hep G2 cancer cell line. Pak J Pharm Sci. 2019;32(3):931-4.
28. Indhumathi C, Durgadevi G, Nithyavani S, Gayathri PK. Estimation of terpenoid content and its antimicrobial property in Enicostemma litorrale. Int J ChemTech Res. 2014;6(9):4264-7.
29. Vaghela JS, Sisodia SS. *In vitro* antioxidant activity of Terminalia chebula fruit extracts. Res J Pharm Technol. 2011;4(12):1835-43.
30. Shimada K, Fujikawa K, Yahara K, Nakamura T. Antioxidative properties of xanthan on the autoxidation of soybean oil in cyclodextrin emulsion. J Agric Food Chem. 1992;40(6):945-8. doi: 10.1021/jf00018a005.
31. Mohanasundaram S, Rangarajan N, Sampath V, Porkodi K, Prakash MVD, Monicka N. GC-MS identification of anti-inflammatory and anticancer metabolites in edible milky white mushroom (Calocybe indica) against human breast cancer (MCF-7) cells. Res J Pharm Technol. 2021;14(8):4300-6.
32. Zhang XY. Principles of chemical analysis. Beijing: China Science Press; 2000. p. 275-6.
33. Mohanasundaram S, Rangarajan N, Sampath V, Porkodi K, Pennarasi M. GC-MS and HPLC analysis of antiglycogenolytic and glycogenic compounds in kaempferol 3–O–gentiobioside containing Senna alata L leaves in experimental rats. Transl Metab Syndr Res. 2021;4:10-7. doi: 10.1016/j.tmsr.2021.07.001.
34. Hema R, Kumaraval S, Gomathi S, Sivasubramaniam C. Gas chromatography-mass spectroscopic analysis of Lasonia inermis Ileaves. JAPS. 2010;3(11):141-3.
35. Yadav RNS, Munin A. Phytochemical analysis of some medicinal plants. J Phytol. 2011;3(12):10-4.
36. Badgujar SB, Patel VV, Bandivdekar AH, Mahajan RT. Traditional uses, phytochemistry and pharmacology of Ficus carica: a review. Pharm Biol. 2014;52(11):1487-503. doi: 10.3109/13880209.2014.892515, PMID 25017517.
37. Kavitha M, Srinivasan PT, LakshmPriya S, Jayakumar LV. Evaluation of nutrient composition and antibacterial potential of leaf and stem of Mukia maderaspatana I. Int J Pharm Res Allied Sci. 2013;2(3):68-76.
38. Gohari AR, Hajimehdipoor H, Saeidnia S, Ajani Y, Hadjiakhoondi A. Antioxidant activity of some medicinal species using FRAP assay. J Med Plants. 2010;10(37).
39. Sujatha J, Asokan S, Rajeshkumar S. Phytochemical analysis and antioxidant activity of chloroform extract of Cassis alata. Res J Pharm Technol. 2018;11(2):439-44. doi: 10.5958/0974-360X.2018.00081.1.
40. Saravanan P, Chandramohan G, Mariajancyrani J, Shanmugasundaram P. GC-MS analysis of phytochemical constituents in ethanolic bark extract of Ficus religiosa Linn. Int J Pharm Pharm Sci. 2014;6(1):457-60.
41. Wang Q, Sivakumar K, Mohanasundaram S. Impacts of extrusion processing on food nutritional components. Int J Syst Assur Eng Manag. 2022;13(S1):364-74. doi: 10.1007/s13198-021-01422-2.
42. Dilek K, Nur C, Aysel U, Ayse DD. Antimicrobial activity and chemical constitutions of West Anatolian olive (Olea europaea L.) leaves. J Food Agric Environ. 2012;10(2):99-102.
43. Priyanka BG, Tresina SP, Mohan VR. Determination of bioactive compounds of dendrophthoe falcata (L. F) Ettingsh: an epiphytic plant. Int J Health Sci Res. 2018;8(11):261-9.
44. Ozdamar A, Aras C, Ozturk R, Akin E, Karacorlu M, Ercikan C. *In vitro* antimicrobial activity of silicone oil against endophthalmitis-causing agents. Retina. 1999;19(2):122-6. doi: 10.1097/00006982-199902000-00006, PMID 10213237.
45. Brunel JM, Loncle C, Vidal N, Dherbomez M, Letourneux Y. Synthesis and antifungal activity of oxygenated cholesterol derivatives. Steroids. 2005;70(13):907-12. doi: 10.1016/j.steroids.2005.06.007, PMID 16139854.
46. Mahmoud FMM, Saad AA, Tarek HT, Sulaiman AA. *In vitro* antifungal activity of Argemone ochroleuca sweet latex against some pathogenic fungi. Afr J Biotechnol. 2013;12(10):1132-7.
47. El-Fayoumy EA, Shanab SMM, Gaballa HS, Tantawy MA, Shalaby EA. Evaluation of antioxidant and anticancer activity of crude extract and different fractions of Chlorella vulgaris axenic culture grown under various concentrations of copper ions. BMC Complement Med Ther. 2021 Feb 5;21(1):51. doi: 10.1186/s12906-020-03194-x, PMID 33546663, PMCID PMC7863377.
48. Selvamangai G, Bhaskar A. GC–MS analysis of photo components in the methanolic extract of Eupatorium triplinerve. Asian Pac J Trop Biomed. 2012;2(3):S1329-32. doi: 10.1016/S2221-1691(12)60410-9.
49. Zayed MZ, Wu A, Sallam SM. Comparative phytochemical constituents of Leucaena leucocephala (Lam.) Leaves, fruits, stem barks, and wood branches grown in Egypt using GCMS method coupled with multivariate statistical approaches. BioResources. 2019;14(1):996-1013.
50. Mohanasundaram S, Ramirez Asis E, Quispe Talla A, Bhatt MW, Shabaz M. Experimental replacement of hops by mango in beer: production and comparison of total phenolics, flavonoids, minerals, carbohydrates, proteins and toxic substances. Int J Syst Assur Eng Manag. 2022;13(S1):132-45. doi: 10.1007/s13198-021-01308-3.
51. Mehtab R, Ibrahim M, Naz A, Faiyaz A, Faheem A, Rasheed M. Immunomodulatory activity and chemical characterization of fixed oils obtained from different parts of oxytropis glabra DC. Pak J Pharm Sci. 2018 May;31(3):755-62. PMID 29716852.