Phytochemical screening by FTIR spectroscopic analysis of ethanolic root extracts of ethnoveterinary medicinal plants

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A B S T R A C T

There has been an increasing interest worldwide on therapeutic values of natural product. The nature provide the mankind vast therapeutic flora with a wide variety of medicinal potential. The revival of intrest in plant derived drugs is mainly due to the current widespread belief that "green medicine" is safe and more dependable than the closely synthetic drugs many of which have adverse side effects. The chemical constituents of plants is desirable for the discovery of therapeutic agents and in discovery the actual value of folklore remedies. Medicinal plants contain organic compounds which provide definite physiological action on the human and animal body. The curative properties of medicinal plants are due to presence of various bioactive substances of different composition which occur as secondary metabolite. These bioactive substances includes tannins, alkaloids, glycosides, phytosterols, saponins, flavonoids, terpenoids, essential oils etc.

Whole plants or plant parts like roots, tubers, stems, leaves, flowers, seeds etc. acts as medicinally significant parts. Tribal medicinemen and herbal practitioners from rural areas used plant and plant parts to cure their ailments as well as their live stocks. 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. While studying the *in vitro* efficacy of bioactive extracts of 15 medicinal plants against ESL producing multi drug resistant bacteria, Iqbal Ahamad *et al*. (2006) detected major groups of compounds as the most active fraction of four plants extracts by infrared spectroscopy. Ramamoorthi and Kannan (2007) screened the bioactive group of chemicals in the dry leaf powder of *Calotropis gigantea* by FTIR analysis. Kareru *et al*. (2008) detected saponins in crude dry powder of 11 plants using FTIR spectroscopy.

Ke ywo rds : *Ampelocissus latifolia, Parthenocissus quinquefolia , Spatholobus purpureus , Peucedanum nagpurnse* , FTIR Spectroscopy, Functional groups.

Introduction

The present study is aimed to analyse the ethanol, benzene, chloroform , acetone, petroleum ether and distill water extracts of roots of 4 medicinal plants such as *Ampelocissus latifolia, Parthenocissus quinquefolia , Spatholobus purpureus , Peucedanum nagpurnse* through FTIR spectroscopy method. The FTIR spectroscopic studies revealed different characteristic peak values with various functional compounds in the extracts. The FTIR analysis of Ethanol root extracts of *Ampelocissus latifolia, Parthenocissus quinquefolia , Spatholobus purpureus and Peucedanum nagpurnse* confirmed the presence of amide, alcohols, phenols, alkanes, carboxylic acids, aldehydes, ketones, alkenes, primary amines, aromatics, esters, ethers, alkyl halides and aliphatic amines compounds, which showed major peaks. The FTIR method was performed on a spectrophotometer system, which was used to detect the

characteristic peak values and their functional groups. The results of the present study generated the FTIR spectrum profile for the medicinally important plants of *Ampelocissus latifolia, Parthenocissus quinquefolia , Spatholobus purpureus , Peucedanum nagpurnse* can be used in the ethnoveterinary practices. The FTIR analysis of aqueous methanolic leaf extracts of *Bauhinia racemosa* for phytochemical compounds was done by Gauravkumar *et al*. (2010).Ragavendran *et al*. (2011) detected the functional groups in various extracts of *Aerva lanata* using spectroscopic method. Thangarajan Starlin *et al*. (2012) detected the elements and functional groups in the ethanol extract of whole plant of *Ichnocarpus frutescens* using FTIR spectroscopic method. Paraj A.Pednekar and Bhanu Raman (2013) carried out the FTIR spectroscopic analysis of methanolic leaf extract of *Ampelocissus latifolia* for antimicrobial compounds. A survey of literature revealed that the FTIR analysis of functional groups was not done so far with the medicinal plants such as *Ampelocissus latifolia, Parthenocissus quinquefolia , Spatholobus purpureus , Peucedanum nagpurnse*. Hence, an attempt is made in the present study to analyse the functional groups of phytoactive compounds present in the root extracts (in different solvents such as ethanol, benzene, chloroform, acetone, and distill water) of the four ethnoveterinary medicinal plants, *Ampelocissus latifolia, Parthenocissus quinquefolia , Spatholobus purpureus , Peucedanum nagpurnse* by FTIR spectroscopic analysis.

Materials and Methods

Collection of plant

Root samples of four ethnoveterinary medicinal plant species such as *Ampelocissus latifolia and Parthenocissus quinquefolia* (Family: Vitaceae) , *Spatholobus purpureus* (Family: Fabaceae) and *Peucedanum nagpurnse, (*Family: Apiaceae*)* were collected from Sarni and Ghodadongri forest area of Betul District, Madhya Pradesh , India and identification of the plant species was done with the help of Flora of Kolhapur District , Dr. S. R. Yadav, Professor of Botany, Shivaji University, Kolhapur.

Preparation of root extract

The shade dried roots of each plant (at 20 C) were powdered in mechanical grinder. 20 grams of root powder (of each plant) was weighed, 150 ml of solvent was added and kept for 3 days. The extract was filtered using Whatman No.1 filter paper and the supernatant was collected. The residue was again extracted two times (with 3 days of interval for each extraction) and supernatants were collected. The supernatants were pooled and evaporated (at room temperature, 28 ± 1 C) until the volume was reduced to 150 ml. Extracts of the root powder of the four plants with ethanol solvents were prepared and stored in air tight bottles for further analysis

Fourier Transform Infrared Spectrophotometer (FTIR)

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 light 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 different solvent extracts of each plant materials were used for FTIR analysis. 10 mg of the dried extract powder was encapsulated in 100 mg 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 1, Japan), with a Scan range from 400 to 4000 cm 1 with a resolution of 4 cm 1.

Results and Discussion

The FTIR spectrum of root extracts prepared in ethanol solvents) of *Ampelocissus latifolia, Parthenocissus quinquefolia , Spatholobus purpureus and Peucedanum nagpurnse* are given in Fig 1 to 4. The data on the peak values and the probable functional groups (obtained by FTIR analysis) present in the root extracts prepared in ethanol *Ampelocissus latifolia, Parthenocissus quinquefolia , Spatholobus purpureus and Peucedanum nagpurnse* are presented in Tables 1 to 4.

FTIR spectral data interpretation in Ethanol (E) extract

Ampelocissus latifolia

It exhibited characteristic band at 3259.90 cm^{-1} shows the presense of O-H stretching and at 2922.99 cm^{-1} shows the C-H stretching, at 2854.15 cm^{-1} shows the O-H stretching, at 2343.20 cm^{-1} shows C=_N stretching, at 2113.52 cm^{-1} shows C=_C stretching, at 1515.76 cm^{-1} shows C=N stretching, at 1441.84 cm^{-1} shows C-H bending, at 1368.14 cm^{-1} shows C-H bending in Ethanolic extract..

Parthenocissus quinquefolia

It exhibited characteristic band at 2959.26 cm^{-1} shows the presense of C-H stretching and O-H stretching (Carboxylic acid), at 2927.71 cm^{-1} shows the C-H stretching (Alkanes), at 2871.73 cm^{-1} shows the C-H stretching, at 1462.29 cm^{-1} shows C-C stretching(Aromatic), at 1379.23 cm^{-1} shows C-H stretching, at 1298.23 cm^{-1} shows N-O symmetric stretching (Nitro compound), at 725.68 cm^{-1} shows C-Cl stretching (Alkyl halide), at 762.72 cm^{-1} shows N-H way (Primary, Secondary amine) in Ethanolic extract.

Spatholobus purpureus

It exhibited characteristic band at 3324.86 cm^{-1} shows the presense of N-H stretch (Primary, secondary Amine, amide) and at 2975.15 cm^{-1} shows the C-H stretching (Alkanes), at 1416.66 cm^{-1} shows the C-C stretching(Aromatic amine), at 1087.37 cm^{-1} shows C-N stretching(Aliphatic amine), at 945.21 cm^{-1} shows O-H bend (Carboxylic acid), at 802.52 cm^{-1} shows C-Cl stretching(Alkyl halides), at 880.35 cm^{-1} shows N-Hl way (primary, secondary amine) in Ethanolic extract.

Peucedanum nagpurnse

It exhibited characteristic band at 3356.73 cm^{-1} shows the presense of N-H bonded and at 2975.28 cm^{-1} shows the C-H stretching , at 2929.48 cm^{-1} shows the C-H stretching, at 1713.97 cm^{-1} shows C=O stretching , at 1661.16 cm^{-1} shows C=N stretching, at 1452.66 cm^{-1} shows C=C stretching, at 1414.48 cm^{-1} shows C=C stretching, at 1329.56 cm^{-1} shows C-F stretching in Ethanolic extract.

Table.1 FTIR spectral peak values and functional groups obtained for the root extract in ethanol solvents of *Ampelocissus latifolia*

Functional groups	**Peak values**
O-H stretch	3092.02
C-Hstretch	3036.49
O-Hstretch	2888.61
C=_N stretch	2387.81
C=_C stretch	2326.77
C=Nstretch	1528.42
C-H bending	1478.39
C-H bending	1393.48

Table.2 FTIR spectral peak values and functional groups obtained for the root extract in ethanol solvents of *Parthenocissus quinquefolia*

Peak values	**Functional groups**
2959.26	C-H stretch,O-H stretch
2927.71	C-H stretch
2871.73	O-H stretch
1462.29	C=_N stretch
1379.23	C=_C stretch
1298.23	C=N stretch
725.68	C-H bending
762.72	C-H bending

Table.3 FTIR spectral peak values and functional groups obtained for the root extract in ethanol solvents of *Spatholobus purpureus*

Peak values	**Functional groups**
3324.86	N-H stretch
2975.15	C-H stretch
1416.66	C- C group
1087.37	C-N stretch
945.21	O-H bending
802.52	C-Cl group
880.35	N-H way

Table.4 FTIR spectral peak values and functional groups obtained for the root extrac in ethanol solvents of *Peucedanum nagpurnse*

Peak values	**Functional groups**
3356.73	N-H bonded
2975.28	C-H stretch
2929.48	C-H stretch
1713.97	C=O stretch
1661.16	C=N stretch
1452.66	C=C stretch
1414.48	C=C stretch
1329.56	C-F stretch

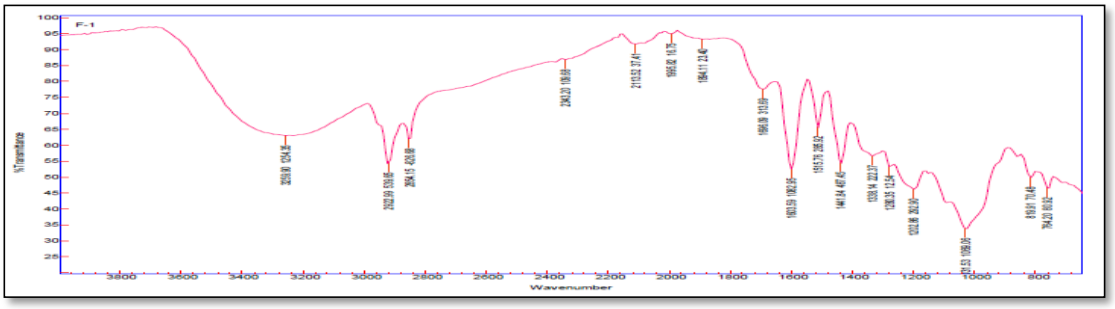

Fig.1 : FT-IR spectrum of *Ampelocissus latifolia* in Ethanolic extract

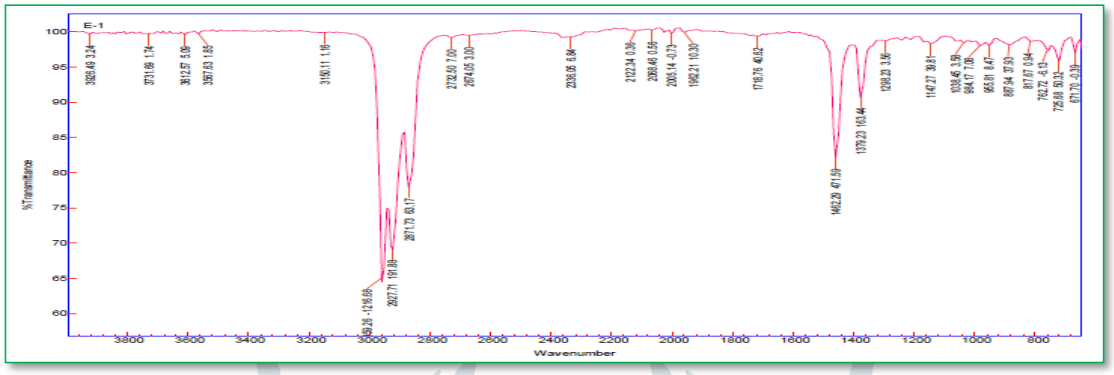

Fig.2 : FT-IR spectrum of *Parthenocissus quinquefolia* in Ethanol extract

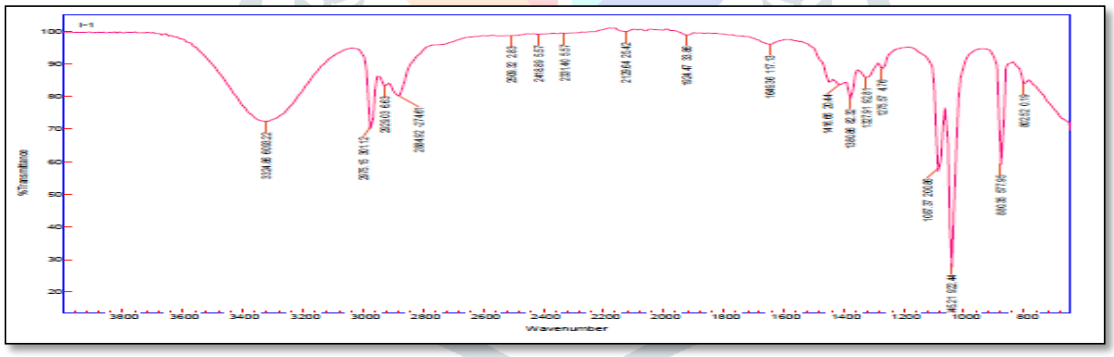

Fig. 3: FT-IR spectrum of *Spatholobus purpureus* in Ethanol extract

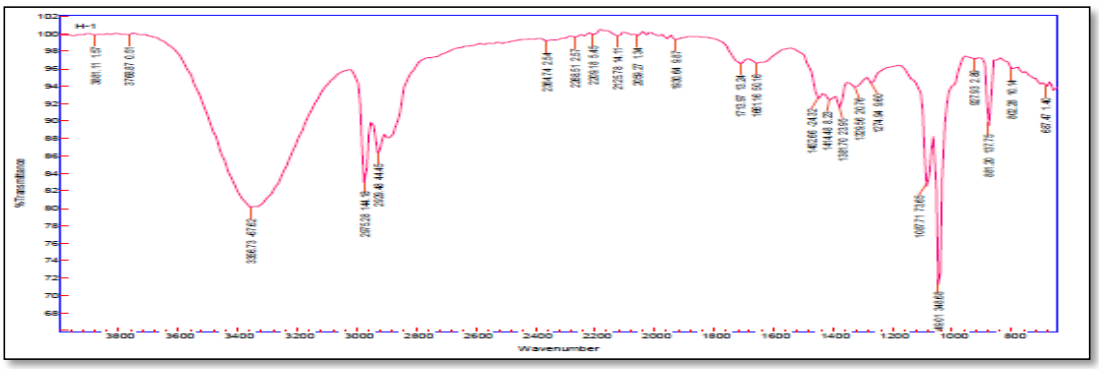

Fig. 4 : FT-IR spectrum of *Peucedanum nagpurnse* in Ethanol extract

From the results obtained in the present study, it could be concluded that the root extracts in ethanol solvents of *Ampelocissus latifolia, Parthenocissus quinquefolia , Spatholobus purpureus , Peucedanum nagpurnse* with their phytoconstituents may act as source of antibiotics. The various functional groups observed in the different extracts probably indicate the presence of carbohydrates, carotenoid, glycogen, amino acids, amides, starch, calotropin, calotropogenin, phosphates, lipids, glycogen and cellulose. Among the functional groups observed in the extracts, OH group was found to be present uniformly only in the ethanol extracts of all plants. As OH group has got the ability of forming hydrogen bonding capacity, presence of OH group particularly in ethanol extract of root of all the 4 plants probably indicates the higher potential of ethanol extract towards inhibitory activity against microorganisms. Such a higher antimicrobial activity of ethanol extracts of root of all those four plants have been already demonstrated (Ashokkumar and Ramaswamy, 2013) together with low IC50 value (Ashokkumar and Ramaswamy, 2013).

Conclusion

The present study focuses the adoption of folk medicines for immediate action on animals care along with livestock related social realities. Moreover, it would be necessary to harness the benefits of organic products from dairy animals and for improving the livelihood of tribal and rural society. In general the study suggested further investigation on the valuable plants would be necessary to derive the fruits of them in animal healthcare practices with scientific approach.

References

Akinjogunla, N.O., Eghafona,I.O., Enabulele,C.I., Mboto, and Ogbemudia, F.O. 2010. African Journal of Pharmacy and Pharmacology. 4 (6): 402-407.

Ashokkumar, R., and Ramaswamy, M. 2013. Comparative study on the antimicrobial activity of leaf extracts of four selected Indian medicinal plants against *Pseudomonas aeruginosa, Pseudomonas fluorescens, Penicillium chrysogenum* and *Penicillium restrictum.* Journal of Chemical, Biological and Physical Sciences. 3(2): 1376-1381.

Ashokkumar, R., and Ramaswamy, M. 2013. Determination of DPPH free radical scavenging oxidation effects of methanolic leaf extracts of some Indian medicinal plant species. Journal of Chemical, Biological and Physical Sciences. 3(2): 1273-1278.

Gaurav Kumar, L., Karthik and Bhaskara Rao, K.V. 2010. Phytochemical composition and *in vitro* Antimicrobial activity of *Bauhinia racemosa* Lamk (CAESALPINIACEAE). International Journal of Pharmaceutical Sciences and Research. 1(11): 51-58.

Iqbal Ahmad and Farrukh Aqil. (2007). *In vitro* efficacy of bioactive extracts of 15 medicinal plants against ESbLproducing multidrug-resistant enteric bacteria. Microbiological Research. 162, 264 - 275.

Kareru, P.G., Keriko, Gachanja, J.M., and Kenji, A.N. 2008. Direct detection of triterpenoid saponins in medicinal plants. African Journal of Traditional, Complementary and Alternative Medicines. 5 (1): 56 60.

Mueen Ahmed, K.K., Rana, A.C., Dixit, V.K. 2005. Calotropis species (Asclepediaceae). A comprehensive review. Pharmacognosy Magazine. 1(2): 48 52.

Muruganantham, S., Anbalagan, G., and Ramamurthy, N. 2009. FT-IR and SEM-EDS Comparative Analysis of Medicinal Plants, *Eclipta alba* Hassk and *Eclipta prostrata* Linn. Romanian Journal of Biophysics. 19(4): 285 294.

Parag A. Pednekar, Bhanu Raman. 2013. Antimicrobial and Antioxidant Potential with FTIR analysis of *Ampelocissus latifolia* (roxb.) Planch. Leaves. Asian Journal of Pharmaceutical and Clinical Research. 6(1): 67-73

Ragavendran,P., Sophia,D., Arul Raj,C., and Gopalakrishnan V.K., 2011. Functional group analysis of various extracts of *Aerva lanata* (L.,) by FTIR spectrum. Pharmacologyonline. 1, 358-364.

Ramamurthy,N., and Kennan, S., 2007. Fourier transform infrared spectroscopic analysis of a plant (*Calotropis gigantean* Linn) from an Industrial Village, Cuddalore Dt, Tamilnadu, India.

Romanian Journal of Biophysics. 17 (4): 269 276. Redwane, A., Lazrek, H.B., Bouallam, S.,
Markouk, M., Amarouch, H., and Jana, M. 2002. Larvicidal activity of extracts from *Quercus iusitanica* var. *Infectoria* galls (Oliv.). Journal of Ethnopharmacology. 79, 261-263.

Thangarajan Starlin, Paramasivam Ragavendran, Chinthamony Arul Raj, Palanisamy Chella Perumal and Velliyur Kanniappan Gopalakrishnan. 2012. Element and Functional Group Analysis of*Ichnocarpus frutescens* R. Br. (Apocynaceae). International Journal of Pharmacy and Pharmaceutical Sciences. 4(5): 343-345.