Phytochemical screening and Characterization using HPLC and FTIR Techniques and analysis of Antioxidant activity of *Ficus Palmata* (Bedu)

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Abstract

From ancient times, traditional medicines have been used in Ayurveda, Siddha and Unani. Numerous illnesses are amenable to Ficus palmata treatment belonging to the Moraceae family. The goal of this work is to identify the chemical components through water, petroleum ether, acetone, ethanol and methanol extracts of Ficus palmata stems using basic phytochemical analysis, HPLC and FTIR spectroscopy. The existence of phenols, tannins, flavonoids, alkaloids, glycosides, steroids, saponins and terpenoids was demonstrated by the results of the phytochemical study. A C18-150 4.6 mm column, 10µ injection volume and 80:20 v/v (methanol: acetonitrile) mobile phase at 30°C were used to conduct a reversed-phase HPLC study.

The UV detector was used to record the detection at 210 and 290 nm. FTIR analysis of stem extracts in methanol and petroleum ether indicated the presence of aliphatic amine compounds with significant peaks along with peaks of primary amines, alcohols, amides, aldehydes, alkanes, alkyl halides, ethers, aromatics and alkenes. The assay for 1,1-diphenyl-2-pycryl-hydrazyl "DPPH" and the test for hydrogen peroxide were used to quantify the free radical scavenging activity.

Keywords: Phytochemical analysis, HPLC, FTIR, *Ficus Palmata*, DPPH, Diseases.

Introduction

Ficus species exhibit a wide range of growth habits, leaf shapes and sizes. They often have a fascinating ecological role, providing food and habitat for various animals including certain species of birds and insects. Additionally, many Ficus species have cultural or religious significance in different parts of the world[10]. *Ficus palmata*, also known as the Indian rock fig or wild fig, is a type of fig tree found in parts of India and Southeast Asia. While it might not be as extensively studied for medicinal purposes compared to some other plants, various parts of the *Ficus palmata* have been traditionally used in folk medicine[22].

In Ayurveda, the traditional medicinal system of India, various parts of plants were utilized for their therapeutic properties. *Ficus palmata* holds significance in Ayurvedic practices, particularly its stem for its potential medicinal benefits: The stem's latex or sap is believed to have properties that aid in wound healing. It has been used topically as a poultice for cuts, wounds and skin infections due to its reported antimicrobial and healing properties. In Ayurvedic traditions, various parts of the *Ficus palmata*, including the stem, are believed to possess anti-inflammatory properties. While the stem might not be commonly used for digestive issues, some Ayurvedic practices suggest that certain parts of the *Ficus palmata* including the fruits, might aid in digestion.

Fig. 1: Image showing the stem of *Ficus palmata*

Antioxidants in plant extracts may scavenge free radicals, reducing oxidative damage to cells and tissues. Some antioxidants possess anti-inflammatory properties which can help to mitigate inflammation-related conditions internally and externally. Antioxidants are associated with reducing the risk of certain chronic diseases like cardiovascular diseases, neurodegenerative disorders and cancer.

Further research involving *in vitro* and *in vivo* studies specific to *Ficus palmata* stem extracts would provide more concrete information on their antioxidant potential[12]. Techniques such as assays measuring the scavenging activity of free radicals like DPPH or ABTS assays are commonly used to assess the antioxidant capacity of plant extracts. FTIR is a powerful analytical technique used to identify and analyze the chemical composition of substances based on their molecular structure. It helps in identifying

various compounds present in the extract such as phenols, flavonoids, alkaloids and other functional groups. This analysis can aid in understanding the potential bioactive components of the plant material and their potential applications in medicine or other industries.

Material and Methods

Plant sample collection and authentication: The foliage of *F. palmata* was collected from the Tehri region of Uttarakhand, India. The BSI (Botanical Survey of India) validated and taxonomically identified the plant samples. A voucher specimen (873) of *F. palmata Forsk.* was deposited at herbarium of BSI, Dehradun.

Preparation of plant extracts: The sequential Soxhlet extraction technique was used for the extraction. The leaves and stem were ground together in a grinder. A homogenous 25 gm of powered plant substance was placed in a thimble and 250 ml of numerous solvents were used for extraction. After that, the thimble was placed inside the Soxhlet apparatus, where extraction was performed using petroleum ether, acetone, ethanol, methanol and water as solvents in sequential order from non-polar to polar. The extraction process lasts for a whole day, or until the solvent in the extractor's siphon tube turns colorless[17].

Finally, soluble fractions in water, methanol, ethanol, acetone and petroleum ether were obtained. Crude extracts were then left behind as the extract was allowed to concentrate in vacuum using a rotating evaporator. The dried extract was kept in refrigerator at 4^0C for future use in different analyses[14,25]. All extracts were obtained from the Tehri regions of Uttarakhand. The following formula was used to determine the extract's percentage yield:

Percentage Yield (%) = Weight of Extract (g)/Weight of leaf powder (g) × 100

Phytochemical Screening: Phytochemical screening of petroleum ether, acetone, ethanol, methanol and water extracts of *Ficus palmata* stem extract was carried out to detect the presence of various phytochemicals such as phenols, flavonoids, alkaloids, coumarins, tannins, saponins, terpenoids, steroids, alkaloids etc. according to the standard protocols[14,25]. Changes in color and/or formation of precipitate with the addition of specified detecting reagents to the test solutions of various fractions were observed and the results were recorded as present (+) or absent (-) based on the observations. All the qualitative phytochemical tests were replicated thrice for confirmation[2,5].

Molisch's Test: In 2000µl of extract, add α- naphthol and shake well, slowly add 1ml of concentrated H_2SO_4. A blue-violet ring indicates the test as positive for carbohydrates.

Fehling's Test: Fehling's solution A consisted of dissolving 34.66 gm of $CuSO_4$ in distilled water. Fehling's solution B consisted of dissolving 173 gm of potassium sodium tartrate and 50 gm of NaOH in water to make 500 ml. The existence of sugar was recommended by a crimson precipitate after mixing A and B with the extract.

Meyer's Test: In 1ml of extract, add drops of Meyer's reagent, the test will be positive for alkaloids if the precipitate is white and creamy.

Test for Glycosides: To 1ml of extract, 10% NaOH was added in two to three drops. Add 500µl of sodium nitroprusside. A change in color to blue will indicate the test as positive. For the Keller-Kiliani test, to 1.2ml of sample, add 1-2 ml of CH_3COOH acid, 2-3 drops of 5% ferric chloride and 4-5 drops of concentrated H_2SO_4. A ring of reddish-brown color indicates the existence of glycosides[4].

Salkowski Test: After adding a couple of drops of concentrated sulfuric acid to the extract, the existence of terpenoids was recommended by the establishment of a yellow-colored lower layer, while the existence of steroids was indicated by the red color of the bottom layer.

Test for Saponins: 5 ml of distilled water was combined with crude extract and the mixture was agitated vigorously. It was believed that the production of steady foam recommended the appearance of saponins.

Alkaline reagent Test: To 1000 µl of crude extract, add 4-5 drops of NaOH solution. If a bright yellow color forms and then turns colorless when a few drops of acid are added, flavonoids are present.

Liebermann-Burchard's Test: To 1ml of extract, add two to three drops of acetic anhydride solution and boil in a water bath. After cooling it, add concentrated sulphuric acid. Two different types of rings will be shown, the lower layer will be red-brown which indicates the presence of triterpenoids and the upper layer will show a green color[24].

Fourier Transform Infrared Spectroscopy: FTIR spectroscopy was used to recognize the chemical bonds formed in the extract of *Ficus palmata* stem. 10mg of dried extract powder was encapsulated in 100mg of analytical grade KBr pellet to prepare the sample disc[15,25]. Plate was loaded in a spectroscopy machine and all data was obtained by collecting the full scan range spectra from 400-4000 cm^{-1}.

DPPH Scavenging for Free Radicals: The activity of the antioxidant was tested with some minor modifications of the method of Jothi and Jebamalar[11]. Various sample concentrations (20%, 40%, 60%, 80% and 100%) were combined with 0.1mM of working DPPH reagent. Keep the mixture incubated at ambient temperature for 2 hours. Discoloration of the sample was predicted by a spectrophotometer at 517 nm. Utilizing the standard ascorbic acid, the results were stated as mg ASC/g of extract[11].

Hydrogen Peroxide Scavenging Activity: 0.1ml of the sample (20%, 40%, 60%, 80% and 100%) was added in 0.4ml of 50mM of phosphate buffer to which 2mM of 0.6ml of H_2O_2 was added, vortex the sample for 10 minutes, absorbance was taken through spectrophotometer at 230nm**.** The results were articulated as mg ASC/gm extract, using ascorbic acid as the benchmark[24].

Results and Discussion

Extraction yield refers to the amount or percentage of a desired substance obtained from a raw material or source during a process of extraction. A higher extraction yield is generally desirable. Factors influencing extraction yield include the extraction technique, solvent used, extraction time, temperature and the characteristics of the raw material. Furthermore, phenolic and flavonoid component recovery is enhanced by the extractant's polarity[8]. Table 1 displays the acquired data, which showed that polar solvents produced better extraction yields and that the extracted yield was significantly higher than that of any other solvent utilized[1,26].

According to table 2, the initial screening of *Ficus palmata* revealed that the stem's methanolic extract contained the highest concentration of bioactive substances including protein, alkaloids, flavonoids, tannin, phenol and polysaccharides compared to petroleum ether extracts. The highest phenolic and flavonoid contents were observed at *Ficus palmata* methanol extract 100% as 49.2±0.48mg/g (R2=0.992) and 16.87±0.43mg/g (w/w) (R2=0.987) (Table 3) respectively in the methanolic extract of *F. Palmata* stem as shown in figures 2 and 3[8,29].

Studies have demonstrated that phenolic moiety components such as flavonoids, carotenoids and tannins are commonly found in natural extracts having antioxidant activity. As a result, phenolic substances are important in lowering the DPPH radical. The evaluation curve for gallic acid, employed as a standard and encompassing the concentration assortment of 1 g/mL to 5 g/ml, was plotted using concentration against absorbance obtained at 765 nm [28] [Figures 2 and 3] [Table 3].

The methods of reverse osmosis (RO) as well as HPLC used to purify gallic acid are showcased in figure 4. Gallic acid was present in larger concentrations in the retentate stream than in the feed, although it was barely detectable in the permeate.

The RO membrane also disqualifies a few additional substances. According to the results, gallic acid is not a selective target for RO. On the other hand, as a result of some other substances passing through the membrane, the content of gallic acid in the retentate extended by 35%. It is possible that RO, which is easy to use and beneficial to the environment, is a useful technology for purifying gallic acid.

Table 1
Percentage yield *Ficus palmata* stem extract.

S.N.	Solvent	Polarity index	% yield
1.	Petroleum ether	0.1	16.72%
2.	Acetone	0.3	28.12%
3.	Ethanol	0.6	46.93%
4.	Methanol	0.7	48.23%
5.	Water	1	55.15%

Table 2
The phytochemical analysis of different stem extracts of *F. palmata*

S.N.	Phytochemical Test	Pet. Ether	Acetone	Ethanol	Methanol	Water
1	Carbohydrate					
	Molisch's test	+	+	+	+	-
	Fehling's test	-	+	+	+	-
	Benedict's test	+	-	-	+	-
2	Alkaloid					
	Mayer's test	-	+	+	+	-
3	Phenol and Tannins	+	-	-	+	-
4	Glycosides					
	Legal test	+	-	+	+	-
	Salkowski test	-	+	-	+	-
5	Saponins	+	-	+	+	+
6	Phenol test	-	-	+	+	-
7	Flavonoids test	-	+	+	+	-
8	Terpenoids test	-	-	-	+	-

Table 3
Phenol and Flavonoid content of both plants

S.N.	Sample	Total phenolic content of *Ficus palmata* (mg GAE/g of extract)	Total flavonoid content of *Ficus palmata* (μg QE/mg of extract)
1	Petroleum ether	23.1 ± 0.30	3.46 ± 0.08
2	Acetone	29.6 ± 0.31	7 ± 0.16
3	Ethanol	43.5 ± 0.45	9.2 ± 0.21
4	Methanol	49.2 ± 0.48	16.87 ± 0.43
5	Water	35.7 ± 0.19	20.14 ± 0.51

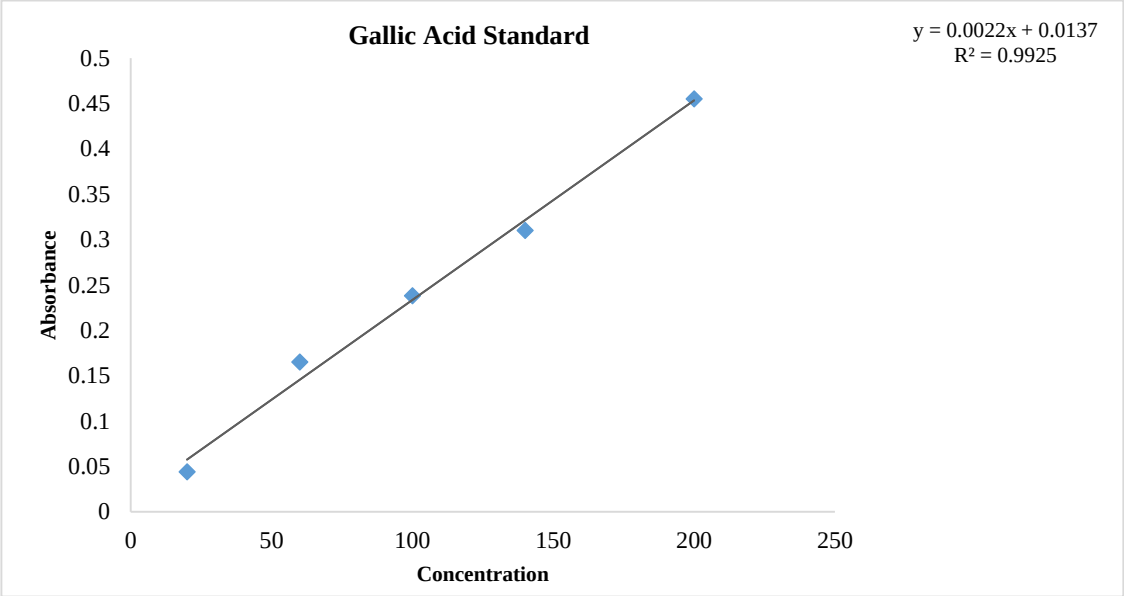


Fig. 2: Evaluation curve of standard Gallic acid against absorbance measured at 765 nm

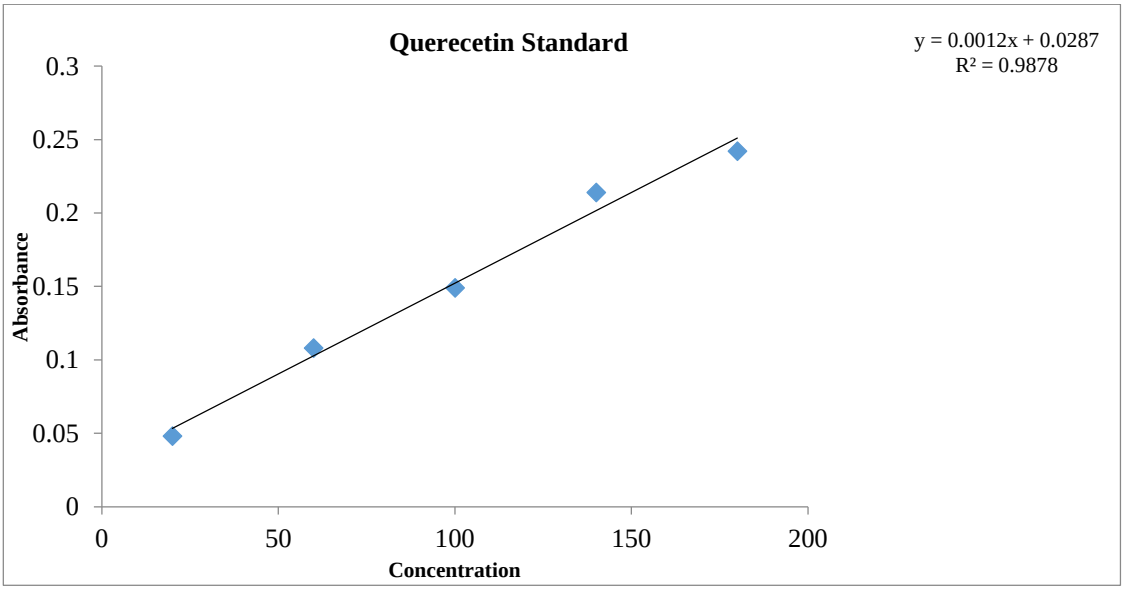


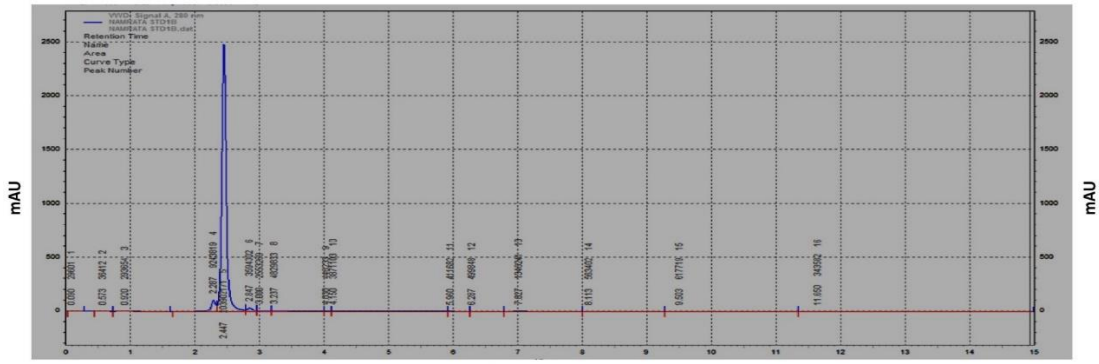
Fig. 3: Evaluation curve of standard Quercetin against absorbance measured at 765 nm

When reinjected for examination, the fraction recovered from the elute in the HPLC system produced a clear gallic acid peak. The percentage area covered in the chromatogram increased dramatically from 17% in the feed to 95% in the collected fraction. This demonstrates that gallic acid may be effectively purified by HPLC without any additional processing such as adsorption, which would increase complexity and expense overall[26] [Figures 4, 5 and 6].

To estimate the components in the extract, petroleum ether and methanol extracts were subjected to HPLC analysis. *Ficus palmata* stem extracts extracted in methanol and

petroleum ether were subjected to HPLC analysis which revealed the presence of several glycoside chemicals in variable quantities including quercetin, flavonoids and anthraquinone. Both phytochemical and HPLC analyses, which exhibited different peaks and retention durations, verified the existence of secondary metabolites.

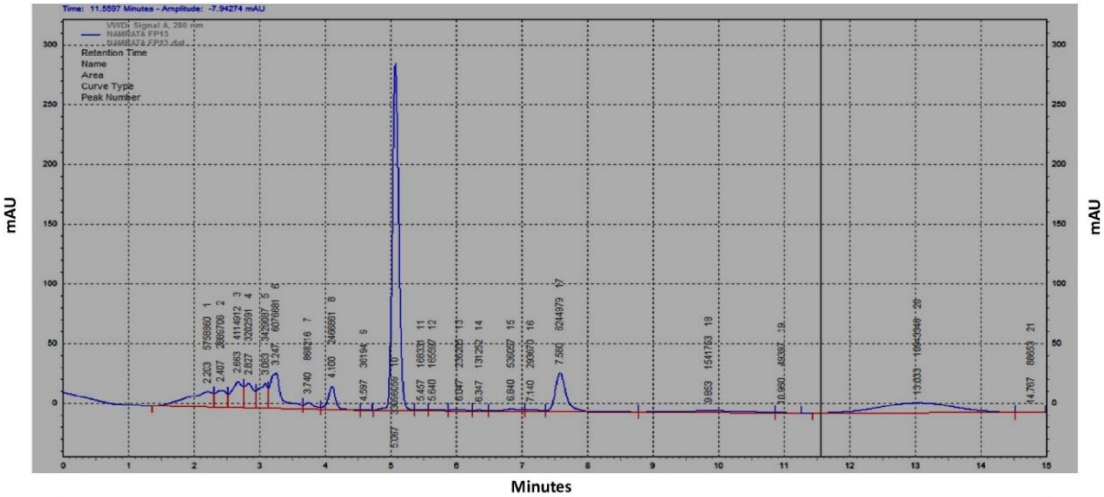
FTIR Analysis: The FTIR analysis was utilized to measure the functional group present in petroleum ether and methanol extract of *Ficus palmata* (stem) based on its peak value in the IR region. The analysis confirms the presence of C-Br, C-H, C-O, C-C, N-H and O-H bands [Tables 4 and 5] [Figures 7 and 8].



VWD: Signal A, 280 nm Results

Retention Time	Area	Area %	Height	Height %
0.090	29601	0.01	3245	0.01
0.573	36412	0.02	3616	0.01
0.920	293654	0.13	17295	0.04
2.287	9243819	3.97	1805938	4.04
2.447	203902171	87.67	41642542	93.18
2.847	3594302	1.55	586482	1.31
3.000	2553269	1.10	195673	0.44
3.237	4829833	2.08	173805	0.39
4.030	446233	0.19	63520	0.14
4.150	3871103	1.66	60026	0.13
5.960	411682	0.18	20180	0.05
6.287	499848	0.21	17936	0.04
7.027	1346241	0.58	76335	0.17
8.113	563402	0.24	9409	0.02
9.503	617719	0.27	7643	0.02
11.650	343582	0.15	4937	0.01

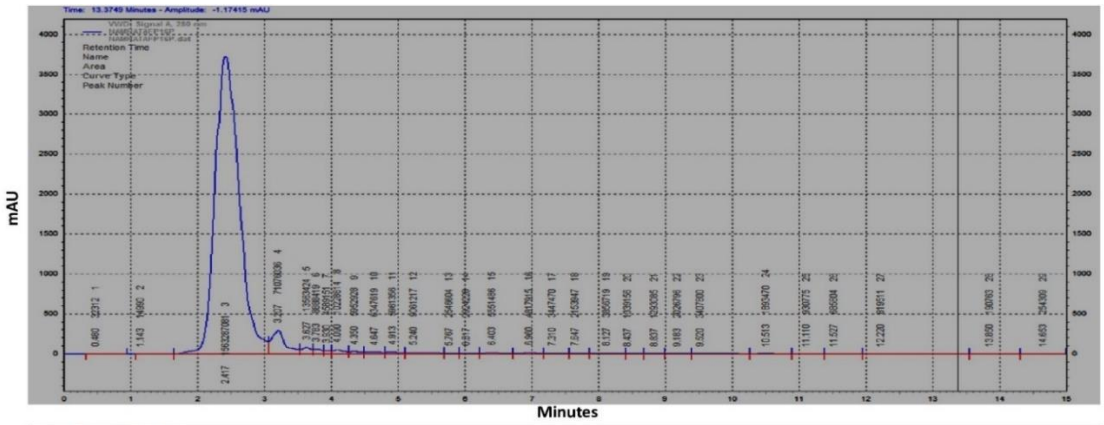
Fig. 4: The purity of the gallic acid was verified by HPLC using RT 2.44



VWD: Signal A, 280 nm Results

Retention Time	Area	Area %	Height	Height %
2.203	5758860	6.99	213306	2.63
2.407	2889706	3.51	234307	2.89
2.663	4114912	5.00	359827	4.44
2.827	3202591	3.89	340701	4.21
3.083	3429087	4.16	351160	4.34
3.247	6076681	7.38	491636	6.07
3.740	868216	1.05	89829	1.11
4.100	2466861	3.00	321643	3.97
4.597	36194	0.04	5858	0.07
5.067	33096059	40.20	4879324	60.25
5.457	168331	0.20	15382	0.19
5.640	165597	0.20	11618	0.14

Fig. 5: HPLC data of *F. palmata* methanol extract



VWD: Signal A, 280 nm Results

Retention Time	Area	Area %	Height	Height %
0.480	32312	0.00	948	0.00
1.143	14990	0.00	320	0.00
2.417	1563287081	89.99	62498030	83.44
3.207	71076036	4.09	4959423	6.62
3.627	13563424	0.78	1400193	1.87
3.783	8888419	0.51	993067	1.33
3.930	4589151	0.26	729823	0.97
4.090	10228614	0.59	830059	1.11
4.350	5952928	0.34	510874	0.68
4.647	6347619	0.37	361316	0.48
4.913	5961356	0.34	436481	0.58
5.240	9061217	0.52	327458	0.44
5.767	2546604	0.15	187968	0.25
6.017	2924228	0.17	178810	0.24
6.403	5551486	0.32	267090	0.36
6.960	4817915	0.28	242982	0.32
7.310	3447470	0.20	179089	0.24
7.647	2153947	0.12	131793	0.18
8.127	3856719	0.22	142296	0.19

Fig. 6: HPLC data of *F. palmata* petroleum ether extract

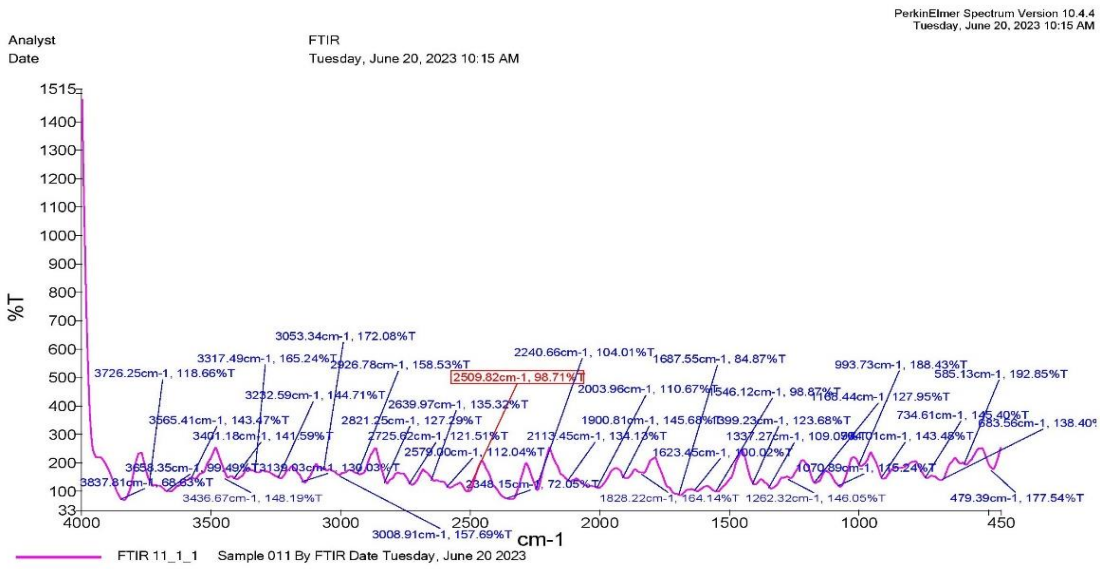


Fig. 7: FTIR analysis and peak value of methanol extract of *Ficus palmate*

Table 4
FTIR spectral peak values and functional groups of methanol extract of *F. palmata* (stem)

Spectrum No.	Wave Number cm^{-1}	Functional Group Assignment	Predicted Compound
1	3317.49	N-H stretch	Amines
2	3053.34	C-H stretch	Alkenes
3	2926.78	C-H stretch	Alkanes
4	2113.45	C=C stretch	Alkynes
5	1828.22	C=O stretch	Anhydrides
6	1262.32	C-F stretch	Alkyl & Aryl halides
7	993.73	C-H stretch	Aromatic compounds
8	585.13	C-Br stretch	Alkyl halides

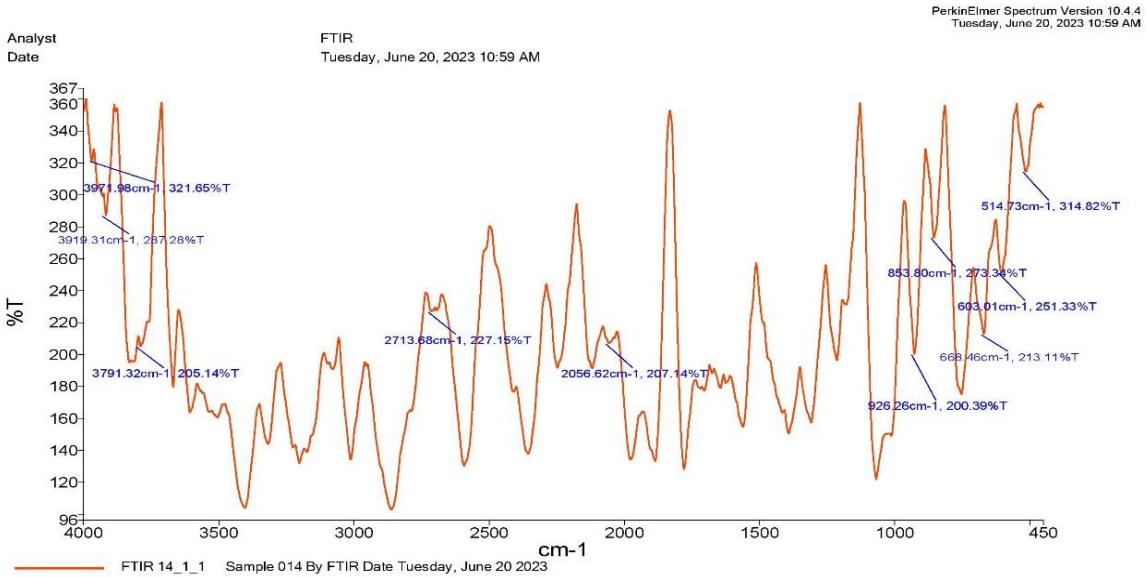


Fig. 8: FTIR analysis and peak value of petroleum ether extract of *Ficus palmata*

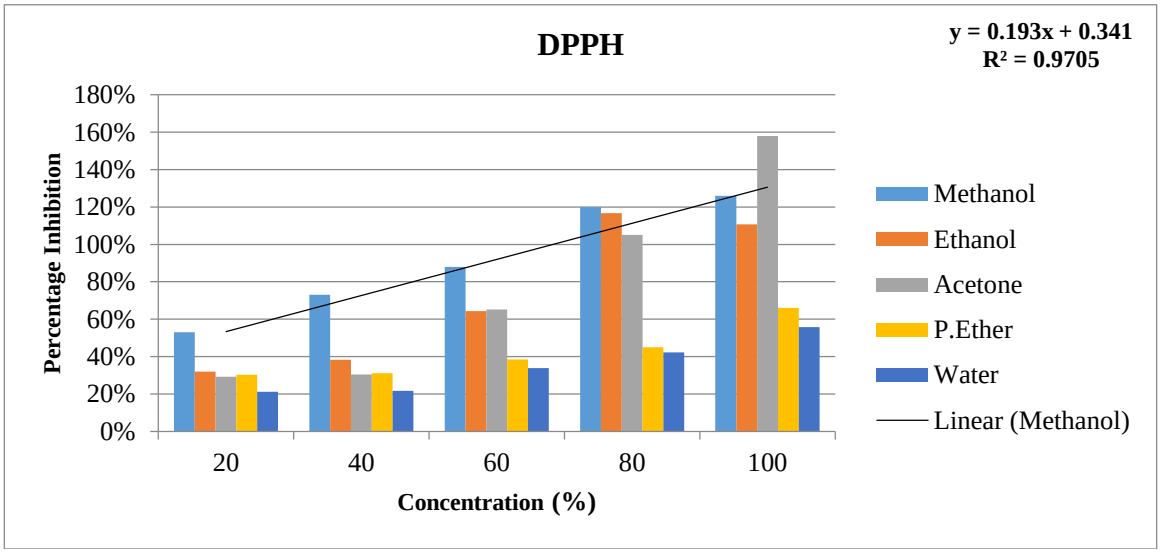


Fig. 9: Percentage inhibition of DPPH for different solvents of *Ficus palmata*

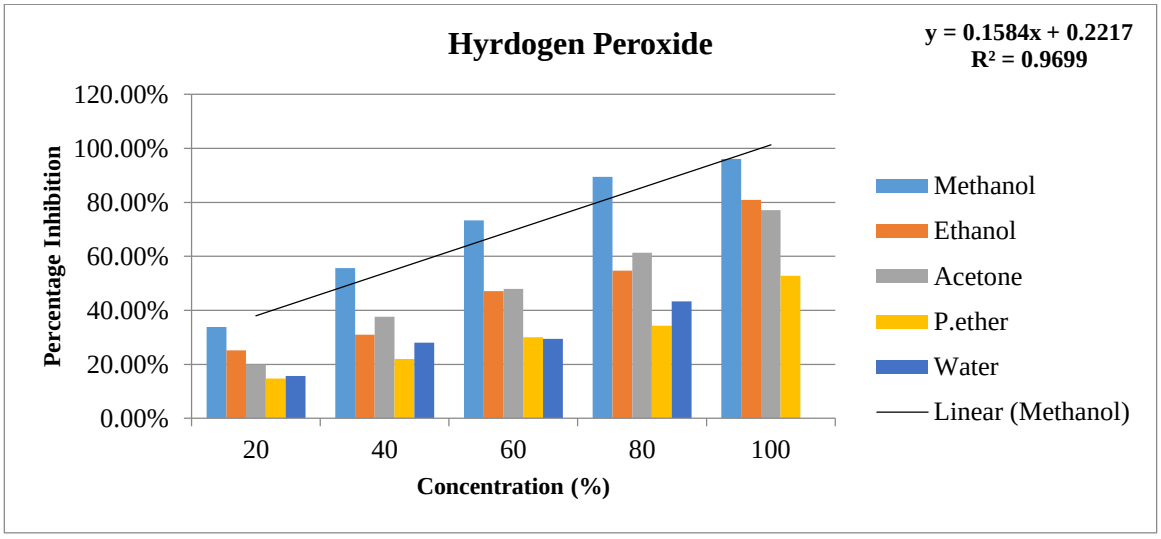


Fig. 10: Percentage inhibition of Hydrogen peroxide for the different solvents of *Ficus palmata*

Table 5
FTIR spectral peak values and functional groups of dried petroleum ether of *F. palmata* (stem)

Spectrum No.	Wave Number cm^{-1}	Functional Group Assignment	Predicted Compound
1	3974.94	O-H stretch	Alcohol
2	3337.89	N-H stretch	Amines
3	2773.42	C-H stretch	Carboxylic acid
4	2117.77	C=C stretch	Alkynes
5	1645.78	C=C stretch	Aromatic compounds
6	1162.12	C-F stretch	Alkyl and Aryl halides
7	587.64	C-Br stretch	Alkyl halides

Table 6
***Ficus palmata* (stem) DPPH scavenging activity in various solvent extracts[6]**

Concentration (µg/ml)	Methanol	Ethanol	Acetone	Petroleum ether	Water
20	53.2 ± 0.30	32 ± 0.19	29.28±0.16	30.2 ± 0.05	21.19 ± 0.12
40	73.8 ± 0.34	38.3 ± 0.22	30.4 ± 0.20	31.1± 0.21	21.66 ± 0.15
60	88.12 ± 0.28	64.28 ± 0.24	65.2 ± 0.23	38.5 ± 0.14	33.8 ± 0.20
80	120.1± 0.35	116.6 ± 0.30	105 ±0.29	45 ± 0.12	42.3 ± 0.22
100	126.5 ± 0.27	110.71 ±0.31	158 ±0.34	66.1 ± 0.09	55.7 ± 0.27

Table 7
***Ficus palmata* (stem) H_2O_2 activity in various solvent extracts[6]**

Concentration (µg/ml)	Methanol	Ethanol	Acetone	Petroleum ether	Water
20	33.80± 0.021	25.23 ± 0.10	20 ± 0.12	14.7±0.007	15.71 ± 0.11
40	55.71 ±0.001	30.95 ± 0.10	37.61 ± 0.12	22 ± 0.04	28.09 ± 0.15
60	73.33 ± 0.04	47.14 ± 0.12	48 ± 0.13	30 ± 0.10	29.52 ± 0.16
80	89.5 ± 0.12	54.7 ± 0.14	61.4 ± 0.15	34.28±0.21	43.3 ± 0.18
100	96.1 ± 0.13	80.9 ± 0.15	77.1 ± 0.16	52.8 ± 0.19	48.5 ± 0.19

Free Radical Scavenging Activity: The primary cause of plant's antioxidant activity is the presence of bioactive compounds within them. The hydrogen peroxide assay and the DPPH assay were used to measure antioxidant activity. Methanolic extract of *Ficus palmata* shows a strong free radical activity shown in figure 9. DPPH assay and H_2O_2 assay show strong activity at FP100% whereas FP80% shows strong activity for hydrogen peroxide assay[8,26] [Tables 6 and 7] [Figures 9 and 10].

Conclusion

The current investigation validated the antioxidative properties of *Ficus palmata* (stem) methanol and petroleum ether extract. The range of plant extracts most likely indicates the existence of phytonutrients such as phenol, flavonoids, sugars, alkaloids, glycosides and saponin. To evaluate the efficacy of bioactive chemicals through *in vivo* studies as well as to show their efficacy and clinical trial safety, more research on bioactive substances is required.

Traditional uses of plants for medicinal purposes often lack extensive scientific validation. While they may contain compounds with therapeutic potential, it is crucial to consult with healthcare professionals before using any plant-based remedies, especially for medicinal purposes. Numerous studies have verified that the existence of these phytochemicals provides the plants physiological and therapeutic qualities, which can be used to cure a variety of illnesses. As a result, extracts from these plants may be valuable source of medications.

Acknowledgement

The instrumentation facilities were provided by Graphic Era University Dehradun in Uttarakhand, India and the authors are grateful to the University.

References

1. Alara O.R., Abdurahman N.H., Mudalip S.K.A. and Olalere O.A., Characterization and effect of extraction solvents on the yield and total phenolic content from Vernonia amygdalina leaves, *Journal of Food Measurement and Characterization*, **12**, 311-316 **(2018)**

2. Alqasoumi S.I., Basudan O.A., Al-Rehaily A.J. and Abdel-Kader M.S., Phytochemical and pharmacological study of Ficus palmata growing in Saudi Arabia, *Saudi Pharmaceutical Journal*, **22(5)**, 460-471 **(2014)**

3. Alrumman S.A., Moustafa M.F., Hesham A.E.L., Alamri S.A. and Hashem M., Phytochemical analysis and inhibitory effects of extract of young fruits of Ficus palmate on some pathogenic microbes, *Egyptian Academic Journal of Biological Sciences, C, Physiology and Molecular Biology*, **6(1)**, 131-139 **(2014)**

4. Anjum N. and Tripathi Y.C., Phytochemical screening and in vitro evaluation of antidiabetic activity of Ficus palmata fruits, *Europ J Pharm Med Res*, **6(11)**, 251-258 **(2019)**

5. Boutaoui N. et al, Qualitative and quantitative phytochemical analysis of different extracts from Thymus algeriensis aerial parts, *Molecules*, **23(2)**, 463 **(2018)**

6. Christova-Bagdassarian V.L., Bagdassarian K.S., Atanassova M.S. and Ahmad M.A., Comparative analysis of total phenolic and total flavonoid contents, rutin, tannins and antioxidant capacity in Apiaceae and Lamiaceae families, *Indian Horticulture Journal*, **4(3 and 4)**, 131-140 **(2014)**

7. Farah N., Bukhari S.A., Ali M., Naqvi S.A.R. and Mahmood S., Phenolic acid profiling and antiglycation studies of leaf and fruit extracts of tyrosine primed Momordica charantia seeds for possible treatment of diabetes mellitus, *Pak. J. Pharm. Sci*, **31(6)**, 2667-2672 **(2018)**

8. Haminiuk C.W.I., Plata-Oviedo M.S.V., de Mattos G., Carpes S.T. and Branco I.G., Extraction and quantification of phenolic acids and flavonols from Eugenia pyriformis using different solvents, *Journal of Food Science and Technology*, **51**, 2862-2866 **(2014)**

9. Harborne J.B., Phytochemical methods: a guide to modern techniques of plant analysis, Chapman and Hall **(1998)**

10. Joshi Y., Joshi A.K., Prasad N. and Juyal D., A review on Ficus palmata (wild Himalayan fig), *The Journal of Phytopharmacology*, **3(5)**, 374-377 **(2014)**

11. Jothi U. and Jebamalar A., Study on estimation and antioxidant activity of Gloriosa superba L. whole plant extract, *Int. J. Sci. Res. in Biological Sciences*, **6**, 3 **(2019)**

12. Kavitha R., Kamalakannan P., Deepa T., Elamathi R., Sridhar S. and Suresh Kumar J., *In vitro* antimicrobial activity and phytochemical analysis of Indian medicinal plant Couroupita guianensis Aubl, *J Chem Pharm Res*, **3(6)**, 115-121 **(2011)**

13. Kothiyal S.C. and Saklani S., Isolation and identification of Ficus palmata leaves and their antimicrobial activities, *Journal of Scientific Research*, **9(2)**, 193-200 **(2017)**

14. Manandhar S., Luitel S. and Dahal R.K., *In vitro* antimicrobial activity of some medicinal plants against human pathogenic bacteria, *Journal of Tropical Medicine*, **2019**, 1895340 **(2019)**

15. Meena H., Pandey H.K., Pandey P., Arya M.C. and Ahmed Z., Evaluation of the antioxidant activity of two important memory enhancing medicinal plants Baccopa monnieri and Centella Asiatica, *Indian Journal of Pharmacology*, **44(1)**, 114 **(2012)**

16. Mujtaba A., Masud T., Ahmad A., Naqvi S.M.S., Qazalbash M.A. and Levin R.E., Effect of solvents on extraction yield, total flavonoid, total phenolic contents, DPPH scavenging activity and antibacterial potential of three apricot cultivars, *Transylvanian Review*, **24(10)**, 1662-1676 **(2016)**

17. Murugan R. and Parimelazhagan T., Comparative evaluation of different extraction methods for antioxidant and anti-inflammatory properties from Osbeckia parvifolia Arn. –An in vitro approach, *Journal of King Saud University-Science*, **26(4)**, 267-275 **(2014)**

18. Negi A., Dobhal K. and Rawat A., A review on the spectrum of pharmacologial activities of ficus palmata Forsk, *World Journal of Pharmacy and Pharmaceutical Sciences*, **8**, 231-239 **(2019)**

19. Nkwocha C.C., Ogugofor M.O., Chukwuma I.F. and Njoku O.U., Identification and characterization of phytochemicals and constituents in Desmodium velutinum stem using high-performance liquid chromatography (HPLC), *Pharmacological Research-Modern Chinese Medicine*, **3**, 100090 **(2022)**

20. Obadoni B.O. and Ochuko P.O., Phytochemical studies and comparative efficacy of the crude extracts of some haemostatic plants in Edo and Delta States of Nigeria, *Global Journal of Pure and Applied Sciences*, **8(2)**, 203-208 **(2002)**

21. Rea K.A., Casaretto J.A., Al-Abdul-Wahid M.S., Sukumaran A., Geddes-McAlister J., Rothstein S.J. and Akhtar T.A., Biosynthesis of cannflavins A and B from Cannabis sativa L, *Phytochemistry*, **164**, 162-171 **(2019)**

22. Saklani S. and Chandra S., Phytochemical screening of Garhwal Himalaya wild edible fruit Ficus palmata, *Int J Pharm Tech Res*, **4(3)**, 1185-91 **(2012)**

23. Salem M.Z., Salem A.Z.M., Camacho L.M. and Ali H.M., Antimicrobial activities and phytochemical composition of extracts of Ficus species: An overview, *Afr. J. Microbiol. Res*, **7(33)**, 4207-4219 **(2013)**

24. Saratale R.G., Saratale G.D., Ghodake G., Cho S.K., Kadam A., Kumar G. and Shin H.S., Wheat straw extracted lignin in silver nanoparticles synthesis: Expanding its prophecy towards antineoplastic potency and hydrogen peroxide sensing ability, *International Journal of Biological Macromolecules*, **128**, 391-400 **(2019)**

25. Siddiqui N., Rauf A., Latif A. and Mahmood Z., Spectrophotometric determination of the total phenolic content, spectral and fluorescence study of the herbal Unani drug Gul-e-Zoofa (Nepeta bracteata Benth), *Journal of Taibah University Medical Sciences*, **12(4)**, 360-363 **(2017)**

26. Singh Namrata, Verma Rashmi, Rawat Pramod, Aziz Rabia and Kala Anushka, *Ficus palmata* and *Ficus auriculata* phytochemical screening in different solvents by HPLC and FTIR spectroscopic analysis, *Scope*, **13(4)**, 459-472 **(2023)**

27. Singleton V.L. and Rossi J.A., Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents, *American Journal of Enology and Viticulture*, **16(3)**, 144-158 **(1965)**

28. Thanigachalam Sathish and Pathak Madhvesh, Photodegradation of Methylene Blue by Nano-Titania developed from Novel Heteroleptic Titanium(IV) Complexes, *Res. J. Chem. Environ.*, **27(1)**, 29-38 **(2023)**

29. Wang J.L., Yu Z.L., Yin F.W., Li D.Y., Liu H.L., Song L. and Zhou D.Y., Comparison of different solvents for extraction of oils from by-products of shrimps Penaeus vannamei and Procambarus clarkia, *Journal of Food Processing and Preservation*, **45(9)**, e15754 **(2021)**.

(Received 26th February 2024, accepted 02nd May 2024)