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Research Article

Phytochemical screening and Fourier Transform IR Analysis of Ficus sagittifolia (Warburg Ex Mildbread and Burret) stem bark

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ABSTRACT

Objective: The current goal of the research is to use preliminary qualitative phytochemical screening and Fourier-transform infrared spectroscopy to analyse the phyto-compounds present in Ficus sagittifolia stem bark (FTIR).

Methods: Phytochemical screening of Ficus sagittifolia stem bark was executed in three extracts obtained from solvents namely chloroform, methanol, and aqueous from powdered stem bark. By using standard procedures, the extracts were subjected to qualitative phytochemical screening. Phytochemical compounds were ample in aqueous stem bark extracts. The characterization of functional groups was done by analysing the extract through FT-IR spectrophotometry.

Results: In the stem bark extract, FTIR spectroscopic analyses revealed the occurrence of Functional groups, which include phenols, alkanes, carboxylic acids and primary amines. Aromatic compounds and aliphatic amine compounds are all examples of aliphatic amine compounds. Various phytochemical screening procedures for methanol, chloroform, and aqueous extracts discovered the existence of flavonoids, carotenoids, tannins, alkaloids and saponins. Present study created the FTIR spectrum profile for the medicinally significant plant Ficus sagittifolia, which reveals the presence of alcoholic and phenolic compounds, alkanes, carboxylic compounds, ketone compounds, alkanes, aliphatic primary amine groups and alkyl halides

Conclusion: The current research study confirms the presence of different phytocompounds like flavonoids, alkaloids, terpenoids, carotenoids, saponins and polyphenols through phytochemical screening and FTIR spectroscopic studies.

Keywords: Phyto-compounds, Qualitative phytochemical screening, FTIR spectroscopic studies, functional groups, characterization.

INTRODUCTION

Therapeutic plants are used to treat a variety of ailments since ancient times and are well recognized for their effectiveness. The plants and herbs with medicinal importance were selected and extensively studied for their phytochemical profile and characterization of functional groups [1].

Ficus, one of the major genus of Moraceace family comprises of more than 800 species [2]. Different parts of this genus including leaves, bark, root, fruits and latex are often used for treatment of ailments associated with reproductive, digestive, endocrine, and respiratory systems [3]. Ficus species have abundant medicinal properties because of the existence of enormous phytochemicals comprising of flavonoids, glycosides, tannins, terpenoids, phenols, coumarins, esters and carbohydrates [4]. They possess significant pharmacological properties such as antimicrobial, antidiabetic, antiulcer, antioxidant and anticancer activities [5]. Furthermore, most Ficus research showed the occurrence of phenolic phyto-compounds as primary components in several parts of the plant, including leaves, stem , stem bark, roots, root bark, fruits, and seeds [5]. Ficus sagittifolia is a huge, evergreen tree with an extensive epiphytic distribution. It has been utilised for many years in West Tropical Africa's traditional medical system to prevent, treat, and cure a variety of human illnesses. [6]. It is popularly known as FULA-PULAAR in Africa. It is known to grow in forests in Cameroun, Casamance, and Senegal. The plant's bark and leaf are used for various purposes like pulmonary and stomach troubles and as colic [7]. Interestingly, details about the medicinal properties of the Ficus species have been sparse.

In continuation of our effort to provide scientific rationale for the use of medicinal plants, hence, this paper reports the qualitative analysis of phytochemicals as well as FTIR spectroscopic studies of F. sagittifolia.

Fig 1: Ficus sagittifolia plant

MATERIALS AND METHODS

Extraction of Ficus sagittifolia stem bark.

The Ficus sagittifolia stem bark was collected from forest area of Tirupathi,Chittoor district and was authenticated by famous taxonomist Dr. K.Madhava Chetty with voucher number 0913.The detached stem bark is washed well and the cleaned stem bark was dried under shade until all the water molecules are evaporated and stem bark is suitable for grinding. After drying, bark of stem was pulverized well using mechanical blender into very fine powder and shifted to airtight container. Using a soxhlet apparatus, the dried and powdered Ficus sagittifolia stem bark was extracted progressively through methanol, chloroform, and water. Following the addition of the solvent (600 mL), and the stem bark was extracted for 6 h at 40 °C, 50 °C, and 60 °C for ethanolic and methanolic extractions. For extraction with water, the temperature used were 90 °C, 100 °C, and 110 °C. [8,9].

Qualitative Phytochemical Screening

Carbohydrates, reducing sugars, steroids, phenol, terpenoids, glycosides, phlobatannins, and anthroquinones are all flavonoids, saponins, alkaloids, tannins, are examples of phytochemicals, were tested in all of the extracts, including methanolic, chloroform, and aqueous stem bark extracts [10]. The phytocompounds were analysed using the following assays and techniques.

1. Tests for Carbohydrates by Benedict's test:

A reddish brown precipitate develops when 2 ml reagent is added to 2 ml of crude extract and heated, suggesting that Carbohydrates are present.

2. Test for reducing sugars

The extracts were shaken with water (distilled water), filtered, and then filtrate was heated for a few minutes with a few drops of Fehling's solution A and B. The presence of reducing sugars is indicated by the formation of an orange red precipitate.

3. Tests for Amino Acids (Ninhydrin test)

3 ml of the extract is added with 3 drops 5% Ninhydrin solution and heated in water bath for 10 min. The presence of amino acids is shown by appearance of purple or blue colour.

4. Tests for Tannins

Formation of blue-black colour upon addition of 5% $FeCl_3$ solution with 2-3 ml extract indicates the presence of Tannins.

5. Tests for Alkaloids using Wagner's test

The presence of alkaloids is indicated by the appearance of a reddish brown precipitate upon addition of reagent small amount to the 2-3 ml filtrate.

6. Tests for flavonoids

Flavonoids are confirmed by the formation of yellow precipitate later add lead acetate solution to the extract

7. Test for Phlobatannins

When plant samples were treated with 1 percent aq. HCL, form red precipitate, it represents phlobatannins are present.

8. Tests for Steroids

The existence of steroids can be confirmed by the colour changes from violet to blue green in all extracts with the addition of acetic anhydride and 2ml of H_2SO_4 to the 2 ml of test solution.

9. Detection of Terpenoids using Salkowski reaction

Formation of reddish brown colouration of the interface when 2 ml of sample (plant extracts) add chloroform (2ml) , Conc H_2SO_4 (2ml) indicates the terpinods are existence.

10. Test for Phenolic compounds using Ferric chloride test:

Extract with ferric chloride solution formation of dark green colour indicates presence of phenolic compounds

11. Test for saponins

After shaking the diluted plant extracts with distilled water graduated cylinder for 15 minutes, the presence of saponins is shown by the production of a 2cm layer of foam.

12. Test for glycosides

The presence of glycosides was determined after hydrolyzing the extract (2 ml) with HCl solution (0.5 ml), neutralising it with NaOH solution (0.5 ml), and adding a few drops of Fehling's solution A and B.

13. Test for anthroquinones

Anthroquinones were detected by the presence of rose pink colour upon addition of 0.5 g extracts and boiling with 10% HCl for 5 mins in a water bath and upon addition of equal volumes of chloroform was added to the cooled filtrate and few drops of 10% ammonia.

Table1: Ficus sagittifolia stem bark extracts were subjected to a qualitative phytochemical analysis.

S. No	Phytochemical constituents	Chloroform	Methanol	Water
1.	Terpenoids	Present	present	present
2.	Flavonoids	Absent	present	present
3.	Alkaloids	Absent	present	present
4.	Steriods	Present	absent	present
5.	Cardiac glycoside	Absent	absent	absent
6.	Phenolic compounds	Present	present	present
7.	Tannins	Absent	present	present
8.	Saponins	Absent	absent	absent
9.	Anthraquinones	Absent	absent	absent
10.	Phlobatannins	Absent	absent	absent
11.	Carbohydrates	Absent	present	present
12.	Reducing sugars	Absent	present	present
13.	Amino acids	Absent	absent	present

FT-IR Spectrophotometric analysis of Ficus sagittifolia stem bark aqueous extract

For FTIR analysis, a dried powder of crude aq extract of Ficus sagittifoli was taken. 10 mg of dried extract powder was encapsulated in 100 mg of KBr pellet to make transparent sample discs. The powdered plant extract sample was put into a Shimadzu IR Affinity 1 FTIR spectroscope with a scan range of 400 to 4000 cm $^{-1}$ and a resolution of 4 cm $^{-1}$. [11, 12]

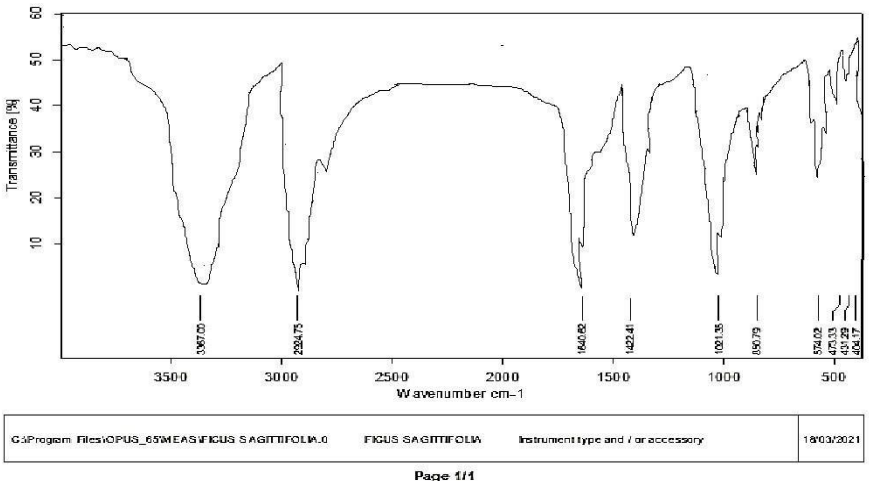

Figure 2: FT-IR spectra of Ficus sagittifolia stem bark extract (aqueous)

Table 2: FT-IR Analysis of Ficus sagittifolia stem bark extract (aqueous)

S.No	Characteristic absorption cm^{-1}	Assignment	Functional group
1.	3367.00	Stretching vibration of –O–H groups that are bonded and non-bonded N-H stretch	Alcohols and phenolic compounds, carboxylic compounds, aliphatic primary amine
2.	2924.75	C-H(CH_2) Vibration-assymetric Stretching	Alkanes
3.	1640.62	C=O Stretching, Symmetrical	Ketone Compound,carboxylic compound
4.	1422.41	C=C-C Aromatic ring stretching Or O-H bending	Aromatic ring stretching
5.	1021.35	-C-N stretching	Amine group
6.	850.79	C–Cl stretches at 850–550 cm^{-1}	Alkyl halide
7.	574.02	C-Br Stretch at 600-500cm^{-1}	Alkyl halide
7.	473.33 431.29 404.17	C-I Stretch at 500cm^{-1}	Alkyl halide

RESULTS AND DISCUSSION

Plant secondary metabolites can be detected by applying standard qualitative phytochemical screening methods [13]. The presence of the bioactive phyto-molecules can be revealed by the results of the screening tests performed on various extracts of Ficus sagittifolia stem bark.

Table 1 shows the results obtained for qualitative screening of bioactive phyto-compounds stem bark extracts of F.sagittifolia in three different solvents. All of the stem bark extracts included the phytochemical components terpenoids and phenolics. All of the stem bark extracts were devoid of phlobatannins, cardiac glycosides, saponins, and anthroquinones. Aqueous and methanolic extracts contained flavonoids, alkaloids, tannins, carbohydrates, and reducing sugars. Steroids exists in aqueous as well as chloroform extracts and presence of amino acids can be seen in aqueous extracts. The aqueous extract of Ficus sagittifolia stem bark clearly contained the majority of the phytocompounds. [14, 15]. Therefore, Ficus sagittifolia aqueous stem bark extract is subjected to FTIR spectroscopy, and the FTIR spectrum is shown in Figure 2. Table 2 shows the functional groups and types of bonds .C–Cl stretching in alkyl halides corresponds to the weak band at 850.79 cm-1, whereas C–Br stretching in alkyl halides corresponds to the weak band at 574.02 cm-1.The bands at 473.33, 431.29, 404.17cm^{-1} corresponds to C-I stretch at 500cm^{-1} reveals the presence of alkyl halide group which is found in the aqueous extract. The strong bands at 1021.35 cm-1 can be attributed to -C-N stretching, which indicates the existence of an amine group in the crude, which was extracted with water. [16, 17]. The band is at 1422.41 cm^{-1} can be ascribed to C=C-C aromatic ring stretching or OH bending reveals the presence of aromatic ring stretching. Peak appearing at 1640.62 cm^{-1} can be ascribed to C=O stretching, symmetrical reveals presence of Ketone Compound. The intense peak at 2924.75 cm^{-1} corresponds to C-H (CH_2) vibration-assymetric stretching reveals the presence of alkanes. Table 2 lists the functional groupings, vibration intensity, and vibration type. The intense peak at 3367.00cm^{-1} is for Alcohols and phenolic compounds are detected by stretching vibrations of bound and non-bonded –O–H groups, as well as N-H stretch, carboxylic compounds and aliphatic primary amines [18, 19].

CONCLUSION

The phytocompounds from various herbs play a vibrant role in the treatment and cure of a myriad human illnesses and it is predictable that 80% of the populations of emerging countries depend on herbal drugs [20, 21]. Ficus sagittifolia stem bark was chosen as the study's investigational material. The purpose of this research work was to evaluate the phytochemical components and functional groups found in the stem bark. The aqueous extract of stem bark indicated the most phytochemical components, according to this study. The aqueous extract may be used to isolate components for further characterisation and structural elucidation of bioactive substances in the future. According to the FT-IR analysis, the –O–H groups N-H stretch in the region of 3367.00 cm-1 has a high peak, and the existence of carboxyl (C=O) groups in the region of 1600 - 1750 cm-1 [22,23]. These functional groups, which represents the flavonoid content, is abundant in aqueous extract. Study furthermore deliver strong confirmation for usage of Ficus

sagittifolia stem bark extract to treat numerous diseases because of the presence of various phytocompounds.

Ethics approval and consent to participate
Not applicable

Consent for publication
Not applicable

Availability of data and material
All data and material should be available upon request.

Competing interests
The authors declare that they have no competing interests to declare.

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Credit authorship contribution statement
Authors Ramya Kuber. B analyzed and interpreted the data of obtained FTIR spectra and a major contributor in writing the manuscript. Theja.I performed the benchwork and experimental work.The authors read and approved the final manuscript.

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