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Fourier Transform Infra – Red Spectroscopy Analysis of *Boerhavia diffusa*, *Euphorbia hirta* and *Amaranthus polygonoides*

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Abstract: The present study is aimed to analyse the aqueous extract of leaves of three plants such as, *Boerhavia diffusa* , *Euphorbia hirta* and *Amaranthus polygonoides* through FT-IR spectroscopy method. The FTIR spectroscopic studies revealed different characteristics Peak values with various compounds in the extracts. The FTIR analysis of aqueous leaf extracts of *Boerhavia diffusa* , *Euphorbia hirta and Amaranthus polygonides*, confirmed the Presence of Aromatic methane, Cycloalkanes, Alkanes, Aromatic esters, Primary alcohol, Terminal methylene, Vinyl terminal, Isopropyl, Primary amines and secondary amines .This article attempts to reveal the use of Fourier Transform Infrared spectroscopy and at the same time creating the interest among the prospective researches in herbal analysis and the results confirm the fact that this plant posses important bioactive constituents useful to treat various diseases.

Keywords: *Fourier Transform Infrared Spectroscopy, Amaranthus polygonoides, Boerhaavia diffusa and Euphorbia hirta.*

I. INTRODUCTION

Plants are known to contain large spectrum of biochemical substances synthesized by both primary and secondary metabolic processes. Such metabolites often play an important role in plant's defense, signaling, interfere with enzymatic and hormonal activities, and cure diseases etc. Nowadays it is essential to confirm such medicinal plants for their phytochemical profile using different sophisticated techniques and scientific methods. FT-IR spectroscopic analysis is one of such powerful techniques used as an useful tool in phytochemical group investigation by identifying and characterizing chemical bonds present in biological samples including plant parts. Earlier studies on FTIR of some Indian medicinal plants have also proved the importance of this technique.(Ashokkumar R, Ramaswamy M., 2014, Annette N, et al., 2014, Anil Kumar VS, et al.,2016, Charushila D, Swaroopa P. 2016).

Fourier Transform Infrared Spectroscopy (FT-IR) is a high-resolution analytical and time saving technique that allows the analysis of compositional and structural information in medicinal plants (Grube M, et al.,2008).Medicinal plants are rich source of bioactive constituents which is effective for pharmacological activity. The main objective of this study was to identify the various functional groups present in the extracts of samples of medicinal plants taken.

Boerhavia diffusa Linn. (Nyctaginaceae) commonly known as 'Punarnava' is a significant drug of Ayurvedic system of medicine in India (Sivarajan VV, Balachandran I 1994). Punarnava (Hogweed) literally means 'bring back to life' or 'renewer'. It is a creeper that grows wild in India and Brazil throughout year but dries during the summer. It bears small fleshy leaves, small reddish pink flowers and fruits in winter. It is bitter in taste and has cooling effect. It has very high medicinal value. Similar to its name it rejuvenates the whole body i.e. with routine use of Punarnava a fellow become young again – full of vigor and vitality. It occurs abundantly as a weed throughout India. In India, the plant is used as a medicine with multiple actions such as stomachic, antileprosy, diuretic, antiasthmatic, diaphoretic, anthelmintics, febrifuge, antiscabies and antiurethritis.(Handa SS et al.,1998, Nadkarni AK. Dr. KM Nadkarni's, 1976). Traditionally, the plant has been evaluated for its hepatoprotective, anti-diabetic, diuretic, anti-inflammatory, antibacterial, antiviral and cancer chemopreventive properties (Rawat *et al*., 2008; Pari *et al*., 2008).

Euphorbia hirta Linn. of the family Euphorbiaceae is a medicinal, rhizomatous herb distributed in South Western Ghats of India and North East Coast of Tamil Nadu(Abdul Rahuman A,. et al., 2007).The plant is native to India but is a pan tropical weed. A small, erect or ascending annual herb reaching up to 50 cm, with hairy stem. The leaves are opposite, elliptical, oblong or oblong-lanceolate, with a faintly toothed margin and darker on the upper surface. The flowers are small, numerous and crowded together in dense cymes of about 1 cm in diameter. The fruits are yellow, three-celled, hairy, keeled capsules, 1-2 mm in diameter, containing three brown, four-sided, angular, wrinkled seeds(Chika C, Ogueke et al.2007).Leaves, stem and flowers are used for treating respiratory ailments especially cough, coryza, bronchitis and asthma. Worm infestations, dysentery, gonorrhoea, jaundice, pimples and digestive problems are also treated with Euphorbia hirta[Kirtikar KR and Basu BD 1991].

Amaranthus polygonoides of the family Amaranthaceae is a annual herbs, stem 20-50 cm tall, glabrous. Leaves alternate; petiolate; lamina ovate-rhombic, 2-5 × 1-2.5 cm, base cuneate, glabrous. Flowers few, sparsely clustered at axils and in terminus. Bracts and bracteoles subulate, 2 mm, abaxially with a distinct midvein, apex long pointed. Tepals 5, lanceolate, long pointed. Stamens shorter than perianth. Stigmas 3. Utricles ovoid subequal to perianth, circumscissile. Seeds brownish black, subglobos.

II. MATERIALS AND METHODS:

PREPARATION OF PLANT EXTRACT

Crude sample extract was prepared by Sox let extraction method. About 20gm of powdered material was uniformly packed into a thimble and extracted with 250ml of aqueous

separately. The process of extraction has to be continued for 24 hours or till the solvent in siphon tube of extractor become colorless. After that the extract was taken in a beaker and kept on hot plate and heated at 30-40ºC till all the solvent got evaporated. Dried extract was kept in refrigerator at 4ºC till future use.

FT-IR Spectroscopic Analysis

Fourier Transform Infrared Spectrophotometer (FTIR) is perhaps the most powerful tool for identifying the types of chemical bonds/functional groups present in the phytochemicals. The wavelength of light absorbed is the salient feature of the chemical bonds seen in the annotated spectrum. By interpreting the infrared absorption spectrum, the chemical bonds in a compound can be determined. Dried powder of aqueous extracts of, *B.difussa* , *E.hirta and A.polygonoides* was used for FTIR analysis. 10mg of the dried extract powder was encapsulated in 100mg of KBr pellet, in order to prepare translucent sample discs. The powdered sample of each extract was loaded in FTIR spectroscope (Shimadzu, Japan), with a Scan range from 400 to 4000 cm^1 with a resolution of 4 cm^{-1}.

III. RESULTS AND DISCUSSIONS

FTIR spectrum was used to identify the functional group of the active components based on the peak value in the region of infrared radiation. The results of FTIR peak value and functional groups were represented in table 1to 3 and the FTIR spectrum profile was illustrated in the figure 1 to 3. FTIR spectrum confirmed the presence of alcohol alkanes aromatic methane terminal methylene in the leaves of the medicinal plants taken.

The FTIR spectrum of *Boerhaavia diffusa* aqueous extract, *Euphorbia hirta*, and *Amaranthus polygonoides* is presented in Table and Figure. The data present in the aqueous extracts of *Boerhaavia diffusa*, *Euphorbia hirta* and *Amaranthus polygonoides* on the peak values and the probable functional groups (obtained by FTIR analysis) are shown in Table. The IR radiation region helps to identify the functional groups of the active ingredients found in the extract based on the FTIR spectrum peak values. After passing the extract into the FTIR, the functional groups of the components were divided based on the ratio of their height. FT-IR spectroscopy provides powerful approach for the structural and functional alterations induced by various factors due to its high sensitivity (Gorgulu ST, et al.,2007). It can be used to confirm the presence of functional constituents and to evaluate the qualities of medicinal materials (Komal Kumar J, Devi Prasad AG. 2011).

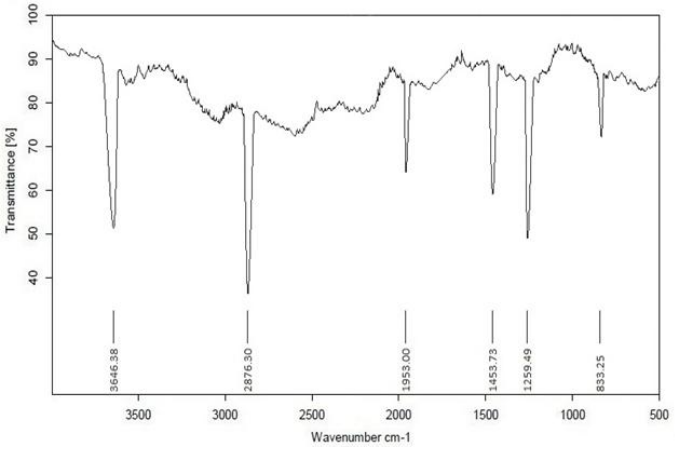

Figure 1: FTIR analysis for *Boerhavia diffusa*

Table: 1 FTIR analysis for *Boerhavia diffusa*

S.No	Absorption frequency (cm^{-1})	Type & Intensity
1	3646.38	Primary alcohol (variable)
2	2876.3	Alkanes (medium)
3	1953	Aromatic methane (weak)
4	1453.73	Alkanes (medium)
5	1259.49	Primary amines (Strong)
6	833.25	Terminal methylene (Strong)

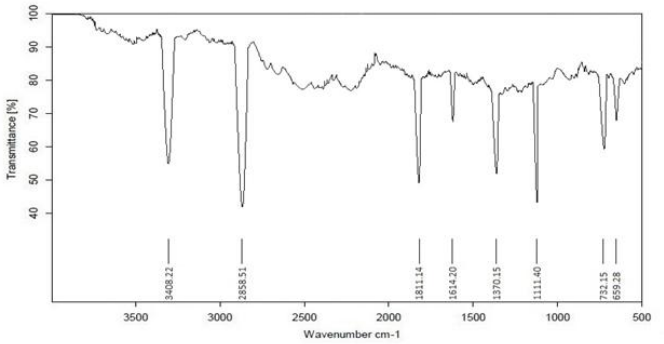

Figure: 2 FTIR analysis for *Euphorbia hirta*

Table: 2 FTIR analysis for *Euphorbia hirta*

S.No	Absorption frequency (cm^{-1})	Type & Intensity
1	3408.22	Primary amines (weak to medium)
2	2858.51	Alkanes (medium)
3	1811.14	Vinyl terminal (Medium)
4	1614.2	Primary amines (medium to strong)
5	1370.15	Isopropyl (Strong)
6	1111.4	Secondary amines (weak to medium)
7	732.15	Alkanes (Strong)
8	659.28	Primary amines (medium)

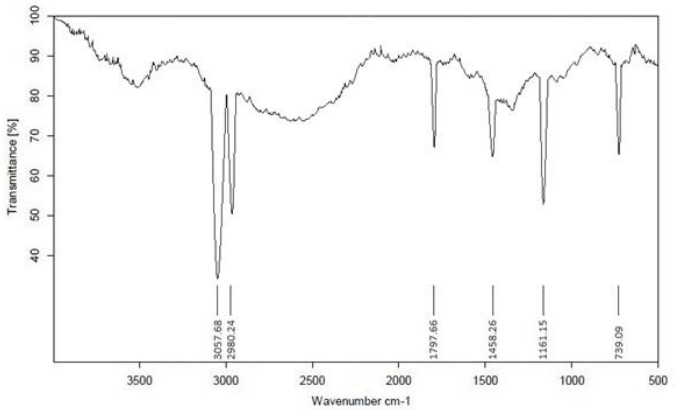

Figure: 3 FTIR analysis for *Amaranthus polygonoides*

Table: 3 FTIR analysis for *Amaranthus polygonoides*

S.No	Absorption frequency (cm^{-1})	Type & Intensity
1	3057.68	Aromatic methane (medium)
2	2980.24	Cycloalkanes (Medium)
3	1797.66	Aromatic methane (weak)
4	1458.26	Alkanes (medium)
5	1161.15	Aromatic esters (very strong)
6	739.09	Ortho disubstituted (very strong)

The results of the FTIR analysis confirmed that in *Boerhavia diffusa* 3646.38, 2876.30, 1953.00, 1453.73, 1259.49 and 833.25 were observed for the absorbance band analyses in the region between 500–3500 cm-1. Whereas *hirta* 3408.22, 2858.51, 1811.14, 1614.20, 1370.15, 1111.40, 732.15 and 659.28 is in *Euphorbia*. Polygonoides peaks in Amaranthus are 3057.68, 2980.24, 1797.66, 1458.26, 1161.15 and 739.09. Muruganantham *et al*. 2009 studied the FTIR spectral analysis of medicinal plants such as *Eclipta albaand Eclipta prostrate* and reported that the very high absorption band for whole plant parts in the area 2933–2922 cm–1 was due to N – H stretching and also reported the presence of functional groups such as carboxylic acids, amines, polysaccharides, nitrates and carbohydrates. 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 usedas disinfectants and dermal cream. Polysaccharides, carbohydrates, chlorates and nitrates play the role of the disinfectants (Muruganantham S, et al ., 2009). The Spectrum revealed the presence of functional constituents which may a member of secondary metabolites that exhibit various medicinal properties (Skoog A, et al 1994]

From the results obtained in the present study it could be concluded that the leaf extracts of *Boerhavia diffusa* , *Euphorbia hirta Amaranthus* and *polygonoides* with their various functional groups observed it the aqueous extracts probably indicates the presence of carbohydrates, amino acids, amides and glycogen cellulose.

CONCLUSION

The results of the present study confirmed that aqueous extract of *Boerhavia diffusa*, *Euphorbia hirta* and *Amaranthus polygonoides* proved to be a wealthy resource of phytoconstituents that can be utilized for various pharmaceutical purposes to evaluate the quality and accuracy of formulating curative potential.

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