RESEARCH ARTICLE

Fourier Transform Infrared Spectroscopy Analysis of Few Medicinal Plants of Chhattisgarh, India

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ABSTRACT

The main objective of the study is to observe the salient features exhibited by the Fourier Transform Infrared Spectroscopy. Five samples of the dried leaves and seeds of medicinal plants Ocimum sanctum, Azadirachta indica, Pongamia pinnata, Celastrus paniculatus and Embelia ribes were selected for study of their Fourier Transform Infrared Spectroscopy. The vibrational assignments, intensities and wave number of dominant peak were obtained from absorption spectra. Various functional groups like ester, alcohol, carboxylic acid, ether, aromatic etc were identified. This article attempts to reveal the use of Fourier Transform Infrared Spectroscopy and at the same time creating interest among the prospective researcher in herbal analysis and this study creates a platform to screen many bio active components to treat various diseases.

Keywords: Fourier Transform Infrared Spectroscopy, Ocimum sanctum, Azadirachta indica, Pongamia pinnata, Celastrus paniculatus and Embelia ribes.

INTRODUCTION

Today there is a growing interest in the research in the field of medicinal plants. Medicinal plants are a great source of herbal drugs. There is tremendous demand for plant based medicines as modern medicine shows adverse side effect of the drugs .As medicinal plants has no side effect and is very effective so there is a tremendous increase in the interest of multinational pharmaceutical companies and domestic manufacturers of herbal based medicines. Medicinal plants are rich source of bio active constituents which is effective for pharmacological activity. The main objective of this study was to identify the various functional groups present in the various extracts of samples of medicinal plants taken.

Ocimum sanctum (Tulsi) belongs to family Lamiaceae. It has significant anti stress properties. Their leaf infusions improve appetite. It is carminative, antipyretic, diaphoretic, expectorant and vermifugal and it is applicable to all types of fever, cough, cold, bronchitis, catarrh, dysentery, diarrhea etc .Oil extracted from the leaves is used as a pest repellent, antibacterial and insecticide .[1]

Azadirachta indica (Neem) belong to family Meliaceae. Traditional healers use various parts of the Neem tree for curing several diseases. It is found very effective in treatment of leprosy, intestinal helminthiasis, hypoglycemic effect.[2] It is mosquito repellent. It is used to cure small pox and chicken pox. It acts as antioxidant so it find application in the prevention or cure of AIDS.[3]

Pongamia pinnata (Karanj) belong to family Fabaceae. It is a legume tree that may be deciduous for short periods.[4] Seeds of Karanj is used as biodiesel. All parts of the plant have been used for curing various diseases like tumours, piles, skin diseases, itches abscess, painful rheumatic joints, wound, ulcers and diarrhea.[5,6,7]

Celastrus paniculatus (Malkangni) belong to family Celastraceae.This plant has been used for sharpening the memory, increasing intellect and improving concentration. Massage of the Seed oil of this plant is used sciatica, lumbago, paralysis, arthritis etc.

Embelia ribes (Vaividang) belong to family Myrsinaceae.It is medicinal woody climber with long slender brittle stem, it is a climbing creeper shrub and flexible. [8] It is considered to be vulnerable due to

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excessive harvesting and because of its many uses.[9] It is highly valuable medicinal plant with carminative, antibacterial, antibiotic, hypoglycemic and anti fertility properties

FTIR (Fourier Transform Infrared) spectroscopy has made a remarkable role in the field of medicinal plant analysis. The measurements made by FTIR were extremely accurate and reproducible. It has made the use of infra red analysis virtually limitless. The commonly used region for Infra red absorption spectroscopy is 4000 -400 cm^{-1} as the absorption radiation of most organic and inorganic compound is within this region. FTIR is one of the most widely used methods to identify the chemical constituents and determine the functional group and the chemical structure of the constituents.[10]

MATERIALS AND METHODS

Collection and identification of plant material

Five medicinal plants Ocimum sanctum, Azadirachta indica, Pongamia pinnata, Celastrus paniculatus and Embelia ribes were collected from Bhilai- Durg region of Chhattisgarh, India. The leaves of Ocimum sanctum, Azadirachta indica and Pongamia pinnata and seeds of Celastrus paniculata and Embelia ribes were collected from Bhilai- Durg region of Chhattisgarh and were taxonomically authenticated. A care was taken to select healthy plants and the plant parts for the study were collected fresh and dried for a week.

Preparation of the plant material

The leaves and seeds of the five medicinal plants were shade dried at room temperature in a clean environment to avoid contamination for few days and powdered in a domestic grinder. The powdered samples were stored in air tight bottles at room temperature for further analysis.

Spectro-Chemical analysis

The FTIR spectra are recorded in KBr by sophisticated computer controlled FTIR Perkin Elmer spectrometer with He-Ne laser as reference. The powdered plant samples of Ocimum sanctum, Azadirachta indica, Pongamia pinnata, Celastrus paniculatus and Embelia ribes were scanned at room temperature and a spectral range of 4000-400 cm^{-1}. In the present it is possible to directly relate the intensities of absorption bands to the concentration of the corresponding functional groups.[11]

RESULT

FTIR spectrum was used to identify the functional group of the active components based on the peak value in the region of infra red radiation. The results of FTIR peak values and functional groups were represented in table 1 and the FTIR spectrum profile was illustrated in the figure 1 to 5. FTIR spectrum confirmed the presence of alcohol, phenol, alkanes , alkyl halide, amino acids , carboxylic acid, aromatic , amines in the leaves and seeds of the medicinal plants taken.

Tablel-1: Infra red absorption bands of medicinal plant leaves and seeds frequencies (cm^{-1})

S. No.	Medicinal plants	O-H	Phenol C-O	N-H str of amine and amide	COOH O-H str	C-H For alkane	Ether C-O str	Ether C=C-O-C str	Ester C=O	C-H bending	Amine C=N str	Amine N-H bond	Amino acid N-H str	C=O str	Aromatic Meta di substituted
1	Ocimum santum	3398.30		2357.38		2926.66				1416.22	1033.76		1646.82		778.31
2	Azadirathta indica	3402.45	1395.52	2359.59	2924.35		1070.55						1647.37		670.53
3	Pongamia pinnata		1385.18	3289.40	2923.79		1260.78	1055.81	1742.40				1637.71		
4	Celastrus paniculata	3350.14	1371.76		2854.31	2925.38		1231.08	1746.29	1461.55	1162.83				718.39
5	Embellia ribes	3438.40	1329.43	3311.49	2923.04	2852.69			1100.08		1197.20	1616.52	2360.56	1459.62	699.35

The more intense band occurring at 3398.30cm-1, 2926.66 cm-1, 2357.38 cm-1, 1646.82 cm-1, 1416.22 cm-1, 1033.76 cm-1 and 778.31 cm-1 corresponding to O-H/N-H/ C-H/C=O stretching, bending, vibrations respectively indicate the presence of alcohol , amines, amides , amino acids ,meta substituted compounds in leaves of Ocimum sanctum (Tulsi).

The intense bands occurring at 3402.45 cm-1, 2924.35 cm-1, 2359.59 cm-1, 1647.37 cm-1, 1395.52 cm-1, 1070.55 cm-1, and 670.53 cm-1 corresponding to O-H / C-O str/ N-H / O-H str/ C-H/ C=O stretching , bending, vibrations respectively indicate the presence of alcohol, phenol, amines, amides , carboxylic group, ester ,ether , amino acids group in leaves of Azadirachta indica (Neem).

The intense bands occurring at 3289.40 cm-1, 2923.79 cm-1 ,1742.40 cm-1,1637.71 cm-1, 1385.18 cm-1, 1260.78 cm-1 and 1055.81 cm-1 corresponding to N-H/ O-H str / C=O/phenol C-O str / stretching, bending, vibrations respectively indicate the presence of amines, amides, carboxylic groups, ester, amino acids ,phenol ,ether groups in the leaves of Pongamia pinnata (Karanj).

The intense bands occurring at 3350.14 cm-1, 2925.38cm-2, 2854.31 cm-1, 1746.29 cm-1, 1461.55 cm-1, 1371.76 cm-1 ,1231.08 cm-1, 1162.83 cm-1 , 718.39 cm-1 corresponding to N-H/ C-H/ C=O/ phenol C-O str/ C=N/ C-H aromatic str/ stretching, bending, vibrations respectively indicate the presence of amines, amides, C-H bond of alkanes, ester, ether, phenol C-O bond,O-H aromatic mono substituted compounds in the seeds of Celastrus paniculatus (Malkangni).

The intense bands occurring at 3438.40 cm-1, 3311.49 cm-1, 2923.04 cm-1, 2852.69 cm-1, 2360.56 cm-1, 1616.52 cm-1, 1459.62 cm-1, 1329.43 cm-1, 1197.20 cm-1 and 699.35 cm-1 corresponding to O -H / N-H / O-H / C-H / N-H /C=O/Phenol O-H / C-Cl / stretching, bending , vibrations respectively indicate the presence of alcohol,amines,carboxylic acid , ester ,C-H bond for alkanes , amino acids etc in the seeds of Embelia ribes (Vaividang).

DISCUSSION

The present study was undertaken with a view to identify the functional groups present in the leaves and seeds of the medicinal plants taken with the help of FTIR analysis. It helps to identify the chemical constituents, elucidate the chemical structure and also effort was taken to understand the significance of functional groups as bio active constituents for the treatment of various diseases. The very strong absorption band observed around 3373-3422 cm-1 may be due to the presence of bonded N-H/C-H/O-H stretching of amines and amides.[12] The very strong absorption band observed in 1600-1660 cm-1 region indicates the presence of amino acids. The strong absorption band observed between 3200-3400 cm-1 indicates the presence of polymeric hydroxyl derivatitives. Vibration of N-H shows the presence of primary amine.[13] The band observed at near 2848 cm-1 represent C-H symmetric stretching of methylene group in aliphatic compounds.[13,14] C=C stretching region falls with the range 1511-1561 cm-1. Similarly the Chelated C=O stretching vibrations lie towards the lower wave number side that is within the range 1621-1635 cm-1.[15]

There is no absorbance in between the region 2220-2260 cm-1 indicates that there are no cyanide groups in all the extracts of the medicinal plants taken. This shows that s amples taken for the study does not contain any toxic substances.[16]

Presence of C=O,C-H,C=C and C-O,C-C and C-O bonding structures were responsible for the presence of alkyl groups, methyl groups , alcohols, ethers, esters, carboxylic acids, anhydrides and deoxyribose .[17,18]. The more intense bands occur at 3419 cm-1,2927,2853,1633,1421,1260,1073,816and 635 cm-1 corresponding to O-H/N-H,C_H,C-O and C-Cl/C-CS stretching / bending vibrations respectively indicate the presence of amino acids , alkenes, nitrates, ethers, organic halogen compounds and carbohydrates in plants.[19]

Carboxylic acid present in the medicinal plant serves as main pharmaceutical product in curing ulcers, jaundice, headache, stomatitis, hemicranias, fever, pain in liver, wound in cattle, treatment of edema and rheumatic joint pains.

Amines, amides and amino acids are the main groups of protein synthesis and herbs serves as herb oil and hair tonic. Sulphur derivative compounds were used

as disinfectants and dermal cream. Polysaccharides, carbohydrates, chlorates and nitrates play the role of the disinfectants.[20]

Protein plays a vital role in the physiology of living organisms. If any alteration takes in the protein turn over, it may have an adverse effect on the important and complex groups of biological materials, comprising the nitrogenous constituents of the body and food intake and thus performing different biological events to maintain homeostasis of the cell (Mitra Baseri, and Baker 2011). Protein content of a cell can be considered a diagnostic tool to determine the physiological phases of a cell. [21]

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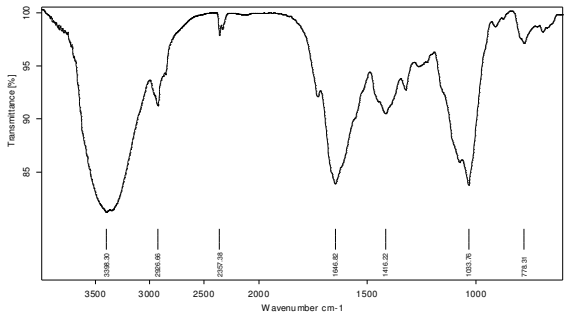

Fig. 1: FTIR Spectra of leaves of Ocimum santum (Tulsi)

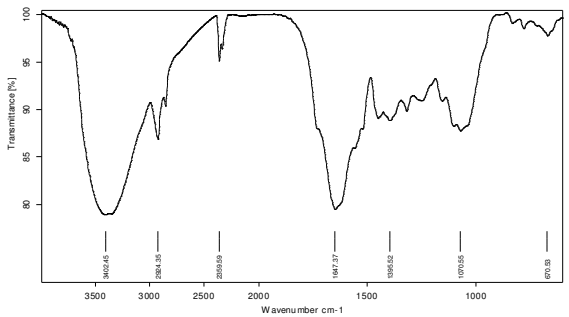

Fig 2: FTIR spectra of leaves of Azadirachta indica (Neem)

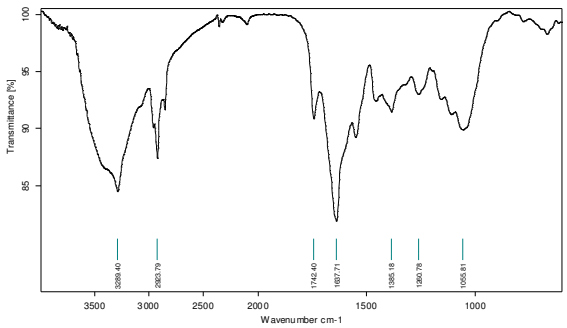

Fig 3: FTIR spectra of leaves of Pongamia pinnata (Karanj)

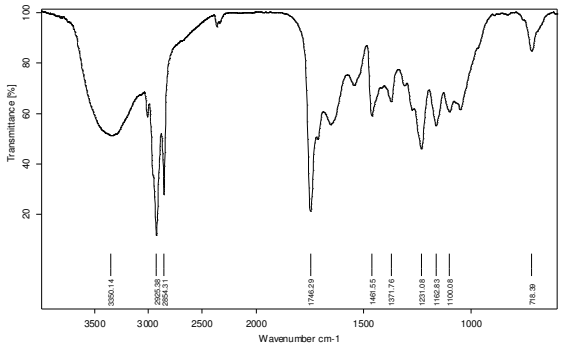

Fig 4: FTIR spectra of seeds of Celastrus paniculatus (Malkangni)

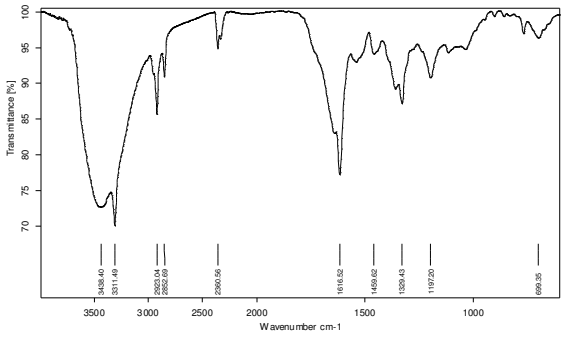

Fig 5: FTIR spectra of seeds of Embelia ribes (Vaividang)

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