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Identification of functional groups in *Corbichonia decumbens* by Fourier-Transform Infrared Spectroscopy

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ABSTRACT

The main objectives of the present study were to evaluate the preliminary phytochemical compounds and FTIR analysis of *Corbichonia decumbens*. The FTIR method was performed on a spectrophotometer system, which was used to detect the characteristic peak values and their functional groups. The results showed in preliminary phytochemical analysis are Alkaloids, Flavonoids, Saponins, Glycosides, Steroids were observed in hexane and ethanol extracts. The phenol and tannins were only present in the ethanolic extract. The FTIR spectroscopic studies revealed different characteristic peak values with various functional compounds in the ethanol extracts. In FTIR analysis of *C. decumbens* there are 33 functional groups were identified. The FTIR analysis of *C. decumbens* was the first attempt based on the literature survey.

Keyword: *Corbichonia decumbens*, FTIR, hexane, ethanol.

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INTRODUCTION

A large number of medicinal plants are used as alternate medicine for diseases of man and other animals since most of them are without side effects when compared with synthetic drugs. Identification of the chemical nature of phytochemical compounds present in the medicinal plants will provide some information on the different functional groups responsible for their medicinal properties. In India thousands of species are known to have medicinal value and the use of different parts of several medicinal plants to cure specific ailments has been in vogue since ancient times. Herbal medicine ids still occupy of about 75 – 80 % of the whole population, mainly in developing countries. In many developing countries traditional medicine is still the mainstay of health care and most of the drugs and cures come from plants. History of herbal remedies is very old; there are many medicinal herbs and spices, which find place in day-to-day uses. Many cooked foods including species are providing remedies for cold, cough and stomach disorders of human system because of their medicinal properties. Herbal remedies can be taken in many forms ranging from infusions of hers or spices to decoction of leaves and flowers from them. There is worldwide realization that any plants known for a particular human disorder prompt us to screen indigenous plants those also having potential for antioxidant and antimicrobial activity (Agr1awal &Srivastava, 2008). There is considerable potential of raw plant materiel for a higher exposure to bioactive phytochemicals such as glucosinolates and their hydrolysis products like flavonoids, and vitamin C (Simoes *et al.,* 2009). The IR spectrum of different extracts reveals structural information about major and minor constituents. The Fourier Transform Infrared (FT-IR) spectroscopy allows the analysis of a relevant amount of compositional and structural information in plants. Yadav and Dixit, (2008); Dhale and Mogle (2011); Murugan and Mohan (2011); Devi *et al.,* (2012). The aim of the present study is analyse the preliminary phytochemical compounds and FTIR analysis of *C. decumbens.*

MATERIALS AND METHODS

Collection of plant materials

The whole plant *C. decumbens* belongs to the family Lophiocarpaceae were collected in and around Kallipalayam, Annur taluk, Coimbatore District, Tamil Nadu, India

Preparation of plant extracts

50g of powdered *C. decumbens* whole plant was successively extracted using 500ml of hexane and ethanol using the Soxhlet extractor for 8–10h.

Preliminary phytochemical analysis

The ethanol and petroleum ether extracts were subjected to preliminary phytochemical tests to determine the group of secondary metabolites present in the powdered *C. decumbens* which was followed by Harborne, 1973.

FT-IR spectrum analysis of *C. decumbens*

Fourier Transform Infrared Spectrophotometer (FTIR) is perhaps the most powerful tool for identifying the types of chemical bonds/functional groups present in the phytochemicals. The wavelength of light absorbed is the salient feature of the chemical bonds seen in the annotated spectrum. By interpreting the infrared absorption spectrum, the chemical bonds in a compound can be determined. Dried powder of ethanol solvent extracts of *C. decumbens* was used for FTIR analysis. 10mg of the dried extract powder was encapsulated in 100mg of KBr pellet, in order to prepare translucent sample discs. The powdered sample of each extract was loaded in FTIR spectroscope (Shimadzu, Japan), with a Scan range from 400 to 4000 cm1 with a resolution of 4 cm-1.

RESULTS

Preliminary phytochemical analysis in *C. decumbens*

Preliminary phytochemical study on *C. decumbens* were carried out to find out the presence of phytochemical constituent's corbichonia decumbens is a small shrub, which is distributed in throughout India. The plant was also screened for antioxidant responses. In this phytochemical evaluation, initially physical constants were evaluated for its presence as well as for its quantity. The petroleum ether and Methanolic extracts were found to contain flavonoids, saponins, glycosides, steroids and phenolic compounds. In the present study plant were collected for the preliminary phytochemical analysis FTIR and antioxidant work of the plant were undertaken. The phytochemical constituents are mainly responsible for the medicinal properties of the plant. The plant were extracted with Soxhlet apparatus using, ethanol. The results are shown in the table. The compounds like alkaloids, flavonoids, glycosides, steroids, phenols, tannins, saponins and resins are the preliminary phytochemical present in this plant, maximum amount of all the compounds in plant were present in Ethanolic extracts than the hexane extracts. In plant more amount of phenols that the other compounds. (Table.No.1)

Table-1: Preliminary phytochemical analysis of *C. decumbens*

S.NO	NAME OF THE SECONDARY METABOLITES	HEXANE EXTRACT	ETHANOL EXTRACT
01	Alkaloids	+	+
02	Flavonoids	+	+
03	Saponins	+	+
04	Glycosides	+	+
05	Steroids	+	+
06	Phenols	-	+
07	Tannins	-	+

+ - Present _ - Absent

FTIR spectrum analysis of *C. decumbens*

The *C. decumbens* ethanol extract was exposed to the FTIR spectroscopic analysis. The FTIR gives broad peak at ethanol extract like 3614, 3502 cm^{-1} which indicates the presence of OH stretching. It gives Strong peak at ethanol 2978, 1138 cm^{-1} which indicates the presence of C-H stretching. The peak obtained at ethanol 1462cm^{-1} which indicates the presence of C-H Bend. The broad peak obtained at ethanol 1269 cm^{-1} which indicates the presence of C-H wag. It gives strong peak at ethanol 1369 cm^{-1} which indicates the presence of C-H Rock. The peak obtained at ethanol 879 cm^{-1} which indicates the presence of C-H Oop. It gives strong peak at ethanol 1288, 1138, 1087, 1049 cm^{-1} which indicates the presence of C-N stretching. The peak obtained at ethanol 1743 cm^{-1} which indicates the presence of C=O stretching. The peak obtained at ethanol 1315, 2353 cm^{-1} which indicates the presence of C-O stretching. It gives strong peak at ethanol 1427 cm^{-1} which indicates the presence of C-C stretching. The peak obtained at ethanol 1678 cm^{-1} which indicates the presence of –C=O- stretching. The peak obtained at ethanol 829, 802, 740 cm^{-1} which indicates the presence of C-Cl stretching. It gives strong peak at ethanol 1994,1967, 1944, 1917, 1897, 1867, 1836, 1793 cm^{-1} which indicates the presence of =C-H stretching. The peak obtained at ethanol 698 cm^{-1} which indicates the presence of –C=C-H: C-H Bend. It gives strong peak at ethanol 3390 cm^{-1} which indicates the presence of N-H stretching. It gives strong peak at ethanol 1647, 1627 cm^{-1} which indicates the presence of N-H Bend. The peak obtained at ethanol 1516, 1338 cm^{-1} which indicates the presence of N-O asymmetric stretch.

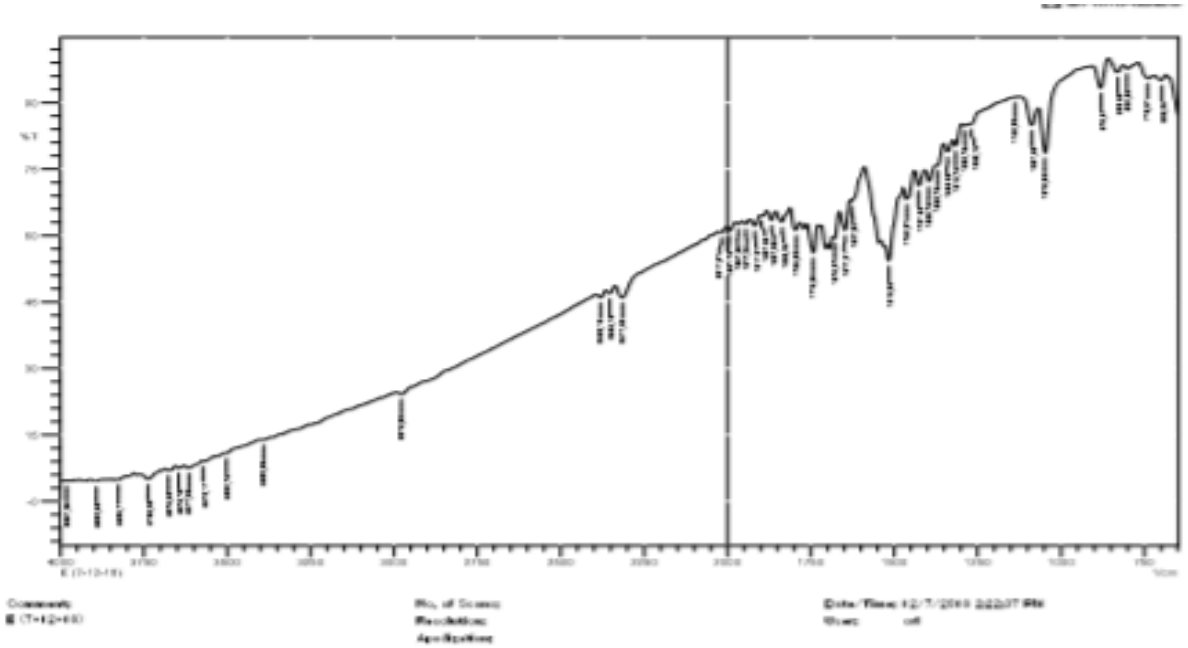

Fig 1: FTIR- Spectrum wave numbers of ethanol extract of *C. decumbens*

Table 2: FTIR spectral wavenumber's values, bonds and functional groups obtained from the aerial parts extract of *C. decumbens*.

S.NO	FREQUENCY cm^{-1}	BOND	FUNCTIONAL GROUP
01	3614	O-H stretch, free hydroxyl	Alcohols , phenols
02	3502	H- bonded (broad S) (O-H)	Con. alcohols & phenols
03	3390	N-H stretch	1:2 amines, amides
04	2978	C-H stretch	Alkenes
05	2353	C-O stretch	Alcohols, carboxylic acids, esters, ethers.
06	1994	=C-H bend	Alkenes
07	1967	=C-H bend	Alkenes
08	1944	=C-H bend	Alkenes
09	1917	=C-H bend	Alkenes
10	1897	=C-H bend	Alkenes
11	1867	=C-H bend	Alkenes
12	1836	=C-H bend	Alkenes
13	1793	=C-H bend	Alkenes
14	1743	C=O stretch	Esters, saturated aliphatic aldehydes, saturated aliphatic.
15	1678	-C=C- stretch	Alkenes
16	1647	N-H bend	1 amines
17	1627	N-H bend	1 amines
18	1516	N-O asymmetric stretch	Nitro compounds
19	1462	C-H bend	Alkenes
20	1427	C-C stretch (in-ring)	Aromatics
21	1369	C-H rock	Alkenes
22	1338	N-O symmetric stretch	Nitro compounds
23	1315	C-O stretch	Alcohols, carboxylic acids, esters, ethers.
24	1288	C-N stretch	Aromatic amines
25	1269	C-H Wag (-CH_2X)	Alkyl halides
26	1138	C-H Wag (-CH_2X), C-N stretch	Alkyl halides Aliphatic amines
27	1087	C-N stretch	Aliphatic amines
28	1049	C-N stretch	Aliphatic amines
29	879	C-H "oop"	Aromatics
30	829	C-Cl stretch	Alkyl halides
31	802	C-Cl stretch	Alkyl halides
32	740	C-Cl stretch	Alkyl halides
33	698	-C=C-H:C-H bend	Alkynes

DISCUSSION

The results of the phytochemical screening and quantitative estimation of the chemical constituents of *C. decumbens* have indicated high content of secondary metabolites (table.no-1). The abundance of the flavonoids which are hydroxylated phenolics substances might be responsible for their therapeutic effectiveness against wide array of microorganisms, probably due to their ability to complex with extracellular and soluble protiens and to complex with the bacterial cell wall (cowan, 1999). Flavonoids and other phenolic compounds are potent water soluble antioxidants and free radical scavengers, which prevent oxidative cell damage, have strong anti-cancer activity (salah *et al.,* 1995; Del-Rio et al*.,* 1997; Okwu, 2004). It is not surpring that *P. crassipes* was earlier reported to have hypotensive activity in cats and rats (Amos *et al.,* 2003). Alkaloids are very important in medicine and constitute most of the valuable drugs. They have marked physiological effect on animals (Edeoga and Eriata, 2001). The concentrations in *S. angustifolia and V. blumeoides* indicates potential source of useful drugs. Saponin concentration was appreciable in *A. mannii* and *S. angustifolia;* it has the property of binding with cholesterol, bitterness and haemolytic activity in aqueous solution (Sodipo *et al.,* 2000). These might contribute to some medicinal properties of the plants.

Fourier Transform Infrared Spectrophotometer (FTIR) is perhaps the most powerful tool for identifying the types of chemical bonds (functional groups) present in compounds. The wavelength of the light is absorbed is characteristic of the chemical bond as can be seen in the annotated spectrum. By interpreting the infrared absorption spectrum, the chemical bonds in a molecule can be determined. Dried powder of Ethanolic extracts of *C. decumbens* were used for FTIR analysis. 10mg of the dried extract powder was encapsulated in 100mg of KBr pellet, in order to prepare translucent sample discs. The powdered sample of each plant specimen was loaded in FTIR spectroscope (Shimadzu, IR Affinity, japan), with a scan range from 400 to 4000cm^{-1} with a resolution of 4 cm^{-1}. The FTIR spectrum in Ethanolic extract of *C. decumbens* were given in Fig 1 to 3. The data on the peak values and the probable functional groups (obtained by FTIR analysis) present in *C. decumbens* are presented in Tables 1 to 5.Mueen Ahmed *et al.,* (2005) showed that the leaves and latex of *C. gigantean* species were found to have cardiac glycosides. The cardiac glycosides were identified as calotropogenin and calotropin. Ramamurthy and Kannan (2007) also confirmed that the leaf parts of *C. gigantean* species showed the presence of cardiac glycosides such as calotropogenin and calotropin besides other organic compounds such as amino acids, chlorophyll, amides, lignins, carbohydrates and starch pertaining to a healthy plant.

Kareru *et al.,* (2008), carried the spectral analysis for saponins in the crude dry powder of 11 plants and detected that *Albizia anthelmintica, Senna didymomotrya, Terminalia brownie*, and *Prunus africana* were likely to be bidesmosidic, oleanane – type triterpenoids, while those detected in *Entada leptostachya* and *Rapanea rhododendroides* might be monodesmosidic saponins. Muruganantham *et al.,* (2009) carried out the FTIR and SEM-EDS spectral analysis of plant parts like leaf, stem, and root of the medicinal plants, *Eclipta alba* and *Eclipta prostrata* are reported the presence of characteristic functional groups of carboxylic acids, amines, amides, sulphur derivatives, polysaccharides, nitrates, chlorates, and carbohydrate that are responsible for various medicinal properties of both herbal plants. The *Eclipta alba* contains a higher percentage of useful elements like Na, Mg, K, Ca, Cu, Zn, and Fe than *Eclipta prostrata* contains more toxic element Cd than *Eclipta alba* (Muruganantham *et al.,* 2009). The FTIR analysis of methanolic and aqueous leaf extracts of *Bauhinia racemosa* revealed the presence of protein, oil, fats, phenolic compounds, flavonoids, saponins, tannins and carbohydrate as major functional groups (Gaurav kumar *et al.,* 2010).Ragavendran *et al.,* (2011) screened the functional groups of carboxylic acids, amines, amides, sulphur derivatives, polysaccharides, organic hydrocarbons, halogens that are responsible for various medicinal properties of *Aerva lantana.* Thangarajan Starlin *et al.,* (2012), while analysing the Ethanolic extracts of *Ichnocarpus frutescens,* by FTIR, revealed functional group components of amino acid, amides, amines, carboxylic acid, carbonyl compounds, organic hydrocarbons and halogens. Parag A Pednekar and Bhanu Raman (2013) analysed the methanolic leaf extract of *Ampelocissus latifolia* by FTIR and reported that the transition metal carbnxyl compounds and aliphatic fluoro compounds were only present in the extract.

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