Fourier Transform Infrared Spectroscopic Analysis of Medicinal Plant (Bhringaraj) from the Duvva Village West Godavari District, Andhra Pradesh, India.

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Abstract- **The main objective of the study is to determine the important features exhibited by FTIR. Dried leaves of Bhringaraj, a medicinal plant used in Ayurveda were selected for study. The vibrational assignments, intensities and wave numbers were obtained by absorption spectra. Various functional groups and chemical constituents were identified. This article gives an insight about the importance of herbal analysis and gives a platform for using these medicinal plants for developing wastewater treatment technology and for improving the quality of drinking water.**

Index terms- **Fourier Transform Infrared Spectroscopic (FTIR), Bhringaraj, water treatment technology.**

I. INTRODUCTION

Medicinal plants are a group of plants that can be used as a drug or therapeutic agent or active ingredient of a medical preparation. Plants form a basis of traditional medicine practices that have originated from historic times. Plants are used as drugs and they are found in arthava veda which is the basis of Ayurvedic medicine (dating back to 2000BCE) the clay tablets in Mesopotamia (1700BCE) and Eber Paprus in Egypt (1550BCE). The demand for plant-based medicines is increasing because they do not have adverse effects, and they are rich source of bioactive ingredients, which show Pharmacological activities. In the present study, FTIR is used to identify the different functional groups present in the leaf powder of Bhringaraj. FTIR has become a versatile tool for identification, characterization and detection of biomolecules [1, 2]. High sensitivity of vibrational spectra helps in identifying biological molecules such as water, proteins, nucleic acid, carbohydrates etc [3]. FTIR peaks are relatively narrow and in many cases can be associated with a vibration of a particular chemical bond (or a single functional group).

II. EXPERIMENTAL METHOD & MATERIALS

Selection of Bhringaraj leaves

The leaves of medicinal plant Bhringaraj were selected for the FTIR analysis were collected from the agriculture lands of Duvva Village, West Godavari District, Andhra Pradesh. The leaves were taxonomically authenticated.

Bhringraj in Ayurveda practitioners is commonly known as false daisy and it belongs to the family of Asteraceae, Botanical Name - Eclipta Alba. It is an erect, prostrate, branched roughly hairy herb grows commonly in moist places all over the world, as a weed. Phytochemical studies on Eclipta revealed the presence of Alkaloids like ecliptine and nicotine and bioactive steroidal alkaloids verazine dehydro verazine eclipatalbine [7]. Dried leaves have been reported to contain coumarins like wedelolactone and its derivatives [8], demethylwedelolactone, iso-demethylwedelolactone and strycholactone [9], many hydrocarbons like ecliptal [10] d-formyl terthienyl [11]. Six new Oleanane triterpene, Glycosides, Eclalbasaponins I-IV are reported [12]. Many types of sterols and flavonoids are present in the bhringraj [13].

FTIR is used for identification of biomolecules [4-6, 24] the chemical constituent's in bhringaraj are known for its anticancer, antileprotic, analgesic, antioxidant, antiviral, antihaemorrhagic, antibacterial, antimyotoxic, antihepatotoxic, spasmogenic, hypotensive and ovicidal properties.

Bhringaraj is used extensively by Ayurvedic practitioners, for treatment of Snakebites [14, 15], Scorpion stings [16]. It has anti-inflammatory [17] Bronchodilator activity [18,19] Nootropic activity [20] and it is used to treat Ranikhet disease [21], Salmonella epidermidis and salmonella typhimurium infections [22], used for hair growth [23, 24] treating skin diseases and eye infections. Due to its anti-inflammatory properties, anti oxidant activity, anti cancer activity [25] and anti hyper lipidemic activity [26] the herb is also used for treating hyperacidity. Bhringaraj is the main herb for the hair care and cirrhosis in Ayurveda. It is believed to maintain and rejuvenate hair, teeth, bones, memory, sight, hearing, kidneys and liver.

Healthy plants and fresh leaves were collected. These leaves were air dried and shade dried at room temperature in clean environment to avoid contamination and powdered in a domestic grinder. The powdered sample is stored in air tight glass bottle at room temperature for further analysis.

III. INSTRUMENTAION

Spectro-Chemical Analysis

The compact light weight Agilent Cary 630 FTIR connected to a sophisticated computer was used to record FTIR spectra of bhringaraj leaves in the spectral range of 4000-400cm^{-1}at room temperature.

IV. RESULTS AND DISCUSSION

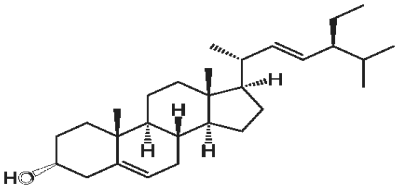
FTIR spectrum of Bhringaraj was used to identify the functional groups of active components based on the peak value in the region 4000-400cm^{-1} of infrared radiation. FTIR spectra of leaves of Bhringaraj were represented in Fig.1

This study has been undertaken with a view of identifying the functional groups present in the Bhringaraj leaves and to understand the significance of bioactive constituents present in it. The FTIR represented in Fig.1 is of complex nature and it indicates the various chemical constituents and chemical structures in the biomolecules given in Table -1, Scheme-1. The FTIR spectra show many absorption bands, the presence of hydroxyl groups in the biomolecule absorbed at 3852.93 cm^{-1}, 3447.12 cm^{-1} and 3107.03 cm^{-1}. The peak at 3852.93cm^{-1} represents OH stretching of hydroxyl groups in phenols [22]. The peak at 3447.10cm^{-1} is due to OH stretching. The absorption peaks at 2918cm^{-1} and 2850cm^{-1} represents asymmetric stretching of CH_2 groups and symmetric stretching of CH_3 groups indicating the presence of chlorophyll in biomolecule [24-29]. The peak at 2202cm^{-1} may be due chain containing carbon double bonded with nitrogen which is termed as nitrile group [30&31]. The band at 2096cm^{-1} represents azide group [31]. IR spectral peaks at 1445cm^{-1} and 1316.650cm^{-1} exhibits a high molecular coupling and this region is very complex [26] involving several modes of vibration of lignin and carbohydrates. A band around 1450cm^{-1} is reported to be deformation of lignin CH_2 and CH_3 which was reported previously. The absorption bands at 1100-1000cm^{-1} is the finger print region indicating several modes such as C-H deformations or C-O or C-C stretching pertaining to carbohydrates. Carbohydrates in the leaves are the major constituents of these absorption bands [32-35].

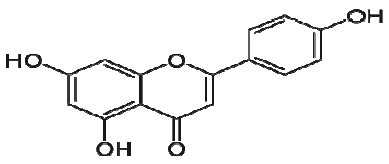
CONCLUSIONS

Water plays a vital role in the development and public health of population in every part of the world. The methodology for the purification of water remains expensive in developing countries. Many water treatment processes use alum and chlorine where Alum causes alizimers disease and pathogenic microbes are resistant to chlorine.

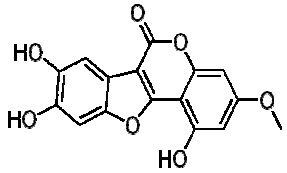
This study has been of preliminary nature with the objective of establishing the use of medicinal plants for water and waste water treatment. To improvise the water quality and to control the water pollution the medicinal plant bhringaraj can be used which contains many chemical components which are confirmed by FTIR in this paper. This bhringaraj medicinal plant has capacity to remove the suspended particles, heavy metals and fluoride from water and waste water by coagulation and adsorption thus increase the quality of water. The sludge which is produce during the treatment is less toxic. Further work and application of bhringaraj and other medicinal plants are in progress.



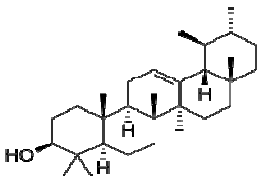
Stigmasterol



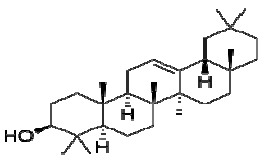
Apigenin



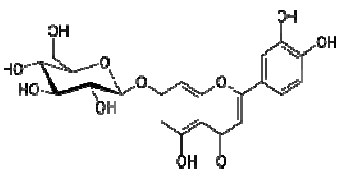
Wedelolactone



α –amyrin



β-amyrin



Luteolin 7-O-glucoside

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Scheme - 1 Structures of Chemical Componetnts Present in Bhringaraj Medical Plant

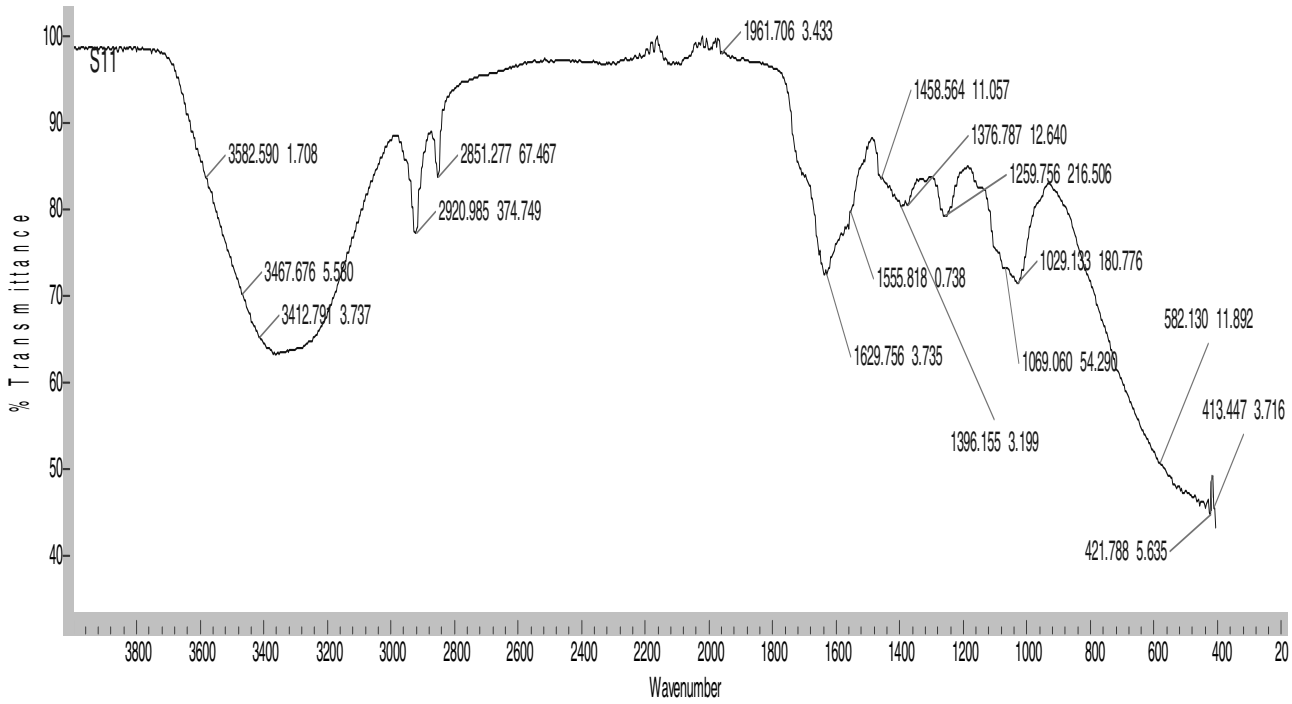

Figure 1. FTIR of Bhringaraj medicinal plant

TABLE -I
CHEMICAL COMPOSITION OF BHRINGARAJ PLANT LEAVES (ECLIPTA ALBA)

S.No	***Chemical constituents***	***Pharmacological acticity***	***Formula***	***Molecular weight (g/mol)***	***Iupac name***	***Other names***
1	Wedelolactone	Anti-hepatotoxic, Antibacterial, Trypsin inhibitor, Antivenom	$C_{16}H_{10}O_7$	314.24	1,8,9-trihydroxy-3-methoxy-6H-[1]benzofuro[3,2-c]chromen-6-one	
2	Demethyl wedelolactone	Antihepatotoxic, Antihaemorrhage, Antivenom, Dye (cosmetic)				
3	Apigenin	Anti-cancer, compound, Anti-inflammatory, flavonoids, Dye	$C_{15}H_{10}O_5$	270.24	5,7-Dihydroxy-2-(4-hydroxyphenyl)-4*H*-1-benzopyran-4-one	4',5,7-Trihydroxyflavone Apigenine, Chamomile, Apigenol,Spigenin,Versulin,
4	Leutolin7-O-gluoside	Antioxidant activity, Antimicrobial	$C_{21}H_{20}O_{11}$	448.37	2-(3,4-dihydroxyphenyl)-5-hydroxy-7 [(2*S*,3*R*,4*S*,5*S*,6*R*)-3,4,5-trihydroxy-6-(hydroxymethyl)oxan-2-yl]oxychromen-4-one	Glucoluteolin, Luteoloside, Cinaroside 7-Glucoluteolin 7-Glucosylluteolin Luteolin-7-glucoside Luteolin-7-O-glucoside
5	Stigmasterol	Antioxidant, Hypoglycemic	$C_{29}H_{48}O$	412.6908	(3*S*,8*S*,9*S*,10*R*,13*R*,14*S*,17*R*)-17-[(*E*,2*R*,5*S*)-5-ethyl-6-methylhept-3-en-2-yl]-10,13-dimethyl-2,3,4,7,8,9,11,12,14,15,16,17-dodecahydro-1*H*-cyclopenta[*a*]phenanthren-3-ol	Stigmasterin

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