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FTIR Fingerprinting of Extracts of *Symplocos racemosa* Roxb. and *Mimusops elengi* L.

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Abstract:
The present study focuses on the FTIR fingerprint evaluation of hydro-alcoholic extract of two medicinal plants *Symplocos racemosa* Roxb. (Lodhra) and *Mimusops elengi* L. (Bakul). Extracts were prepared using bark of *Symplocos racemosa* Roxb. and flowers of *Mimusops elengi* L. by cold extraction using vertical shaking for 16 hrs. *Mimusops elengi* L. extract has shown presence of β-amryin, betulinic acid, lupeol, ursolic acid, basic acid, taraxerol by identification of alcoholic and carbonyl functional groups. Similarly, secondary metabolites like betulinic acid, ellagic acid, symposide, (-) – Epiafzelechin, β-amryin, betulin, oleanic acid were confirmed as functional groups for aromatic and carbonyl compounds were observed.

Keywords: FTIR fingerprint, *Symplocos racemosa* Roxb., *Mimusops elengi* L.

Introduction:

Mimusops elengi L. traditionally known as Bakul is an evergreen tree found in different parts of India, Pakistan, and Bangladesh. It is a rich source of phytochemicals like ursolic acid, betulinic acid, lupeol, and quercetin [1], [2]. All morphological parts of this plant like flowers, bark, leaves, flowers, and seeds are reported to be used in treatment of cardiac, stomachic, dental and hepatic disorders [3],[4].*Symplocos racemosa* Roxb. is an evergreen tree which is commonly called as Lodhra is found in plains and lower hills throughout North and East India. It is reported to be used in the treatment of menorrhagia, other uterine disorders, inflammation, cleaning of uterus, liver and bowel complaints, tumors, asthma, fever, snake-bite and gonorrhea [5], [6], [7].

Composition and levels of bioactive compounds in plants vary with genetic factors, geographical origins, agricultural practices, harvesting and post harvesting processes, extraction processes etc. Safety and therapeutic efficacy of plants is dependent on their phytochemical composition [8]. Chromatography and spectroscopy are effective tools in identification of phytochemical fingerprint which will be helpful in evaluation of qualitative and quantitative composition of phytochemicals in herbal medicines [9].

FTIR is one of the spectrometry techniques which is solvent free green technique requiring minimal sample preparation and provides highly sensitive analysis in short time[10], [11]. It is a non – destructive technique which can provide rapid fingerprint of herbal drugs [12],[13],[14]. FTIR fingerprint of

functional groups is based on the unique wavelength of functional groups that can be used for identification of different groups of phytochemicals present in the medicinal plant powder or extract [15], [16].

Current work focuses on evaluation of FTIR fingerprint of plant materials as one of the analytical techniques that can be used in the quality evaluation of the plant raw materials and to make an estimate of the content of phytochemicals [3], [17].

Materials and methods:

Plant materials:

Fresh flowers of *Mimusops elengi* L. were collected from Alibag region in India and fresh bark of *Symplocos racemosa* Roxb. was collected from Mahabaleshwar in India. Both plant raw materials were authenticated from the Agharkar Research Institute, Pune, India. After collection, plant materials were cleaned and shade dried for 4-5 days till complete dryness. After drying, both plant materials were ground to fine powder and sieved through BSS 85 mesh. The sieved powders were stored in labeled air tight container till analysis.

Preparation of extract:

10 mL of distilled water-alcohol (50:50 V/V) was added to 1.0 g of plant powder and vortexed for 30 seconds. The mixture was kept on vertical shaker for 16 hrs. After 16 hrs, the mixture was filtered through Whatman filter no. 41.The filtrate was collected and was concentrated using low vacuum evaporator (Make: ZYMARK-Turbo Vap-LV Evaporator) at 37°C. The extract was collected and analyzed.

Preparation of samples:

3 mg of each plant extract was weighed and mixed with 70 mg of moisture free KBr. Pellet discs were prepared, mounted on pellet holder and analyzed using FTIR (JASCO - 4100) spectrometer.

FTIR analysis:

The Fourier Transform Infrared spectrum (FTIR) of each extract was recorded in the middle infrared region (MIR) (from wave-number 400 - 4000 $cm^{-1)}$, using a JASCO FT/IR-4100 spectrometer. The spectral data was processed with JASCO SpectraManager II software. Samples were analysed at 100 scans with resolution of 4 cm^{-1} using Cosine apodization in the frequency regions of 4000-400 cm^{-1}.

Results and discussion:

The FTIR spectra (4000-400 cm^{-1}) of hydro-alcoholic extracts of *Symplocos racemosa* Roxb. confirms the presence of phytochemicals like betulinic acid, ellagic acid, symposide, (-) – Epiafzelechin, β-amryin, betulin, oleanic acid as functional groups like carbonyl group (C=O stretching) between 1630-1730 cm^{-1}, aromatic compounds (C=C, C-H) between 1365-1520 cm^{-1} and 700-915 cm^{-1} were identified. Along with these alcohols and esters were identified between 1041-1287 cm^{-1}.

In *Mimusops elengi* L. shows the presence of carbonyl compounds between 1600-1730 cm^{-1}, aromatic compounds between 1365-1520 cm^{-1} and 700-900 cm^{-1} from which we can confirm the presence of β-amryin, betulinic acid, lupeol, ursolic acid, basic acid, taraxerol. It has also shown the presence of alcohols and esters in range of 1015-1290 cm^{-1}.

Figure no. 2.0 shows the FTIR spectra for *Symplocos racemosa* Roxb extract and figure 2.1 shows the FTIR spectra for *Mimusops elengi* L. Table no. 1.0 and table no. 2.0 enlist the wave-number of peaks along with their respective functional groups identified in sample of *Symplocos racemosa* Roxb. and

Mimusops elengi L. respectively. The assignments of stretching and bending of vibrations were compared with data reported earlier [18], [19], [11], [20], [21], [22], and [23]. For both the samples fingerprint region was identified between 700 to 1730 cm^{-1}.

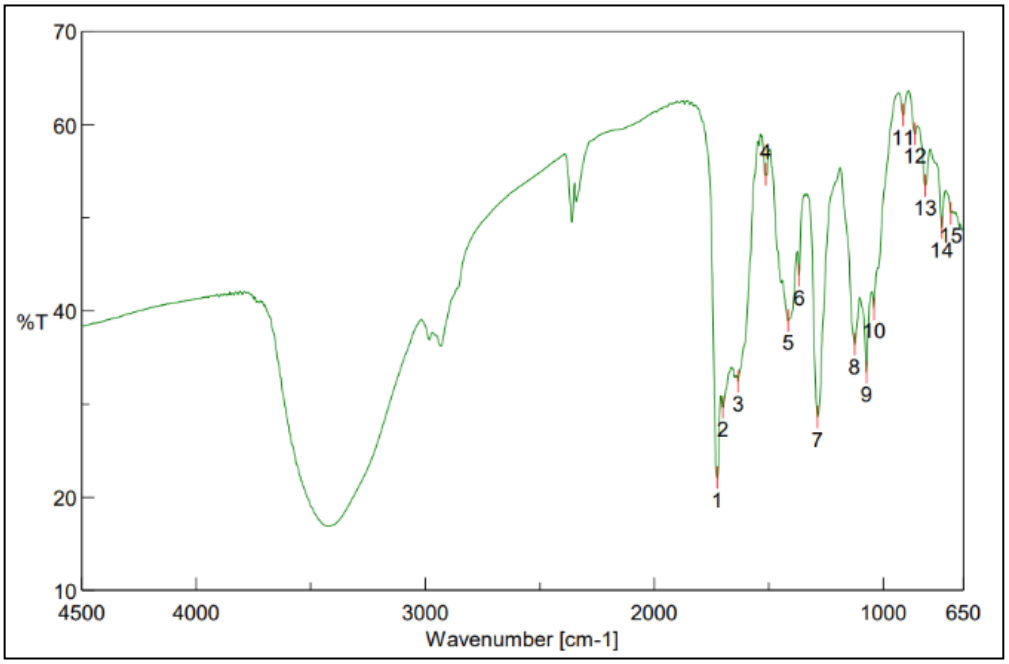

Figure no. 2.0 FTIR spectrum of *Symplocos racemosa* Roxb.

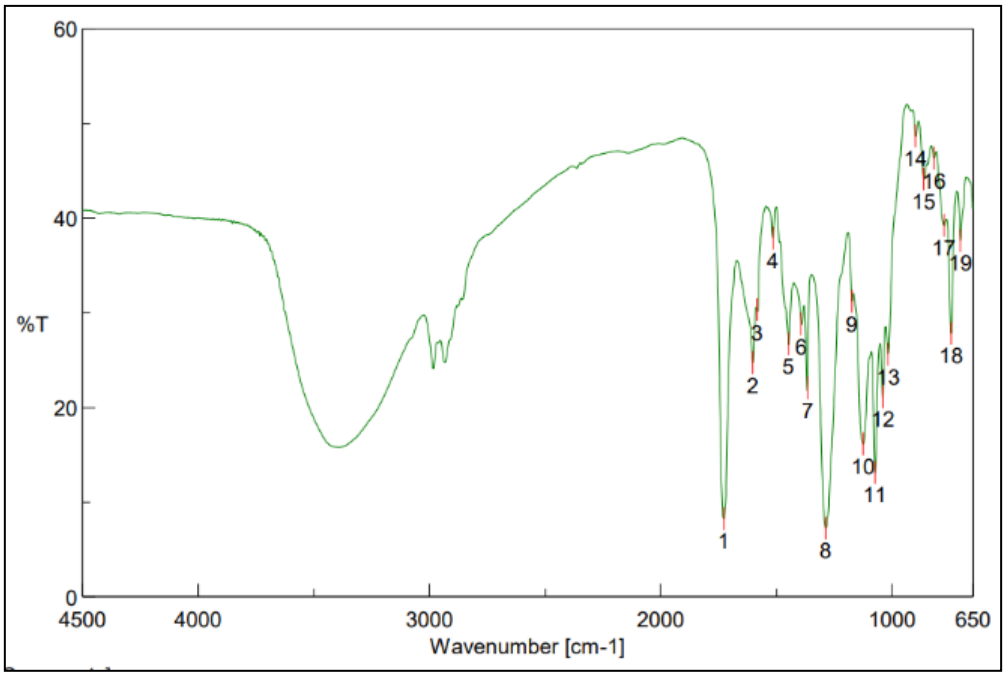

Figure no. 2.1 FTIR spectrum of *Mimusops elengi* L.

Region	Wavenumber (cm^{-1})	Functional groups
1630-1730	1725.98	Conjugated C=C of stretching vibration, C=O stretching vibration of aliphatic aldehydes, COO- antisymmetric stretching
	1699.94	
	1634.38	
1365-1520	1512.88	C–H (CH3 , CH2),C–H (CH3) Bending, C=C (aromatic), S=O (SO2), C-X, N=O (NO2) Stretching, C-O stretching vibrations (amide) and C-C stretching from
	1415.49	
	1367.28	
1040-1290	1287.28	O- H bending vibration, C–O stretching,C–C stretching of carbohydrates, C-O streching saturated secondary alcohol
	1125.26	
	1073.19	
	1041.37	
700-915	913.129	C-H out-of-plane bending vibrations , C-X (halogen), -C-H(aromatic), C-H out-of-plane bending vibrations , HC=CH- (trans/cis) Bending (out of plane)
	862.025	
	816.706	
	744.388	
	704.855	

Table no. 1.0 FTIR interpretation of compounds from of *Symplocos racemosa* Roxb.

Region	Wavenumber (cm^{-1})	Functional groups
1600-1730	1728.87	Conjugated C=C of stretching vibration, C=O stretching vibration of aliphatic aldehydes, COO- antisymmetric
	1602.56	
1365-1520	1516.74	C–H (CH3 , CH2),C–H (CH3) Bending, C=C (aromatic), S=O (SO2), C-X, N=O (NO2) Stretching, C-O stretching vibrations (amide) and C-C stretching from phenyl groups, COO-symmetric stretching, CH2 bending, CH2symmetric
	1446.35	
	1393.32	
	1366.32	
1015-1290	1287.25	O- H bending vibration,-C–O; -CH2 - Stretching; Bending, C-O streching saturated secondary alcohol, C–O stretching, C–C stretching of carbohydrates, C-O streching
	1173.47	
	1127.19	
	1124.3	
	1074.16	
	1016.3	
700-900	900.594	C-H out-of-plane bending vibrations , C-X (halogen), -C-H(aromatic), C-H out-of-plane bending vibrations , HC=CH-(trans/cis) Bending (out of plane)
	863.953	
	817.67	
	776.208	
	744.388	
	704.855	

Table no. 2.0 FTIR interpretation of compounds from *Mimusops elengi* L.

Conclusion:

In the current study revealed presence of phytochemicals like betulinic acid, ellagic acid, symposide, (-) – Epiafzelechin, β-amryin, betulin, oleanic acid from extract of *Symplocos racemosa* Roxb. by identification of functional groups like alcohols, carbonyl compounds, and aromatic compounds. Presence of β-amryin, betulinic acid, lupeol, ursolic acid, basic acid, taraxerol was confirmed from

Mimusops elengi L. extract by identification of functional groups like aldehydes, carbonyl compounds, and aromatic compounds.

FTIR spectrogram obtained during the analysis can be further used as a supporting data along with other parameters in quality evaluation of both plant materials. By comparing such FTIR fingerprints one can also check whether plant raw materials are adulterated with some other similar plant species or not. As FT-IR analysis requires very less amount of samples and no solvents are used, it is one of the easy and simple techniques for evaluation of quality of plant raw materials. Since the FTIR spectrum is reproducible, characteristic peaks can be used to quantify phytochemicals by generating linearity between the intensity of response and the concentration of plant material in the pellet.

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