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FTIR screening of phytocompounds in plant *Spermacoce hispida* L. of Vallimalai Hills at Vellore district

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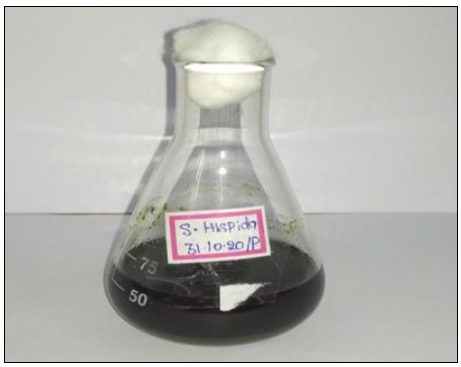
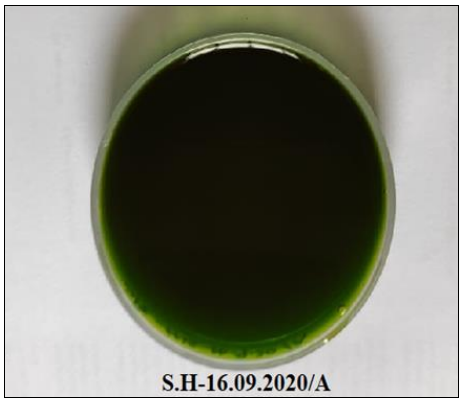
Abstract
The objective of this study is to detect the FTIR fingerprints of phytocompounds in the plant *Spermacoce hispida* L. The FTIR analysis of methanol leaf extract of plant *Spermacoce hispida* L. revealed the presence of 19 bioactive phytocompounds such as aliphatic primary amine, alkene, alkanes, amine salt, aldehydes, aromatic compound, α, β-unsaturated ester, conjugated alkene, nitro compound, sulfonyl chloride, phenol, aromatic amine, alkyl aryl ether, vinyl ether, ester, tertiary alcohol, primary alcohol, carboxylic acids and halo compound.

Keywords: Phytocompounds, *Spermacoce hispida* L., FTIR, bioactive compounds, medicinal plants

1. Introduction
Plants have been related with human health since time immemorial, and they have been a source of medicine since human civilisation [1]. They include diverse Phytoconstituents in bark, leaves, flowers, roots, fruits, and seeds that have great therapeutic potential [2-3]. These physiologically active naturally occurring chemical compounds are not made for other species; they are provided by plants to protect their cells from environmental threats such as pollution, stress, drought, UV exposure, and pathogenic attack [4], naturally occurring diseases, insect pests, and environmental pressures must be repelled [5-6]. In recent years, therapeutic plants gained widespread attention [7]. Polyphenols, flavonoids, alkaloids, polysaccharides, and essential oils have gained attention for their biological effects [8-9]. In recent years, medicinal plant therapies received global attention [10]. At the start of the 21st century, a research found that 61% of medications were derived from plants. In undeveloped and emerging countries, 80% of the population relies on traditional medicine for primary health care [11]. 08 of 30 highly promoted drugs are also natural. Bioactive chemicals are more effective with fewer adverse effects [12]. Decoction of flowers and sensitive stalks alleviate diaphoresis. In gout and rheumatism, roots are employed [13]. Uterine stimulant, antibacterial, febrifuge, and jaundice treatment [14-15]. *Mollugo cerviana* (L.). Ser is a southern Indian herb with antibacterial and anti-inflammatory effects [16-17]. It grows in all Tamilnadu districts. FTIR, HPTLC, and GC-MS analyses are only a few of the methods that can be used to identify the phytochemical components in plant extracts [18]. One of these is Fourier transform infrared spectroscopy, a physicochemical analytical method that gives an accurate image of the metabolic makeup of leaves at a specific time [19]. It can be used to identify unknown molecular compositions, corresponding chemical functional groups, and complex secondary metabolite structures in plants [20-21], as well as small variations in primary and secondary metabolites in leaves [22].

2. Plant description
2.1 Classification
Kingdom: *Plantae*
Phylum: *Tracheophyta*
Division: *Magnoliophyta*
Class: *Magnoliopsida*
Order: *Gentianales*
Family: *Rubiaceae*
Genus: *Spermacoce* L
Species: *Spermacoce hispida* L.





2.3 *Spermacoce hispida* names in various language
Tamil: *Nathaichuri, Nattaiccuri,*
English: *Shaggy button weed,*
Malayalam: *Natthachoori, Tharthavel, Tartaval, Kudalchurukki, Nattachuri,*
Sanskrit: *Booka, Vasuka, madanaghanti, madanghanta,*
Hindi: *madanaghanti,*
Kannada: *daare botu, daare kaddi, madana buddame gida, madana ganti, madanabadu, madanaganti, megidda,*
Malay: *Rumput anak temot, Rumput sulawa, Rumput sumbro,*
Telugu: *madana, madana budatha kaada, madana kaada, madana kattu, madana-ghettu, madanaghanti, madanagrandhi, madanagranthi, modina, madanabudata,*
Bengali: *Madchbuntkadu,*
Marathi: *gedo, ghamtachi-bhaji*
Oriya: *Solaganthi,*
Gujarathi: *Madhur Zadi, Khar Sar shekh lou,*
Santal: *Pitwara,*
Chinese: *cao ye feng hua cao,*
Sinhalese: *Heen getakola,*
Other Indian Names: *Bukah, Gedo, Ghamtachi-bhaji, Kutalccurukki, Madana, Madanabadu, Nathai choori, Nattaccuri, Tartaval, Thaarthaaval pacha, Thathara.*

2.4 Medicinal uses
Spermacoce hispida is used to heal stomach ailments and also used as tonic and anti dandruff. The flowers have been applied to boils, eruptions, swellings and also regarded as an emetic and as a remedy for coughs and malaria.

3. Materials and Method
Matured fresh leaves of *Spermacoce hispida* L., *Mollugo cerviana*, and *Aeschynomene indica* were gathered separately in a perforated polythene bag from the foothills of Vallimalai, an extension of the Eastern Ghats, in the Vellore District. To get rid of the insects' eggs and larvae as well as other filthy things stuck to the leaves, they were all carefully rinsed with tap water. The newspapers were immediately covered uniformly with freshly washed leaves to eliminate the moisture, and they were left that way in a dark area until completely dry. By manually crushing the leaves, the entire drying process was ensured. The dried leaves were then ground into a fine powder and placed into the Soxhlet apparatus' thimble. With the aid of a heating mantle, the bottom of the Soxhlet, which was filled with methanol, was heated to a temperature that was just one or two degrees Celsius below the boiling point of methanol. The presence of a pale white powder inside the thimble indicated that all of the phytocompounds had been extracted. The thimble's bottom-collected green extracts were poured over the petri dish, which was then left at room temperature to allow the methanol to evaporate. After that, they were powdered by drying them under vacuum pressure. A transparent pellet was created by combining the dried powder with KBr. Finally, the pellet was stored in a holder while FTIR was used to analyse the bioactive chemicals.

4. Result and Discussion
FTIR analysis was used to identify bioactive phytocompounds in methanol leaf extract of the plant *Spermacoce hispida*, *Mollugo cerviana* and *Aeschynomene indica*. The results of the present study given in the Table 1. Showed a total of 31 peaks, indicating the presence of 20 different bioactive compounds. The spectral peak at 3388.32 (3400-3300) with medium N-H Stretching indicates the presence of aliphatic

primary amine showed a concordant with the results observed in the methanol extract of *Solanum surratence* [23]. The peak at 3037.34 (medium C-H stretching) exhibit the presence of bioactive compounds alkenes have a strong resemblance with methanol leaf extract of *Annonas quamosa* [24]. The spectral peaks at 2954.41, 2923.56 2879.2 (medium C-H Stretching), 1455.99 (medium C-H bend) and 723.175 (medium C-H rock)for alkanes have mere similarity with the peaks at 2995.87, 2954.41, 2923.56, 2848.35 and 2875.34 for methanol leaf extract of *Andrographis echioides* [25], peaks at 2991.05, 2921.63, 2873 and 42, 2856 for methanol leaf extract of *Cumin cyminum* [26], peaks at 2923.36, 2879.2 and 2855.1 for methanol leaf extract of *Tephrosia purpurea* [27], peaks at 2925.48 and 2856.06 for methanol leaf extract of *Cardiospermum halicacabum*[28], peaks at 2991.05, 2873.42 and 2856.06 for the methanol leaf extract of *Cumin cyminum* [29]. Peaks at 2848.35 (strong boroad N-H stretching) indicates the presence of amine salt has a concordance with the peak at 2770.24 observed for *Cumin cyminum* [29]. Peaks at 2772.17 (medium H-C=O: C-H Stretching) for the presence of aldehyde showed a mere similarity with peaks at 1844.8 for *Andrographis echioides* [25]. Peaks at 1812.76 (weak C-H bending) for the presence of aromatic compound has a concordance with peaks at 1864.83 for *Cocos nucifera*, at 1895.68, 184.22 and 1833.97 for C*umin cymiun*, *Solanum lycoperisicum* and *Cocusnusifera* [26] 1836, 86 *Tephrosia purpurea* [27]. The peak at 1730.8 (Strong C=O stretching) indicates the existence of α, β-unsaturated ester, which resembles peaks at 1720.19 for *Cardiospermum halicacabum* [28]. Absorption peaks at 1702.84 (strong C=O stretching) indicates that Conjugated aldehyde has a concordance with similar results observed for peaks at 1698.98 in *Cardiospermum halicacabum* [28]. Peaks at 1671.98 (weak C=C stretching), 1651.73 (medium C=C stretching), 1606.41 (medium C=C stretching) and 830.205 (medium C=C bending) indicates the presence of bioactive phytocompounds alkene and conjugated alkene which have some similarity with peaks observed at 822.491, 712.569 for alkenes in *Andrographis echioides* [25], at 3008.41 for C*umin cymiun*, *Solanum lycoperisicum* and *Cocusnusifera* [26], at 1627.63,1654.62, 977.733, 806.099 and 888.059 for *Tephrosia purpurea* [27], 1656.77, 832.133, 800.314 and 710.64 for *Cardiospermum halicacabum* [28], at 1606.41 for Conjugated alkene in *Tephrosia purpurea* [27], at 1634.38, 1603.52 in *Andrographis echioides* [25]. Spectral peaks at 1410.67 (strong S=O stretching) for sulfonyl chloride has a close resemblance with Sulfonyl chloride in *Cardiospermum halicacabum* at 1408.75 [28], 1380.141 *C.cyminum* [29]. Spectral peaks at 1520.6 (strong N-O asymmetric stretch) for nitro-compound showed a similarity with Nitro compounds in *Andrographis echioides* at peaks 1513.85, 1486.85 [25], in *Tephrosia purpurea* at 1504.2, 1531.2 and 1482.99 [27], in *Cardiospermum halicacabum* at 1522.52, 1478.17 and 1498.42 [28]. Spectral peaks at 1379.82 (medium O-H bending) for Phenol has a close resemblance with phenol in *C.cyminum* at 1322.93 [29] in *Andrographis echioides* at 1386.57, 1311.36 [25], in C*umin cymiun*, *Solanum lycoperisicum and Cocusnusifera* at 1325.82 [26].Peaks at 1328.71(strong C-N stretching) for aromatic amine has a close relationship with aromatic amine in *Tephrosia purpurea* at 1324.86 [27], in C*umin cymiun*, *Solanum lycoperisicum and Cocusnusifera* at 1236.15 [26]. Peaks at1249.65 (strong C-O stretching) for alkyl aryl ether showed a close similarity with Alkyl aryl ether in *C.cyminum* at 1246.75 [29] in *Andrographis echioides* at 1228.43 [25]. Peaks 211.08 (strong C-O stretching) forvinyl ether has strong concordant with vinyl ether in *Andrographis echioides* at 1204.33 [25], in C*umin cymiun*, *Solanum lycoperisicum and Cocusnusifera* at 1225.54, 1208.18 and 1205.29 [26], in *Tephrosia purpurea* at1204.33 [27]. The pectral peaks at1166.72 (strong C-O stretching) forester has a strong similarity withester in *Cardiospermum halicacabum* at1190.83, 1170.58 [28], in *Tephrosia purpurea at* 1184.08 [25], in *Andrographis echioides* at 1184.08 [25]. Spectral peaks at 1135.87 (strong C-O stretching) for tertiary alcohol has a strong closeness with tertiary alcohol in *Andrographis echioides* at 1159.97, 1142.62 [25], in C*umin cymiun, Solanum lycoperisicum and Cocusnusifera* at 157.08, 1129.12 [26]. Spectral peaks at 1074.16 (strong C-O stretching) for primary alcohol has a concordance with primary alcohol *Andrographis echioides* in 1080.91, 1056.8[25], in C*umin cymiun*, *Solanum lycoperisicum* at 1077.05 and in *Cocusnusifera* at 1070.3 [26], in *Tephrosia purpurea* at 1067.41 [27]. The peaks at 918.914 (medium O-H bend) for carboxylic acids exhibit a mere intimacy with carboxylic acids *Cardiospermum halicacabum* at 935.306 [28], in *Tephrosia purpurea* at 1706.69, 1424.17 and 918.914 [27], in C*umin cymiun* at 1716.34, 1436.71, 939.163, 921.807 [26], in *Solanum lycoperisicum* at 940.128, 916.022 [26], in *Cocusnusifera* at 2672.86, 1422.24 [26], in C*umin cymiun*, *Solanum lycoperisicum and Cocusnusifera* at 2676.71, 2621.75, 1557.24, 1422.24, 917.95[26], in *Andrographis echioides* at 1417.42, 929.521 [25], in *C.cyminum* at 1716.34, 1436.71 and 939.163 [29]. Peaks at 863.953 (strong C-H ‘Oop’’) for aromatics has nearness with aromatics in *Cardiospermum halicacabum* at 1447.31 [28], in *Tephrosia purpurea* at 3013.23, 861.06 and 788.743 [27], in C*umin cymiun* at 1454.06, 897.701 [26] in *Solanum lycoperisicum* at 863.953[26], in C*umin cymiun*, *Solanum lycoperisicum* and *Cocusnusifera* at 869.739 [26], in *Andrographis echioides* at1441.53, 757.888 [25], in *Cumin cyminum* at 1454.06, 897.701 [29]. The spectral peaks at 599.753 (strong C-l stretching) indicate the presence of halo compound has an affinity with halo compound in *Cardiospermum halicacabum* at 624.823 [28], in *Tephrosia purpurea* at 602.646, 534.185 [27], in *Cocusnusifera* at 662.428, 590.111, 507.187 [26], in C*umin cymiun, Solanum lycoperisicum and Cocusnusifera* at 755.96 [26], in *Andrographis echioides* at 575.646, 534.185 [25].

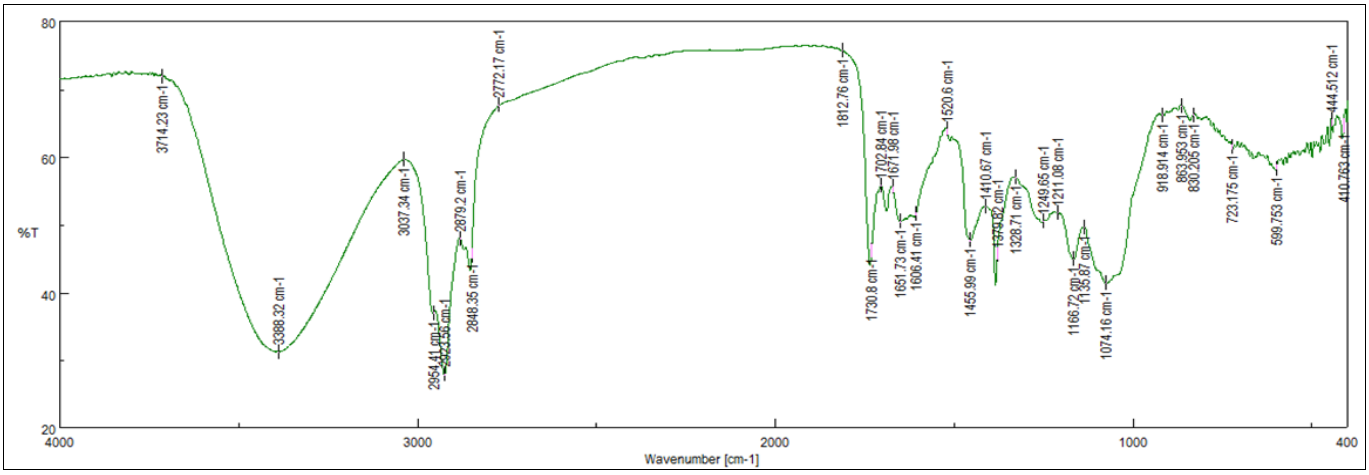


Fig 1: FTIR spectrum of methanol extract of leaf of *Spermacoce hispida* L.

Table 1: FTIR peak values elated reference range, functional group and bioactive compounds for methanol extract of leaf of *Spermacoce hispida* L.

S. No	Wave number cm^{-1} (reference article)	Wave number (cm^{-1}) (Test Sample)	Functional group assignment	Intensity	Phytocompound identified
1.	-	3714.23	-	-	Unknown
2.	3400-3300	3388.32	N-H Stretching	Medium	Aliphatic primary amine
3.	3100-3000	3037.34	C-H stretching	Medium	Alkene
4.	3000–2850	2954.41	C-H Stretching	Medium	Alkanes
5.	3000–2850	2923.56	C-H Stretching	Medium	Alkanes
6.	3000–2850	2879.2	C-H Stretching	Medium	Alkanes
7.	3000-2800	2848.35	N-H stretching	strong, broad	Amine salt
8.	2830–2695	2772.17	H-C=O: C-H Stretching	Medium	Aldehydes
9.	2000-1650	1812.76	C-H bending	Weak	Aromatic compound
10.	1730-1715	1730.8	C=O stretching	Strong	α,β-unsaturated ester
11.	1710-1685	1702.84	C=O stretching	Strong	Conjugated aldehyde
12.	1678-1668	1671.98	C=C stretching	Weak	Alkene
13.	1662-1626	1651.73	C=C stretching	Medium	Alkene
14.	1650-1600	1606.41	C=C stretching	Medium	Conjugated alkene
15.	1470–1450	1455.99	C-H bend	Medium	Alkanes
16.	1550–1475	1520.6	N-O asymmetric stretch	Strong	Nitro compound
17.	1410-1380	1410.67	S=O stretching	strong	Sulfonyl chloride
18.	1390-1310	1379.82	O-H bending	Medium	Phenol
19.	1342-1266	1328.71	C-N stretching	Strong	Aromatic amine
20	1275-1200	1249.65	C-O stretching	Strong	Alkyl aryl ether
21.	1225-1200	1211.08	C-O stretching	Strong	Vinyl ether
22.	1210-1163	1166.72	C-O stretching	Strong	Ester
23.	1205-1124	1135.87	C-O stretching	Strong	Tertiary alcohol
24.	1085-1050	1074.16	C-O stretching	Strong	Primary alcohol
25.	950–910	918.914	O-H bend	Medium	Carboxylic acids
26.	900–675	863.953	C-H ‘Oop’’	Strong	Aromatics
27.	840-790	830.205	C=C bending	Medium	Alkene
28.	725–720	723.175	C–H rock	Medium	alkanes
29.	600-500	599.753	C-l stretching	strong	Halo compound
30.	-	444.512	-	-	Unknown
31.	-	410.763	-	-	Unknown

5. Conclusion

The plant *Spermacoce hispida* is traditionally used to cure many diseases and disorders because of the presence of all above bioactive phytocompounds aliphatic primary amine, alkene, alkanes, amine salt, aldehydes, aromatic compound, α, β-unsaturated ester, conjugated alkene, nitro compound, sulfonyl chloride, phenol, aromatic amine, alkyl aryl ether, vinyl ether, ester, tertiary alcohol, primary alcohol, carboxylic acids and halo compound.

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