https://doi.org/10.48047/AFJBS.6.7.2024.4021-4028

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Fourier Transform Infrared Spectroscopy Analysisand Phytochemical Screening of Selected Medicinal Plant Extracts

Mohd Zishan[1], Dolly Wattal Dhar[1] and Uzma Manzoor[2*]

[1]Sharda School of Agricultural Sciences, Sharda University, Greater Noida-201306; [2]School of Agriculture, Galgotias University, Greater Noida-203201

[*]Corresponding author's E-mail: uzmamanzoor52@gmail.com

Article History
Volume 6, Issue 7, 2024
Received: 09 March 2024
Accepted: 19 April 2024
doi:
10.48047/AFJBS.6.7.2024.4021-4028

Abstract
Plant extracts play an important role in management of pest and diseases in crops. Various plants available are used for treating various fungal diseases in crops. Screening of promising plant extract is vital to develop sustainable management options for pests and diseases.Keeping this in view, it was thought pertinent to have phytochemical screening of medicinal plant extracts to justify the putative use of the plants in the remedy of diseases in crops.The functional groups of medicinal plant leaf extracts have been analysed by the Fourier Transform Infrared Spectroscopy technique to recognize and identify the various kinds of functional groups that exist in mixtures and it has been found that all the tested plant extracts have various flavonoids, tannins and glycosides which contribute to anti-fungal properties.

Keywords: Anti-fungal, Disease control, Fungi, Plant extracts, Phytochemicalanalysis, FTIR

INTRODUCTION

Plants are viewed as a vital source of novel bioactive compounds. Yet surprisingly, the possibilities of medicinal plants as a profound source for new pest and disease control are to a large extent unexplored. It has been estimated that only a small number of the estimated 250,000 – 500,000 plants have been screened for their phytochemical constituents with an even less percentage tested for biological and pharmacological investigation (Mahesh and Satish, 2008). Essentially, natural products derived from plants are biologically active secondary metabolites with rich potential to treat various diseases. Some of these bioactive compounds include alkaloids, flavonoids, terpenoids, saponins etc (Quiroga et al. 2001). Biological, chemical and pharmacological investigations are complementary procedures used in the discovery and isolation of novel plant constituents. The evidences show that the medicinal plants are used as source of traditional medicines in ancient China, India and Middle-East and it is as so old as mankind (Mahesh and Satish, 2008). Medicinal plant extracts reveal great source of antimicrobial and anti-fungal properties. Various parts of medicinal plants such as stems, roots, leaves, seeds and barks etc. are used as raw ingredient for making different types of potent formulations. These raw plant extracts possess extraordinary pharmacological properties such antifungal, antibacterial, antiviral, anti-

inflammatory, anti-diabetic, anti-allergic, and antidepressant activities. Phytopathogens spread diseases and infections in crops, vegetables, fruits, cereals, and grains causing economic loss to farmers. The synthetic pesticides used globallyto control pest and diseases in crops enter in food chains and many phytopathogens have become resistant towards these chemical pesticides. Consequently, it has been in demand to promote substitute agents for the replacement of synthetic pesticides which are globally eco-friendly and safe for human beings and the environment (Cibele et al., 2010). Keeping this in view, it was thought pertinent to have phytochemical screening of selected medicinal plant extracts to justify the putative use of the plants in the remedy of diseases caused by fungi. The functional groups of medicinal plant leaf extracts have been analysed by the Fourier Transform Infrared Spectroscopy technique to recognize and identify the various kinds of functional groups that exist in the extracts.

MATERIAL AND METHODS

Fresh leaves of four medicinal plants, *Syzygiumcumini, Delonixregia, Melia azedarach,* and *Albizialebbeck* were collected from the campus of Sharda University Greater Noida, India. These medicinal plant leaves were washed three times with distilled water and then washed with 1% mercuric chloride for 20 seconds followed by washing with distilled water three times. The samples were dried in hot air oven at 45-50°C followed by crushing in electric grinder to make a powder. 10 grams of dried plant leaf powder of each plant was added with 100 ml acetone solvent in a conical flask and kept into shaker for continuous shaking for 48 hours. These were filtered with whatman filter paper and evaporated without heat. The extractswere collected and stored for further use. Various phytochemical tests were carried out by following methods (Tinky et al., 2020).

Examination for Alkaloid

2 ml of medicinal plant extract and 1ml Meyer's reagent was added in a test tube. The appearance of pale yellow precipitate showed the presence of alkaloids.

Examination of Flavonoids

The medicinal plant extract was added in a test tube and 5ml dilute NH_3 with concentrated $H_2SO_4$was added. The presence of yellow coloured precipitates indicated the presence of flavonoids.

Examination of Glycosides

The medicinal plant extract was added in test tube and 5ml Molisch's reagent was added with concentrated H_2SO_4. The appearance of violet colour indicated the presence of glycosides.

Examination of Tannins/ Polyphenol

The medicinal plant extract in a test tube was diluted and mixed with 3-4 drops of 10% $FeCl_3$. The blue colour indicated for gallic tannins and the green colour indicated catechol tannin.

Examination of Volatile Oils:

2 ml medicinal plant extract was shaken with 0.1 ml NaOH and was added with small amount of dilute HCl. The appearance of white precipitates indicated volatile oil.

Examination of Reducing Sugar:

0.5 ml of medicinal plant extract was added with 1 ml of water. 5-8 drops of Fehling's solution were added and then heated. The brick red precipitation indicated the presence of reducing sugars.

Collection and processing of plant materials for FTIR analysis

Fresh leaves of four medicinal plants, *Syzygiumcumini,Delonixregia, Melia azedarach* and *Albizialebbeck* were collected from the campus of Sharda University Greater Noida, India. The leaves were cleaned with water, blotted on filter paper to remove water and dried in an oven set at 50°C for 6 hours. The dry leaf material was pulverized to a fine powder and stored in amber colour air tight containers at room temperature until use. The samples were defatted with hexane at 40 °C for 8 h in a soxhlet extractor following soxhlet extraction method Ba 3–38.The functional groups of medicinal plant leaf extracts were analysed by the FTIR technique (Agilent Cary 630). Each sample was loaded with a scan range from 650cm^{-1} to 4000cm^{-1} with a resolution of 8cm^{-1}. In the present study, the FTIR spectroscopy was used to identify the functional groups based on the peak values in the IR present in defatted samples. The defatted powders were subjected to FTIR analysis and the functional groups of the components were separated based on its peaks.

RESULTS AND DISCUSSION

The phytochemical analysis of the active extracts indicated that these extracts contained bioactive compounds that are well noted for their anti-fungi properties. Alkaloid, glycosides, flavonoid and tannins were observed to be present in the acetone leaf extracts of the plant materials. (Table 1).It is well known that the chemical constituents of medicinal plants which influence their biological activities are not due to single moiety. The presence of these constituents gives an indication of the medicinal value of the plants. Apparently, the anti-fungal properties of acetone extracts of the plant leaves utilized in this work can be attributed to the presence of active principles which constitute an important source of fungicides, pesticides and many pharmaceutical drugs (Billerbirck et al., 2001).

Table 1: Phytochemical analysis of various medicinal plant extracts

Phytochemical Compounds	***Syzygiumcumini***	***Melia azedarach***	***Delonexregia***	***Albizialebbeck***	***Syzygiumcumini***
Alkaloids	+	+	+	+	-
Flavonoids	+	+	+	+	+
Glycosides	+	+	+	+	+
Tannins/Polyphenol	+	+	+	-	+
Volatile oils	+	+	+	-	-
Reducing sugars	-	-	-	-	+

Figures 1-4 and table 2-5show FTIR peaks of extracts and functional groups, respectively. FTIR is possibly a very potent technique to recognize and identify the various kinds of functional groups that exist in samples. This technique investigates various distinguished peak values in the consequences of different functionalgroups in the compounds (Ashok Kumar and Ramaswamy, 2014).

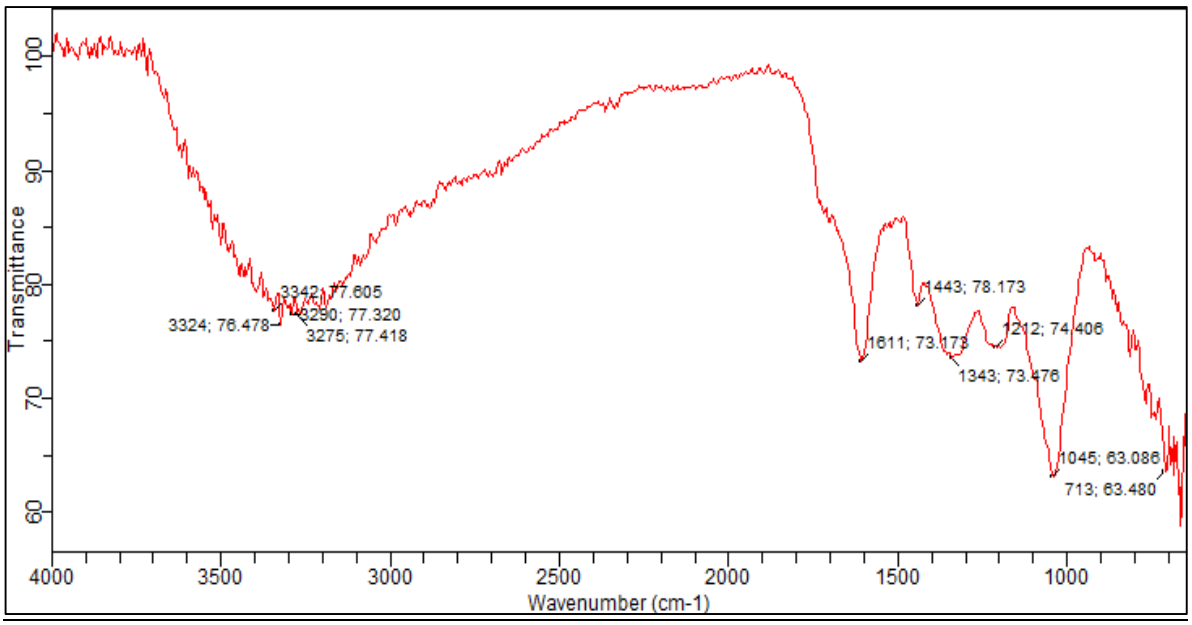


Figure 1. FTIR peaks of aqueous extract of *Syzygiumcumini* leaf

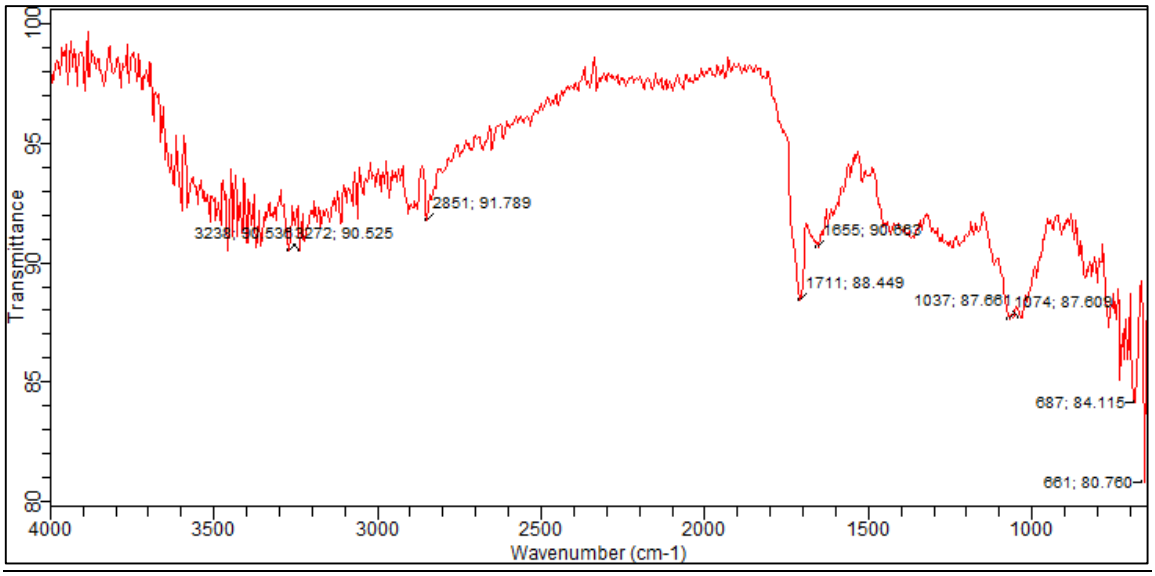
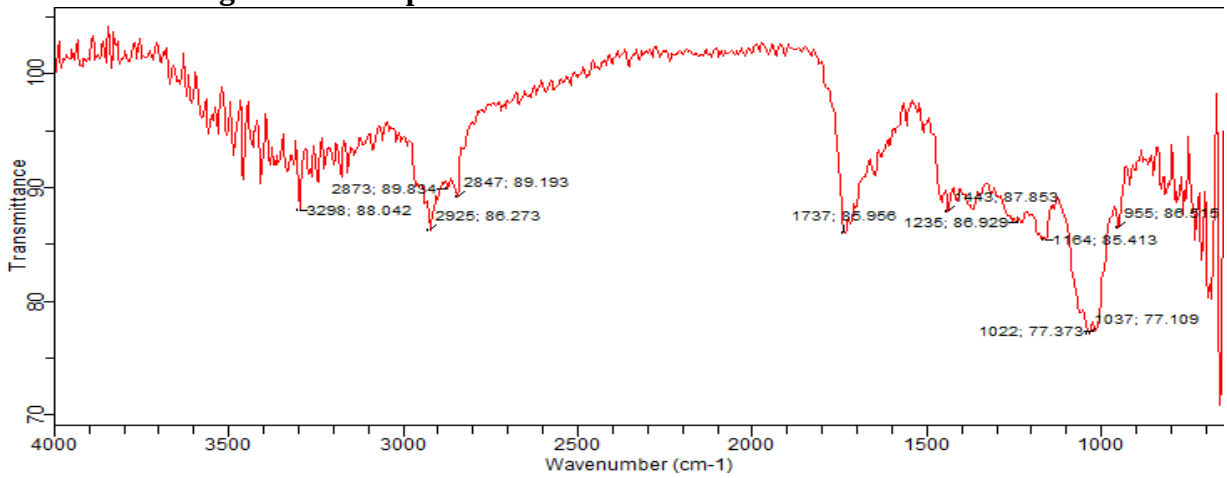


Figure 2. FTIR peaks of acetone extract of *Albizialebbeck* leaf



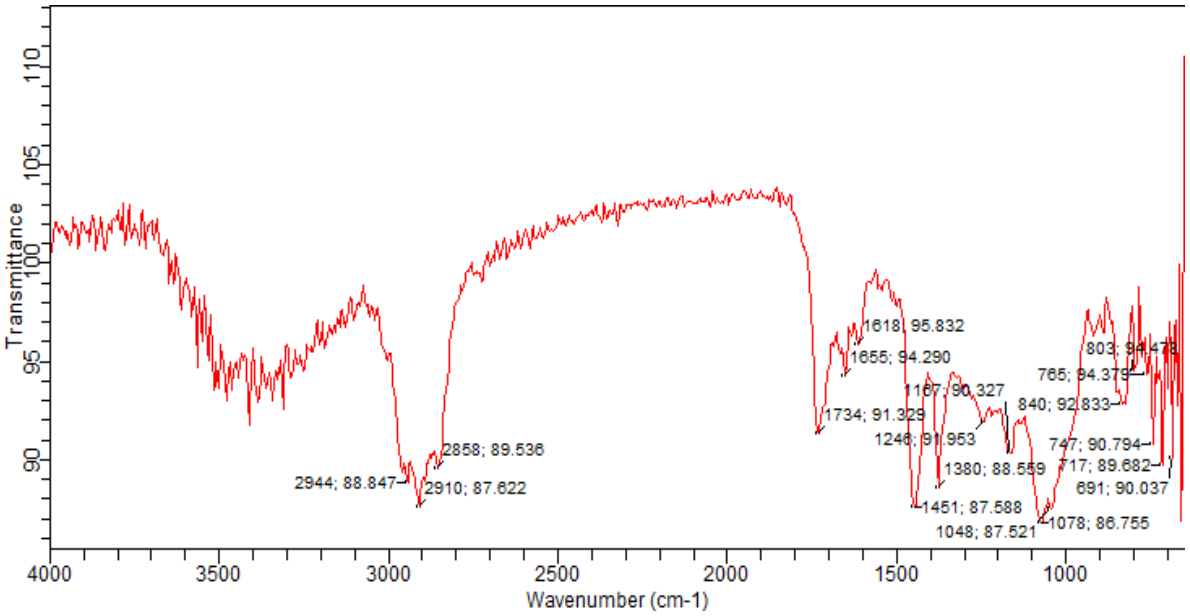


Figure 3. FTIR peaks of extract of *Melia azedarach* leaf

Figure 4. FTIR peaks of *Delonixregia* leaf

Table 2: FTIR assignment table of *Syzygiumcuminii*leaf

S. No.	Peak value (cm-1)	Functional group	Intensity	Phytochemical compound	References
1	3342	O-H Stretching	Strong	Alcohol	Rani et al., 2021
2	3324	O-H Stretching	Strong	Alcohol	Rani et al., 2021
3	3324	O-H Stretching	Strong	Alcohol	Rani et al., 2021
4	3275	O-H Stretching	Strong	Alcohol	Rani et al., 2021
5	1611	C-C Stretching	Medium	Conjugated alkene	Rani et al., 2021
6	1443	C-C Stretching	Medium	Aromatics	Rani et al., 2021
7	1343	O-H Bending	Medium	Phenol	Rani et al., 2021
8	1212	C-O Stretching	Strong	Ether compound	Rani et al., 2021, Chandra, S., 2019
9	1045	C-N Stretching	Strong	Aliphatic amines	Singh et al., 2023
10	713	C-Cl Stretching	Strong	Halogen compound	Singh et al., 2023

Table 3: FTIR assignment table of *Albizialebbeck* leaf

S. No.	Peak value (cm-1)	Functional group	Intensity	Phytochemical compound	References
1	3372	O-H Stretching	Strong	Alcohol	Rani et al., 2021
2	3338	O-H Stretching	Strong	Alcohol	Rani et al., 2021
3	2851	C-H Stretching	Medium	Alkanes	Rani et al., 2021, Chandra, S., 2019
4	1711	C=O Stretching	Strong	Ketone compound	Ashok Kumar and Ramaswamy, 2014
5	1655	C-H Bending	Weak	Aromatic compound	Rani et al., 2021
6	1074	C-N Stretching	Strong	Aliphatic amines	Singh et al., 2023

7	1037	C-N Bending	Strong	Aliphatic amines	Singh et al., 2023
8	687	C-Br Stretching	Strong	Halogen compound	Singh et al., 2023, Sahayaraj et al., 2023
9	661	C-Br Stretching	Strong	Halogen compound	Singh et al., 2023, Sahayaraj et al., 2023

Table 4: FTIR assignment table of *Melia azedarach* leaf

S. No.	Peak value (cm-1)	Functional group	Intensity	Phytochemical compound	References
1	3298	O-H Stretching	Strong	Alcohol	Rani et al., 2021
2	2925	C-H Stretching	Medium	Alkanes	Rani et al., 2021
3	2873	C-H Stretching	Medium	Alkanes	Rani et al., 2021, Chandra, S., 2019
4	2847	C-H Stretching	Medium	Alkanes	Rani et al., 2021
5	1737	C=O Stretching	Medium	Aldehyde compound	Singh et al., 2023, Chandra, S., 2019
6	1443	C-C Stretching	Medium	Aromatics	Rani et al., 2021
7	1235	C-O Stretching	Strong	Ether compound	Rani et al., 2021
8	1165	C-O Stretching	Strong	Ester	Rani et al., 2021, Chandra, S., 2019
9	1037	C-N Stretching	Strong	Aliphatic amines	Singh et al., 2023
10	1022	C-N Stretching	Strong	Aliphatic amines	Singh et al., 2023

Table 5: FTIR assignment table of *Delonixregia* leaf

S. No.	Peak value (cm-1)	Functional group	Intensity	Phytochemical compound	References
1	2944	C-H Stretching	Medium	Alkanes	Rani et al., 2021
2	2910	C-H Stretching	Medium	Alkanes	Rani et al., 2021, Chandra, S., 2019
3	2858	C-H Stretching	Medium	Alkanes	Rani et al., 2021,5
4	1734	C=O Stretching	Strong	Aldehyde	Singh et al., 2023,5
5	1655	C-H Bending	Weak	Aromatic compound	Rani et al., 2021
6	1618	C=C Stretching	Medium	Conjugated alkene	Rani et al., 2021
7	1451	C-C Stretching	Medium	Aromatic compound	Rani et al., 2021
8	1380	O-H Bending	Medium	Phenol	Rani et al., 2021
9	1246	C-O Stretching	Strong	Ether compound	Rani et al., 2021
10	1167	C-O Stretching	Strong	Ester	Rani et al., 2021
11	1078	C-O Stretching	Strong	Primary alcohol	Rani et al., 2021
12	1048	C-N Stretching	Strong	Aliphatic amine	Singh et al.,

					2023
13	840	C-Cl Stretching	Medium	Halogen compound	Rani et al., 2021
14	803	C=C Bending	Medium	Alkene	Rani et al., 2021
15	765	C-Cl Stretching	Strong	Halogen compound	Sahayaraj et al., 2015
16	747	C-Cl Stretching	Strong	Halogen compound	Singh et al., 2023
17	717	C-Cl Stretching	Strong	Halogen compound	Singh et al., 2023
18	691	C=C Bending	Strong	Alkene	Rani et al., 2021

CONCLUSION

The presence of these constituents like flavonoids, tannins, glycosides, etcin the extractsgive an indication of the medicinal value of the plants. Apparently, the anti-fungal properties of acetone extracts of the plants parts can be utilized and attributed to the presence of active principles which constitute an important source of fungicides, pesticides and many pharmaceutical drugs (Billerberk et al., 2001). FTIR analysis confirmed the presence of free alcohol, intermolecular bonded alcohol, intramolecular bonded alcohol, alkane, aromatic compounds, imine or oxime or ketone or alkene, phenol and amine stretching. However, more investigation is required to isolate and identify the reliable antioxidant and antimicrobial molecules present in the plant extracts.

REFERENCES

1. Ashok Kumar, R. and Ramaswamy, M. (2014). Phytochemical screening by FTIR spectroscopic analysis of leaf extracts of selected Indian Medicinal plants. International journal of Current Microbiology and applied Sciences, 3(1), 395-406.
2. Billerberk, V.G., Roques, C.G., Bessière, J.M., Fonvieille, J.L. and Dargent, R. (2001). Effects of *Cymbopogonnardus* (L.) W. Watson essential oil on the growth and morphogenesis of *Aspergillus niger*, Canadian Journal of Microbiology, 47, 9-17
3. Chandra, S.(2019). Fourier transform infrared (Ft-Ir) spectroscopic analysis of *Nicotianaplumbaginifolia* (Solanaceae). Antiseptic, *12*(3), 3000-2850.
4. Cibele, M.A., Costa, B., Silva, A.G., Souza, E.B., Silva, M.V., Correia, M.T., Anna, D.S. and Lúcia de Menezes, L.V. (2016). Antimicrobial activity of several Brazilian medicinal plants against phytopathogenic bacteria. African Journal of Microbiology Research,10(17), 578-583.
5. Rani, K.S., Mumtaz, M., Priyank, R. and Chandran, M.(2021). Phytochemical screening by FTIR spectroscopic analysis of methanol leaf extract of herb Andrographis echioides. Journal of Ayurvedic and Herbal Medicine, *7*(4), 257-261.
6. Sahayaraj, P.A., Gowri, J., Dharmalingam, V., Shobana, R. and Prema, A.A.(2015). Phytochemical screening by FTIR spectroscopic analysis of leaf and stem extracts of Wedeliabiflora. International Journal of Nano Corrosion and Engineering, *2*(5), 322-334.
7. Singh P.K., Mishra, P., Kannojia, P., Bijauliya, R.K., Singh, Y. and Gangwar, A.K.(2023). Phytochemical screening by HPLC analysis and FTIR spectroscopic techniques of Cassia tora leaves extract in different solvents. European chemical bulletin, 12(5), 6697-6703.
8. Tinky, S., Pandey, B., Shrestha, B.K.,Koju, G.M.,Thusa, R. andKarki, N. (2020). Phytochemical Screening of Medicinal Plants and Study of the Effect of Phytoconstituents in Seed Germination, Tribhuvan University Journal, 35(2), 1-11.

9. Quiroga, E.N., Sampietro, A.R. and Vattuone, M.A. (2001). Screening antifungal activities of selected medicinal plants, Journal of Ethnopharmacology, 74, 8996.