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EXPLORING THE CHEMICAL FINGERPRINTS: FOURIER TRANSFORM INFRARED SPECTROSCOPY ANALYSIS OF SELECTED PLANTS USED IN THE TREATMENT OF UROLITHIASIS

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Abstract:

The functional groups present in plant extracts have been identified using FTIR Spectroscopy, which has been proven to be a reliable and sensitive approach. These functional groups were identified using IR region in the range of 400-4000cm^{-1}. It may be the most important, reliable method for determining the kinds of chemical groups (functional groups) that are present in compounds. The leaf powders of *Ouretlanata*(L.) Kuntze and*Tribullusterrestris*(L.) were taken for the present study. The predominance of functional groups in the chosen samples, such as amines, alcohols, phenol, carboxylic acids, ethers, and esters, is linked to their therapeutic qualities, particularly the urolithiatic property. It will be further determined with the help of GCMS analysis.

Keywords: FTIR analysis, Urolithiasis, functional group, IR region, leaf powder

INTRODUCTION

Stone development is associated with an increase in the excretion of substances that lead to the production of stones, such as calcium, cystine, oxalate, phosphate, urate, and xanthine and the most typical kind of nephrolithiasis is calcium oxalate stones(**Yachi *et al*., 2018**). One of the widely utilised techniques for classifying chemical components is Fourier Transform Infrared Spectroscopy, which has been employed as a crucial technique to identify medications for pharmacopoeia in many nations (**Subashini*et al*., 2015**).The functional groups present in plant extracts have been identified using FTIR Spectroscopy, which has been proven to be a reliable and sensitive approach (**Florence and Jeeva, 2015**).These functional groups were identified using IR region in the range of 400-4000cm^{-1}. It may be the most important, reliable method for determining the kinds of chemical groups (functional groups) that are present in compounds. A property of the chemical bond that may be noticed in the annotated spectrum is the wavelength of light, which fascinates. FTIR has been used to estimate the chemical bonds in the molecules (**Sahayaraj*et al*., 2015, Dove and Mayes, 1991**).The goal of the current study is to identify the

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phytochemicals present in the selected medicinal plants that have been identified as being highly effective in the treatment of urolithiasis through FTIR. The plants were selected from the study area that is Korampallam village, Thoothukudi district, Tamil Nadu, India after conducting a through ethnobotanical study of the area. The selected plants are leaf powders of Ouret*lanata*(L.) Kuntze and*Tribullusterrestris*(L.)

MATERIALS AND METHODS

Collection of Sample

Fresh leaves of leaf powders of *Ouretlanata*(L.) Kuntze and*Tribullusterrestris*(L.)were collected from Korampallam village, Thoothukudi district, Tamil Nadu, India and it was transferred in to an air tight bag.

Processing of Sample

The collected samples were washed with tap water thrice to remove the contaminants and it was shade dried for one week to remove the moisture content. Dried samples were further grinded to get fine particles of the sample and it was stored in a container.

FT– IR

The powdered samples were lyophilized and mixed with KBr pellets and thensubjectedtoFT-IRspectralanalysis.ThedriedpelletsweresubjectedtoFT-IRspectroscopy measurement in the spectral range of 4000 – 400 cm with resolution of 4cm. The results were compared with standard values and the functional groups wereidentified.

RESULTS AND DISCUSSION

The structural elucidation of the leaf powder of the selected plant samples 1 and 2 become executed by FTIR analysis is shown in Table **1 and 2** and **Figure 1**.

The following functional groups have been found in the IR spectrum of leaf powder of *Ouretlanata*. At 3737.79 cm^{-1}, a strong peak was seen, demonstrating O-H stretching with the functional group of alcohol. The following two peaks, 3335.66 $cm^{-1}$and 2915.2 cm^{-1}, are C-H stretching with the functional groups of alkyne and alkane. The subsequent peak, with a peak of 2310.56 $cm^{-1}$and carbon dioxide as the functional group, displays O=C=O stretching. The C=O stretching and C=C stretching with the functional groups of ester and alkane, respectively, are shown in the peaks at 1744.49 $cm^{-1}$and 1642.27 cm^{-1}.The N-O stretching with the functional group of the Nitro compound is visible in the following peaks, which are observed at 1545.84 $cm^{-1}$and 1510.16 cm^{-1}. At 1424.33 cm^{-1}, the O-H bending of the carboxylic acid's functional group can be seen. Additionally, it has functional groups like sulfonyl chloride, aromatic amine, amine, and tertiary alcohol with S=O, C-N, and C-O stretching at 1395.4 cm^{-1},1320.18 cm^{-1},

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1242.07 cm^{-1}, and 1163.96 cm^{-1}, respectively. Carboxylic acid, the primary chemical component of *Ouretlanata*, is used as a key medicinal in treating ulcers, jaundice, head discomfort, stomatitis, hemicarnia, fever, pain in the liver, wounds in cattle, edema, and rheumatic joint problems. All extracts are also abundant in amides and amino acids, the primary building blocks of protein synthesis, as well as polysaccharides, organic halogens, and nitrates, which have antimicrobial properties (Sugunabai*et al.*, 2017, Yamunadevi*et al.*, 2012). Alkyl halides, phenol and alkanes were typically shown to be more effective against microorganisms and antilithitic property in FTIR analyses of plant samples (Janakiraman*et al.*, 2011, Ragavendran *et al*., 2011). Similar results were observed in *Centella asiatica* as well (Agme-Ghodke et al., 2016, Sugunabai*et al.*, 2017, Byakodi*et al.*, 2019).

Table 1: FTIR Peak values and Functional Groups of *Ouretlanata*

S.No,	Peak value	Group	Functional group	Peak detail
1.	3737.79	O-H stretching	Alcohol	Medium
2.	3335.66	C-H stretching	Alkyne	Strong
3.	2915.2	C-H stretching	Alkane	Medium
4.	2310.56	O=C=O stretching	Carbon dioxide	Strong
5.	1744.49	C=O stretching	Ester	Strong
6.	1642.27	C=C stretching	Alkene	Strong
7.	1545.84	N-O stretching	Nitro compound	Strong
8.	1510.16	N-O stretching	Nitro compound	Strong
9.	1460.98	C-H bending	Alkane	Medium
10.	1424.33	O-H bending	Carboxylic acid	Medium
11.	1395.4	S=O stretching	Sulfonyl chloride	Strong
12.	1373.22	S=O stretching	Sulfonate	Strong
13.	1320.18	C-N stretching	Aromatic amine	Strong
14.	1242.07	C-N stretching	Amine	Medium
15.	1163.96	C-O stretching	Tertiary alcohol	Strong
16.	1114.78	C-O stretching	Aliphatic ether	Strong
17.	1032.81	S=O stretching	Sulfoxide	Strong

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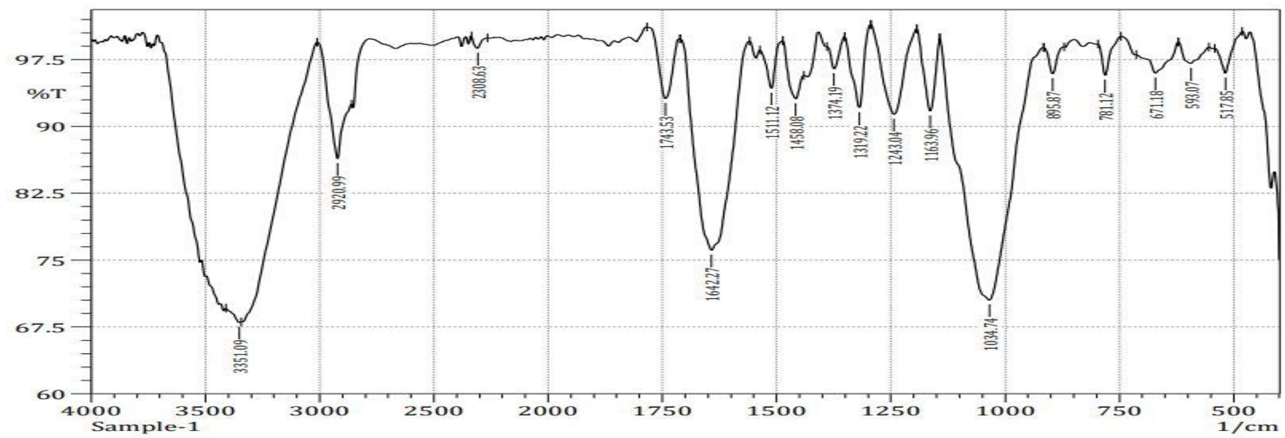
18.	894.91	C=C bending	Alkene	Strong
19.	828.37	C=C bending	Alkene	Medium
20.	781.12	C-H bending	1,2,3-trisubstituted	Medium
21.	672.15	C-Br stretching	Halo compound	Strong
22.	635.5	C-Br stretching	Halo compound	Strong
23.	584.39	C-I stretching	Halo compound	Strong
24.	518.82	C-Br stretching	Halo compound	Strong

Figure 1: FT IR Spectrum of *Ouretlanata*



Leaf powder of *Tribulus terrestris*IR spectra fall into the following functional groups. At 3337.59 cm^{-1}, a noticeable peak was seen, demonstrating O-H stretching with the functional group of alcohol. Aliphatic primary amines' N-H stretching is represented by the following two peaks, 3353.98 $cm^{-1}$and 2923.88 cm^{-1}, respectively. The functional group of the isocyanate can be seen by N=C=O stretching at a distinct peak at 2310.56cm^{-1}. The C=C stretching with the functional groups of cyclopentanone and alkene is shown in the peaks at 1744.49cm^{-1} and 1642.27 cm^{-1}. The N-O stretching with the functional group of the Nitro molecule is shown in the next peak, which can be located at 1511.12 cm^{-1}.O-H bending is seen at 1456.16 $cm^{-1}$and 1382.87 cm^{-1} for the functional groups of the carboxylic acid and phenol, respectively. The functional groups C-N and C-O, with lengths of 1319.22 cm^{-1}, 1243.04 cm^{-1}respectively, include aromatic amines and amines. The results of FTIR spectra showed the existence of primary and secondary amines, amides, aldehydes, alcohol, ketone, phenol, esters, alkanes, arenes, and alkyl halides. These functional groups confirmed the presence of secondary metabolites such as proteins, steroids, fatty acids, glycosides, saponins, phenols, flavonoids, tannins, terpenes, and tannins, which could be linked to *T. terrestris's* therapeutic antilithiatic ability (Jyoti *et al.*, 2017).

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The urolithiatic activity of Metha spicata also showed the functional group same as the studies above (Jain *et al.*, 2016). Similar results were observed in FTIR analysis of *Micrococcamercurialis* (L.) Benth. (Kalaichelvi and Dhivya, 2017) and in *Peristrophebicalyculata* (Retz.) Nees (Janakiraman *et al.*, 2011).

Table 2: FTIR Peak values and Functional Groups of *Tribulus terrestris*

S.No,	Peak value	Group	Functional group	Peak detail
1.	3747.43	O-H stretching	Alcohol	Medium
2.	3337.59	N-H stretching	Aliphatic primary amine	Medium
3.	2923.88	C-H stretching	Alkane	Medium
4.	2310.56	N=C=O stretching	Isocyanate	Strong
5.	1744.49	C=C stretching	Cyclopentanone	Strong
6.	1642.27	C=C stretching	Alkene	Strong
7.	1511.12	N-O stretching	Nitro compound	Strong
8.	1456.16	O-H bending	Carboxylic acid	Medium
9.	1382.87	O-H bending	Phenol	Medium
10.	1317.29	C-N stretching	Aromatic amine	Strong
11.	1244.97	C-N stretching	Amine	Medium
12.	1052.1	S=O stretching	Sulfoxide	Strong
13.	894.91	C=C bending	Alkene	Strong
14.	780.15	C=C bending	Alkene	Strong

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15.	671.18	C=C bending	Alkene	Strong
16.	608.5	C-Br stretching	Halo compound	Strong
17.	516.89	C-Br stretching	Halo compound	Strong

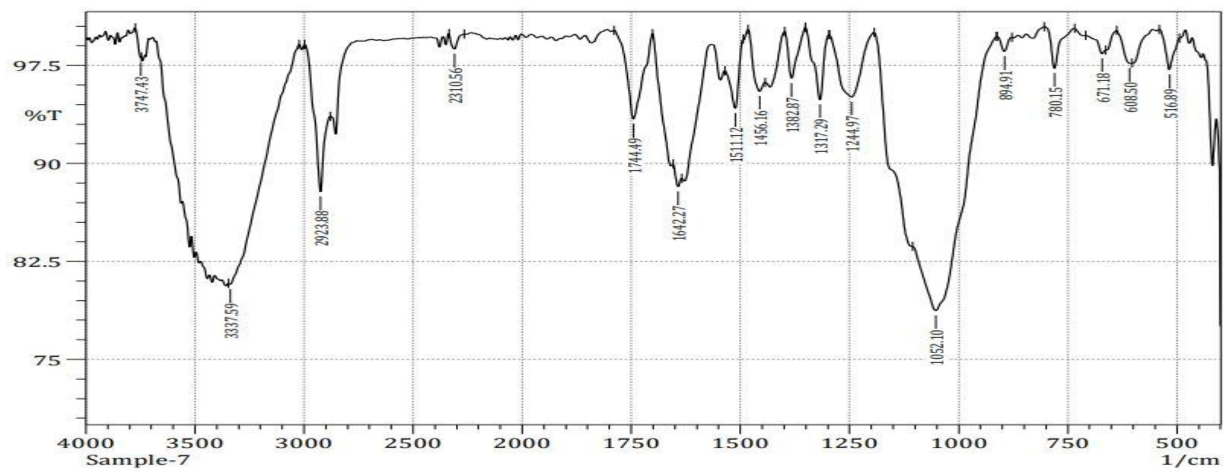

Figure 2: FT IR Spectrum of *Tribulus terrestris*

CONCLUSION:

Through FT-IR analysis, the functional group contained in the leaf powder of *Ouretlanata and Tribullusterrestris* was determined. The predominance of functional groups in the chosen samples, such as amines, alcohols, phenol, carboxylic acids, ethers, and esters, is linked to their therapeutic qualities, particularly the urolithiatic property.

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CONFLICT OF INTERST

None

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