FTIR AND ^{1}H-NMR ANALYSIS OF *CAYRATIA PEDATA* (Lam.)

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Abstract

Cayratia pedata (Lam.) Gagnep belonging to the family vitaceae, is a woody climber found widely in Asia. This plant is having many medicinal properties. To elucidate the leaf compounds in detail for the first time advanced analytical techniques FTIR and ^{1}H-NMR are being used in this plant.The present study reveals five different functional groups namely Aromatic amines, Ethers, Alcohols, ketones and Alkenes present in the leaf of *Cayratia pedata* through Fourier Transform Infrared (FTIR) spectroscopy. It also reports the number and the electronic state of protons through Proton Nuclear Magnetic Resonance(^{1}H-NMR) taken from acetone extract of the leaf. It gives the atomic information of the molecules like primary, secondary and teritiary Alkyl compounds, benzyl compounds, Esters and Flourides. The phytochemical compounds of *Cayratia pedata* found from these analytical techniques have the therapeutic importance.

Keywords: *Cayratia pedata*, FTIR, Functional groups, ^{1}H-NMR, phytochemical

I. INTRODUCTION

As we all know, the chemical and synthetic drugs show a lot of side effects when used for the ailments. That's the reason why present generation is focussed on natural compounds which have no side effects and the cure for ailments is also permanent. Hence a wide variety of natural compounds are considered for the usage as drugs. This system and the process is not new today as already our ancestors followed the same from the ancient times. Hence the popularity and demand for the natural remedies has grown up in the form of Ayurveda, Homeopathy, Naturopathy etc. These natural compounds are nothing but the phytochemicals present in the medicinal plants. They are derived by different extracting techniques and are used as drugs for treating different diseases.

Here, *Cayratia pedata* a climber locally known as 'kattuppirandai' in tamil and 'Edakula madula mari' in telugu is a well known medicinal plant being used by tribal people as an antibacterial, antifungal (Nayak B Lazar J,2014) antiulcer (Shatha sheelaV *et al* 2016), anti-inflammatory(Wadhawa G C *et al* ,2017) antioxidant (Kalaichelvi k *et al* 2018), anti-diarrheal(P.Karthik *et al*,2011)etc,. As it is having all these properties this plant attracted the researchers. The leaves of *Cayratia pedata* are used as immunity booster (S.Sharmila *et al* ,2014) in hill areas . It is reported as a folklore medicine. Qualitative phytochemical screening of leaves is already done. It showed the presence of carbohydrates , proteins, amino acids, alkaloids, phenols, flavonoids, seponins, tannins and sterols(Sharmila S *et al*, 2018). Qualitative screening is done by TLC(Rajmohan T *et al*, 2014) also and quantitative screening is done by HPTLC(Rajmohan T *et al* ,2014) and GC-MS(Aswathy T R *et al* ,2019) analysis. For the first time now the quantitative and qualitative phytochemical screening is done through advanced analytical techniques called FTIR(Fourier Transform Infrared) spectroscopy and proton NMR (Nuclear Magnetic Resonance).

FTIR gives detailed information about all the functional groups present in leaf material as it is one of the advanced technologies to analyse a compound. While proton NMR as it is highly sophisticated instrument ,it provides information about different proton peaks in the spectra through which we can deduce the different molecular structures present in the leaf compound. Here acetone extract is used for the spectra as acetone extract is highly polar and is capable of increasing the solubility of the leaf powder through soxhalet extraction (Laurence Harwood M *et al* ,2017)which is widely used in the research purpose as it is one of the best extraction methods. Based on the list of types of functional groups we can assess the importance of each group and its action as a potent drug for different ailments. Proton peaks in the spectra according to the chemical shifts gives the information of atomic structures and the molecules that are present through which we can analyse the structure and property of each molecule and can further study its mode of action in treating different diseases and its protective effects in organisms.

II. MATERIALS AND METHODS

2.1 Collection of plant material:

Leaves of the plant *Cayratia pedata* were collected from the garden of Kanchi Manunivar Research center, puducherry.

2.2 Authentication :

The plant *Cayratia pedata* was collected and the herbarium was prepared. Authentication of the plant was taken from the French Institute of puducherry.

2.3 Preparation of leaf powder:

After collecting the fresh leaves from the garden, they are washed under running tap water to get the leaves thoroughly cleaned. Then washed the leaves with distilled water. The leaves were shade dried for 15 days and then after it was fully dried , the leaves were made into powder with mixer grinder. The powder was sieved to get leaf fine powder. The powder was stored in a glass bottle.

2.4 Preparation of Acetone extract:

Using Soxhalet Apparatus the acetone extract is prepared by taking 12.5 grams of dried leaf powder in 150ml of acetone .The extraction process was run for 3 hrs and the extract was concentrated using rotary evaporator.

2.5 FTIR(Fourier Transform Infrared) spectroscopy

For FTIR analysis FTIR spectrometer (Model:6700;thermo Nicolet,Madison,W1 USA) is used. 1mg of dried fine leaf powder of *Cayratia pedata* was blended with 100mg of KBr powder and compressed into pellets. Then is observed under spectroscopy.

2.6 ^{1}H-NMR(Nuclear Magnetic Resonance)

Acetone extract of *Cayratia pedata* is dissolved in Dueteriated acetone solvent for nuclear magnetic resonance(NMR) studies at 25^{0}c using an NMR spectrometer at 400MHz(Advance-11;Bruker,Zurich,Switzerland).

III. RESULTS AND DISCUSSION

Observation of FTIR graph was done and with standard IR spectrum(Movasaghi,M,S.Rehman,*et.al* 2008),the functional groups are found with the peaks shown in graph.There are 8 peaks in the range between 4000 to 400^{-1}cm. At 3343.3^{-1}cm range O-H stretching was present and is identified as Alcohol group. At 2924.3^{-1}cm range N=H stretching was observed and it is identified as Amine group. At 1650^{-1}cm range C=O stretching is seen and identified as ketone group.At 1418.3^{-1}cm again O-H stetching is observed and it corresponds to Alcohol.At 1319.7^{-1}cm C-N stretching is observed and it is identified as Aromatic amine.At 1064.0^{-1}cm C-O stretching is observed and it is identified as primary Alcohol.At 779.8^{-1}cm C=C stretching is seen and it is identified as Alkene.At 660.6^{-1}cm C-Cl stretching is observed and it belongs to Chloro compound. All these results are tabulated .

Figure 1. spectra of fourier transfer infrared spectroscopy(FTIR)

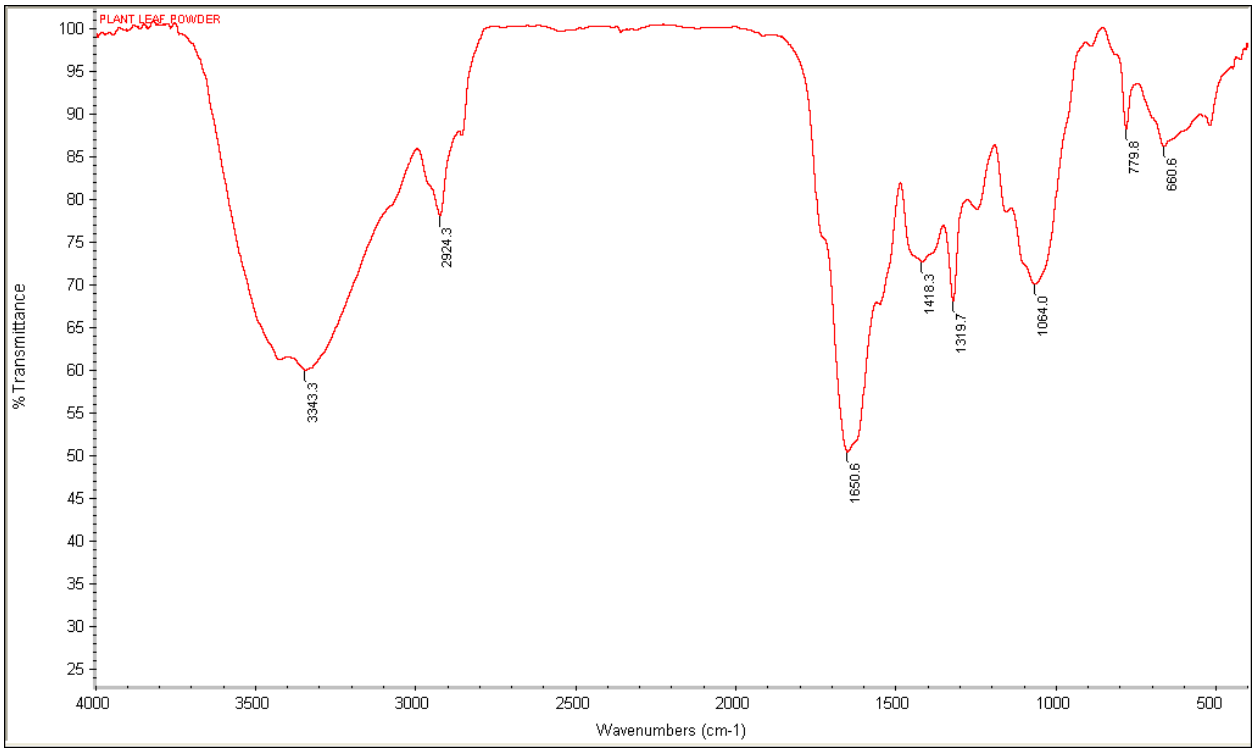

Table 1: Functional groups retrieved from FTIR spectra

S.No	PeakAbsorption Range (cm^{-1})	Bond Appearance	Group	Compound class
1.	3343.3	Strong	O-H streching	Alcohol
2.	2924.3	medium	N-H streching	Amine salt
3.	1650.6	strong	C=0 streching	Ketone
4.	1418.3	medium	O-H streching	Alcohol
5.	1319.7	strong	C-N streching	Aromatic amine
6.	1064.0	strong	C-O streching	1^0 Alcohol
7.	779.8	medium	C=C streching	Alkene
8.	660.6	strong	C-Cl streching	Chloro compound

^{1}H-NMR spectra given an idea of compounds that are biologically active in the form of proton peaks. The peaks are observed in the range of 1-12 ppm and identified according to the standard ^{1}H-NMR data(Silvestein RM 2005).The proton peaks between the range 0.769 to 0.854 ppm corresponds to primary Alcohol.The sharp peaks at 1.307 ppm corresponds to secondary Alcohol. The proton peak between the range 1.569 to 1.582 ppm is identified as tertiary Alcohol . peaks from 1.583 to 1.926 ppm corresponds to Amine compound. The peaks between 2.039 to 2.210 ppm belongs to Ester or Acid nature of compounds. The peaks ranging between 2.220 to 2.242 ppm corresponds benzylic compounds. Peaks from 3.342 to 3.980 ppm corresponds to Ether constituents. Peaks between the range 4.031 to 4.103ppm specifies Fluoride contained molecules. Peaks from 5.12 to 8.107 ppm gives the information about the molecules that contain Amide groups. All the compounds at different chemical shift values can be the molecules of proteins, carbohydrates, tannins, saponins,phenols, etc. , All the compounds from the results are tabulated.

Figure 2: Proton Nuclear magnetic resonance (NMR)spectra

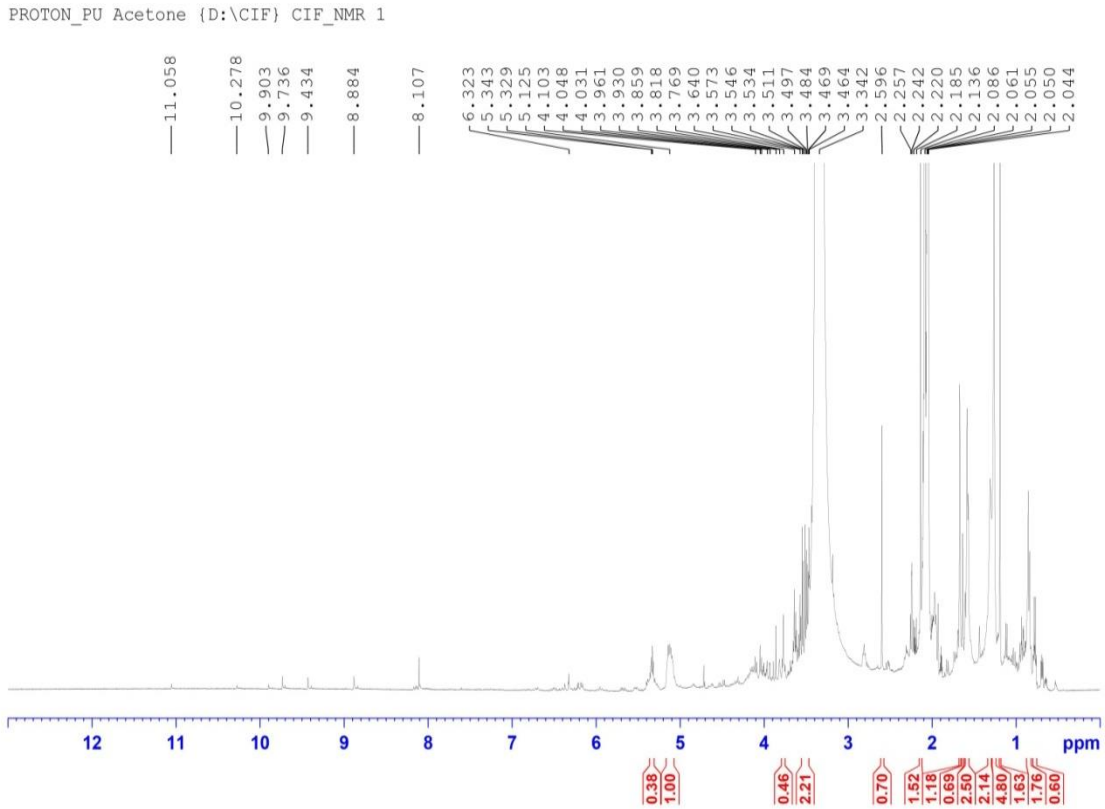

Table 2: compound retrieved from ^{1}H-NMR

S.No	Range (ppm)	Compounds
1.	0.769 – 0.854	1^{0}H Alkyl
2.	1.307	2^{0}H Alkyl
3.	1.569-1.582	3^{0}H Alkyl
4.	1.583-1.926	Amine
5.	2.039-2.210	Ester/Acids
6.	2.220-2.242	Benzylic
7.	2.257-2.596	Benzylic
8.	3.342-3.980	Ethers
9.	4.031-4.103	Flourides
10.	5.125-8.107	Amides

IV. CONCLUSION

From all the above data it is clear that *Cayrtia pedata* is having many biologically active compounds that are giving it a medical importance. Different functional groups like Alcohols, ketones, Aromatic Amines, chloro compounds etc,.from FTIR spectra proves cayratia pedata leaf having potential therapeutic nature of compounds. From ^{1}H-NMR the Atomic structures corresponds to Alkyl compounds , Esters or Acidic compounds, Benzylic compounds, Flourides, Amides and Ethers may belongs to the moieties of carbohydrates, proteins, tannins, saponins, phenols ,Alkaloids etc., proven *Cayratia pedata* leaves are having potent active molecules which are a rich source of nutrients and can be potential drugs to treat different ailments . Further research is needed to derive the compounds in detail and to know much more by different applications in model organisms.

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