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Functional Group Analysis of *Andrographis paniculata* by FT IR Spectrum

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Abstract: The functional group analysis of various extracts (Hexane, Toluene, Tetrahydrofuran, Aqueous and Methanol) of potential indigenous medicinal plant *Andrographis paniculata* was recorded. The vibrational assignments, intensities and wave number (cm^{-1}) of dominant peak were obtained from absorption spectra. By this analysis, functional groups such as aminoacids, amides, amines, carboxylic acid, carbonyl compounds, organic hydrocarbons, halogens are present in all the 3 extracts. The present results showed that the crude extracts of this plant having high therapeutic value. In future it is used to treat against various diseases.

Key words: Functional groups, chemical compounds, medicinal plant, secondary metabolites, organic hydrocarbons, crude extracts

INTRODUCTION

Medicinal plants are the potential resource of drugs for ancient systems of medicine, therefore, man has been using crude plant extracts to protect himself against various diseases and also to improve his life-style. There are variety of secondary metabolites present in medicinal plants such as phenolic compounds, alkaloid, tannins, saponins, terpenoids, carboxylic acids, amino acids and inorganic acids. These secondary metabolites have wide array of medicinal properties (Parekh). Therefore, the analysis of these secondary metabolites would help in determining various biological activities of plants. A variety of techniques can be used to determine and estimate the presences of such phytocontituents in medicinal plants. Chromatography and spectroscopic techniques are the most useful and popular tools to detect these chemical compounds. FT-IR (Fourier Transform Infrared) spectral analysis of revealed the presence of various functional groups and chemical structures present in the bioactive constituents of medicinal plants (Maobe and Nyarango, 2013). The FT-IR analysis help to identify the alcohol, phenol, alkanes, alkyl halides, amino acids, carboxylic acid, aromatic, amines present in the medicinal plant extracts (Jagmohan, 2018). Moreover, FTIR spectroscopy is an established time saving method to characterize and identified functional groups (Grube).

MATERIALS AND METHODS

Collection of plant materials: The fresh leaves of *A. paniculata* were collected from the local areas. The collected plant material was authenticated by Dr. V. Nandagopalan, Associate Professor, PG and Research Department of Botany, National College, Tiruchirappalli, Tamilnadu. The voucher specimen has been deposited at the Department of Microbiology, Kamaraj College, Tuticorin, Tamil Nadu. The collected samples were air dried for 7 days at room temperature (25°C). The dried samples were ground into fine powder and kept away from heat, moisture and sunlight.

Preparation of extracts: About 500 g dry powder of *A. paniculata* was sequentially extracted with hexane, toluene, tetrahydrofuran, methanol and water using the Soxhlet apparatus on the water bath for 12 h each. Each of the mixtures was carefully filtered using filter paper (Whatmann No. 1) and concentrated using a rotary evaporator. The extracts were stored in sterile bottles at -18°C kept as aliquots until further evaluation.

Ultra Violet-Visible spectral analysis (UV-Vis): The electronic absorption spectra of the plant extracts were recorded in range of 200-800 nm in suitable solvent on a Systronics 2201 double beam UV-Vis., spectrophotometer. Absorbance values were plotted against the wave number. The electronic spectral measurements were used

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for assigning the stereochemistry of ions in the complexes based on the number transition peaks (Saxena and Saxena, 2012).

Fourier Transform Infra Red spectroscopy analysis (FT IR): FT IR spectra of the plant extracts were recorded on Bruker Alpha T, Germany FT-IR 783 spectrophotometer in the range of 4000-550 cm^{-1} range using KBr disc (KBr pellet technique). The percentage transmission was recorded against wave number (Kabra *et al*., 2013). The peak values of the UV-VIS and FT IR were recorded.

RESULTS AND DISCUSSION

Spectroscopic techniques have powerful analytical tools for the analysis of pharmaceuticals and biological activities. The FT-IR spectrum was used to identify the functional groups of the active compounds based on the peak value in the region of infrared radiation. The different crude extracts of *A. paniculata* were analyzed by the FT IR spectrometers and the functional groups f the compounds were separated based on its peak ratio.

The UV visible profile of the different extracts of *Andrographis paniculata* was elucidated at the wavelength of 200- 800 nm (Chanda *et al.,* 2013) (Fig. 1). The different extracts of *A. paniculata*, showed the major bands at 290-300, 420-440 and 640 nm with the absorbance value of 2.35, 2.279, 2.406, 2.349 and 3.378, respectively. This showed the presence of phenols, flavonoids, carotenoids and chlorophylls. In another study reported that the UV-Visible spectra of 6 medicinal plants identified the maxima wavelengths specific for phenolics at 280-330 nm, carotenoids at 420-470 nm and chlorophylls at 663 nm (Zavoi *et al*., 2011).

In the present study, hexane extract of *A. paniculata* bands occurring at 2967, 2866, 1661, 1377 and 1034 cm^{-1} corresponding to C-H and C-O stretching indicated the presence of alkanes and ether group of compounds (Fig. 2). The toluene extract of *A. paniculata,* the bands occurring at 3026, 1603, 1494 and 1460 cm^{-1} corresponding to N-O and C-O stretching indicated the presence of amines, carboxylic group and ether group of compounds (Fig. 3). In an earlier study it was reported that the toluene extract of *Semecarpus anacardium* showed the bands at 3649, 2918, 1726, 1315, 1188 and 970 cm^{-1} corresponding to O-H, C-H, C-O, NO_2 and C-H stretching indicated the presence of

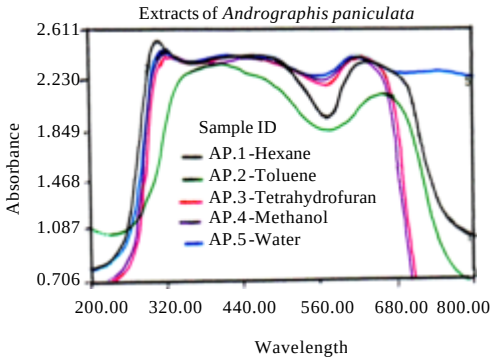

Fig. 1: UV spectrum of extracts of *A. paniculata*

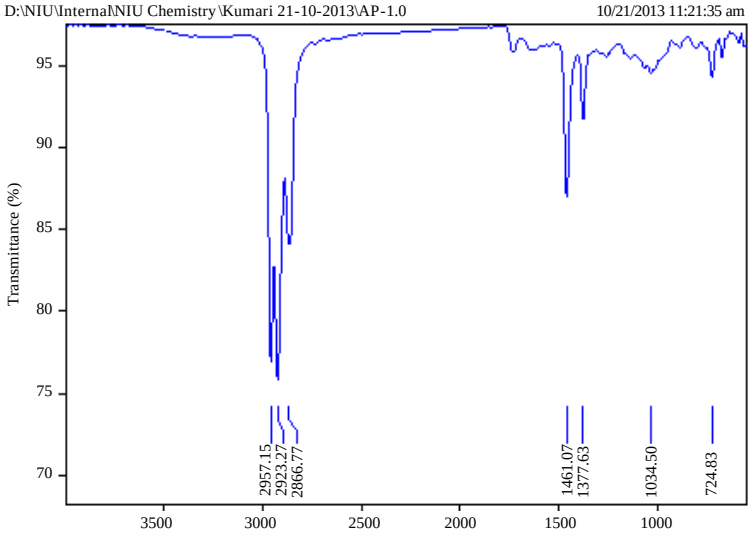

Fig. 2: FT IR spectrum of hexane extract of *Andrographis paniculata*

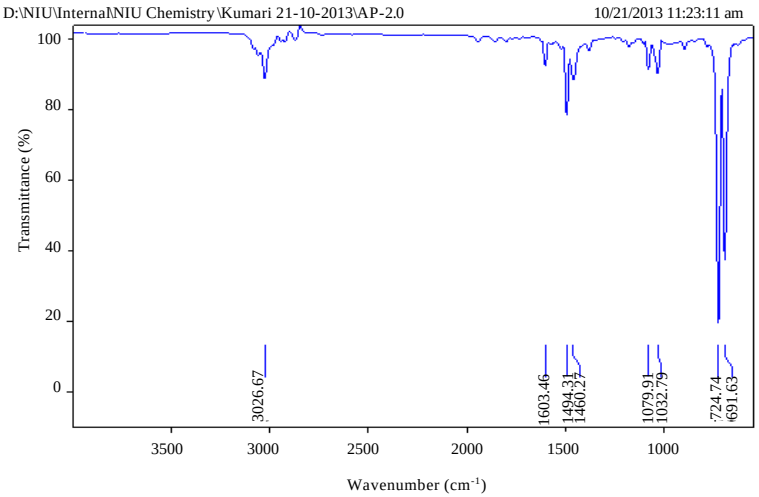

Fig. 3: FT IR spectrum of toluene extract of *Andrographis paniculata*

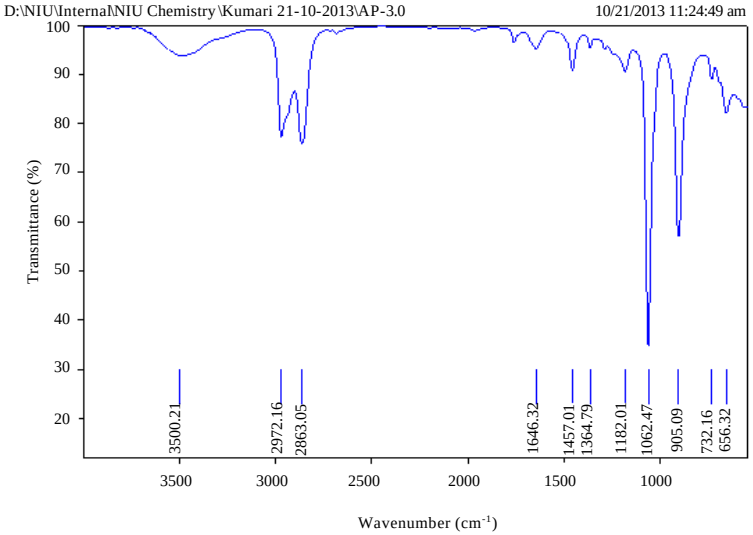

Fig. 4: FT IR spectrum of tetrahydrofuran extract of *Andrographis paniculata*

carboxylic acids, alkanes, aldehydes, nitro compound, secondary amines and alkene compounds (Pednekar and Raman, 2013).

In the present study, tetrahydrofuran extract of *A. paniculata* showed the bauds at 3500, 3972, 2863, 1646, 1457 and 1364 cm^{-1} corresponding to OH, C-H, C = O and C–O stretching indicated the presence of alcohol, alkanes, aldehyde and ether group of compounds (Fig. 4). The methanol extracts showed the bands at 3436, 2997, 2914, 1659 and 1434 cm^{-1} corresponding to O-H, H-O, CH/COOH, C = O and C-O stretching indicated the presence of hydroxyl, amines, alkanes, ketone and ether group of compounds (Fig. 5).

The aqueous extracts showed 3409, 2928, 2147, 1704 and 1361 cm^{-1} corresponding to O-H, H-O, C = O and C-O stretching indicated the presence of hydroxyl, amines, ketone and ether group of compounds (Fig. 6). In an earlier report it was found that the methanol extract of Agar woods leaves showed the bands at 3384, 2923, 2851, 1708, 1618 and 1468 cm^{-1} corresponding to O-H, C-H, C = O, C = C and C-C stretching indicated the presence of alcohol, methylene, carboxylic acid and aromatic compounds (Khalil *et al*., 2013). More functional groups were recorded in the methanolic extract of the *A. paniculata*. The presence of characteristic functional groups carboxylic acids, amines, amides, sulphur derivatives, polysaccharides, organic hydrocarbons, halogens are responsible for various medicinal properties of *Andrographis paniculata* (Table 1).

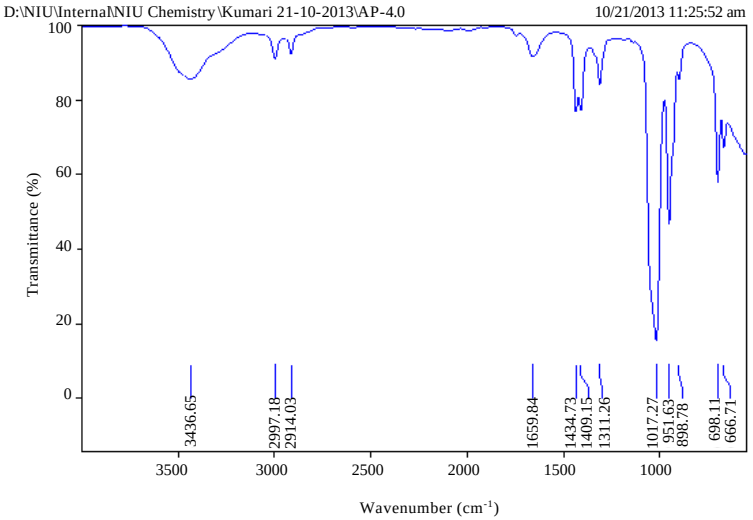

Fig. 5: FT IR spectrum of methanol extract of *Andrographis paniculata*

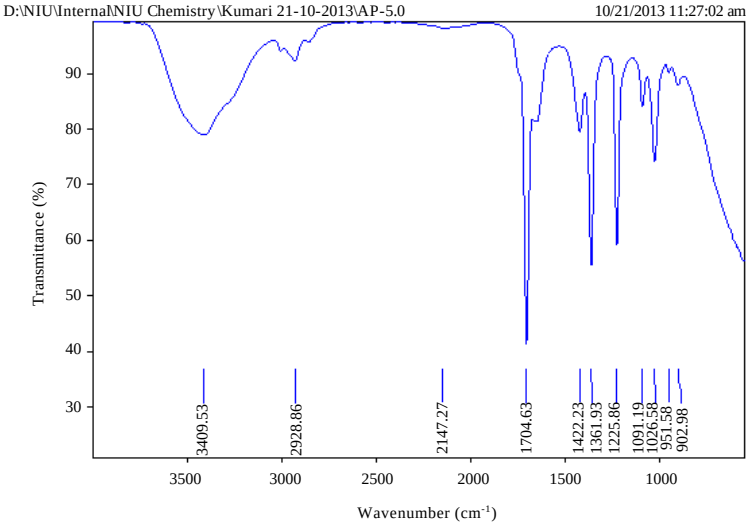

Fig. 6: FT IR spectrum of aqueous extract of *Andrographis paniculata*

Table 1: Various medicinla properties

Wave number (cm^{-1})	Bond	Functional groups
3409	O-H	Hydrogen bonded alcohols, phenols
2928	H-O	
2147	C = O	Aldehydes, ketones, carboxylic acids, esters
1704	C-O	Alcohols, ethers, carboxylic acids, esters
1361	C-O	Alcohols, ethers, carboxylic acids, esters

CONCLUSION

The present studies, the functional groups present in the phytochemical constituents of the selected medicinal plant were elucidated using FT IR analysis and also, using for the treatment of various ailments.

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