INTERNATIONAL RESEARCH JOURNAL OF PHARMACY
www.irjponline.com ISSN 2230 – 8407
Research Article

FOURIER TRANSFORM INFRA RED (FT-IR) SPECTRAL STUDIES OF *FOENICULUM VULGARE*

V. Devika[1]*, S. Mohandass[2], T. Nusrath[1]
[1]Assistant Professor, Department of Biochemistry, Dr.N.G.P. Arts and Science College, Coimbatore, India
[2]Principal, Kaamadhenu Arts and Science College, Sathyamangalam, India
Email:devikangp@gmail.com

Article Received on: 13/01/13 Revised on: 21/02/13 Approved for publication: 11/03/13

DOI: 10.7897/2230-8407.04343
IRJP is an official publication of Moksha Publishing House. Website: www.mokshaph.com

ABSTRACT
Plants have been used in traditional medicine for several thousand years. Medicinal plants as a group comprise approximately 8000 species and account for about 50% of all the higher flowering plant species in India. In the present study, the plant *Foeniculum vulgare* was subjected to FT-IR spectroscopy. FT-IR-is a vibrational spectroscopy that records absorptions of IR light by chemical bonds in all molecules incl. polymers. *Foeniculum vulgare* (Apiaceae) commonly known as fennel is a well known and important medicinal and aromatic plant widely used as carminative, digestive, lactogogue and diuretic and in treating respiratory and gastrointestinal disorders. The results showed the detections of the bands in organic molecules. Thus the study became evident that the plant posses some bioactive compounds at various bands obtained after FT-IR.
Keywords: FT-IR, *Foeniculum vulgare*, Fennel, Spectroscopy

INTRODUCTION

Since ancient times, plants have been an exemplary source of medicine.[1] The use of traditional medicines and medicinal plants in most developing countries as therapeutic agents for the maintenance of good health has been widely observed. The World Health Organization estimated that 80% of the populations of developing countries rely on traditional medicines, mostly plant drugs, for their primary health care needs.[2]

Nowadays, many of the plants around the world are used for medicine. These plants actually have healing properties which are known as medicinal plants. Most of plants are usually related to natural products, which are known or actually refer to herbs and dietary supplement. The compounds that are responsible for medicinal property of the drug are usually secondary metabolites. Plant natural product chemistry has played an active role in generating a significant number of drug candidate compounds in a drug discovery program[3]. Plants are the richest resource of drugs of traditional systems of medicine, modern medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drugs.[4]

Infrared (IR) spectroscopy has the potential to provide biochemical information without disturbing the biological sample. Consequently, the spectroscopic study of biological cells and tissue is an active area of research, its primary goal being to elucidate how accurately infrared spectroscopy can determine whether cells or tissue are damaged. Fourier transforms infrared Spectrometers, with their high signal-to-noise ratio and high precision in absorbance and wave number measurements have caused a resurgence of interest in the use of infrared spectra for identification of biomolecules.[10]

FT-IR is one of the most widely used methods to identify the chemical constituents and elucidate the compounds structures, and has been used as a requisite method to identify medicines in pharmacopoeia of many countries. Owing to the fingerprint characters and extensive applicability to the samples, FT-IR has played an important role in pharmaceutical analysis in recent years.[5]

Infrared spectroscopy is a powerful method for the study of molecular structure and intermolecular interaction in biological tissues and cells.[6] Therefore we made an attempt to study the bimolecular constituents of the medicinal plants.

Fourier transform infrared spectroscopy is preferred over dispersive or filter methods of infrared spectral analysis for several reasons

- It is a non-destructive technique
- It provides a precise measurement method which requires no external calibration
- It can increase speed, collecting a scan every second
- It can increase sensitivity – one second scans can be co-added together to ratio out random noise
- It has greater optical throughput
- It is mechanically simple with only one moving part

Fourier Transform Infrared (FT-IR) spectrometry was developed in order to overcome the limitations encountered with dispersive instruments. The main difficulty was the slow scanning process. A method for measuring all of the infrared frequencies simultaneously, rather than individually, was needed. A solution was developed which employed a very simple optical device called an interferometer. The interferometer produces a unique type of signal which has all of the infrared frequencies "encoded" into it. The signal can be measured very quickly, usually on the order of one second or so. Thus, the time element per sample is reduced to a matter of a few seconds rather than several minutes.

Advantages of FT-IR

Some of the major advantages of FT-IR over the dispersive technique include:

Speed

Because all of the frequencies are measured simultaneously, most measurements by FT-IR are made in a matter of seconds rather than several minutes. This is sometimes referred to as the Felgett Advantage.

Sensitivity
Sensitivity is dramatically improved with FT-IR for many reasons. The detectors employed are much more sensitive, the optical throughput is much higher (referred to as the Jacquinot Advantage) which results in much lower noise levels, and the fast scans enable the co addition of several scans in order to reduce the random measurement noise to any desired level (referred to as signal averaging).

Mechanical Simplicity
The moving mirror in the interferometer is the only continuously moving part in the instrument. Thus, there is very little possibility of mechanical breakdown.

Internally Calibrated
These instruments employ a HeNe laser as an internal wavelength calibration standard (referred to as the Connes Advantage). These instruments are self-calibrating and never need to be calibrated by the user.
These advantages, along with several others, make measurements made by FT-IR extremely accurate and reproducible. Thus, it a very reliable technique for positive identification of virtually any sample. The sensitivity benefits enable identification of even the smallest of contaminants. This makes FT-IR an invaluable tool for quality control or quality assurance applications whether it is batch-to-batch comparisons to quality standards or analysis of an unknown contaminant. In addition, the sensitivity and accuracy of FT-IR detectors, along with a wide variety of software algorithms, have dramatically increased the practical use of infrared for quantitative analysis. Quantitative methods can be easily developed and calibrated and can be incorporated into simple procedures for routine analysis.
Thus, the Fourier Transform Infrared (FT-IR) technique has brought significant practical advantages to infrared spectroscopy. It has made possible the development of many new sampling techniques which were designed to tackle challenging problems which were impossible by older, technology. It has made the use of infrared analysis virtually limitless.
Fennel (*Foeniculum vulgare*) is a plant species in the genus *Foeniculum* (treated as the sole species in the genus by most botanists). It is a member of the family *Apiaceae* (formerly the *Umbelliferae*). It is a hardy, perennial, umbelliferous herb, with yellow flowers and feathery leaves. It is indigenous to the shores of the Mediterranean, but has become widely naturalized in many parts of the world, especially on dry soils near the sea-coast and on riverbanks.[7]
It is a highly aromatic and flavorful herb with culinary and medicinal uses, and, along with the similar-tasting anise, is one of the primary ingredients of absinthe. Florence fennel is a selection with a swollen, bulb-like stem base that is used as a vegetable. Fennel is used as a food plant by the larvae of some Lepidoptera species including the mouse moth and the anise swallowtail[8].
Fennel, *Foeniculum vulgare*, is a perennial herb. It is erect, glaucous green, and grows to heights of up to 2.5 m, with hollow stems. The leaves grow up to 40 cm long; they are finely dissected, with the ultimate segments filiform (threadlike), about 0.5 mm wide. (Its leaves are similar to those of dill, but thinner.) The flowers are produced in terminal compound umbels 5–15 cm wide, each umbel section having 20–50 tiny yellow flowers on short pedicels. The fruit is a dry seed from 4–10 mm long, half as wide or less, and grooved. [9]
Fennel is used for the following:

- Digestion
- slimming and weight loss
- detoxifier
- boosting metabolism
- stomach cramps
- heart burn
- helps with morning sickness
- bloating
- flushing the kidneys
- helpful after chemotherapy and radiation

MATERIALS AND METHODS

Collection and identification of plant material
The shoots stem and leaves of *Foeniculum vulgare* plant were collected from Coimbatore district, TamilNadu and it was authenticated from TNAU, Cbe.

Preparation of the plant material
The leaves and stem were shade dried at room temperature in a clean environment to avoid contamination for 14 days and powdered in a domestic grinder. The powdered samples were stored in air tight glass bottles at room temperature for further analysis.

Sample Preparation
The powdered samples were kept in a lyophilizer to remove moisture. The samples were ground in an agate mortar and pestle in order to obtain fine powder. Powdered leaves and stem samples were mixed with paraffin liquid (at a ratio of3 Identification of cellular components of medicinal plants by FTIR2791/100) completely, and subsequently the mixture of each plant was subjected to FTIR spectroscopic analysis.
The study was carried out in South Indian Textile research Association (SITRA), Coimbatore.

RESULTS AND DISCUSSION

Results of FTIR spectroscopic studies have revealed the existence of various chemical constituents in leaves and stem of *foeniculum vulgare* (Figure 1 - Figure 5).

The IR spectra were recorded and the data are presented as;
Spectra data of *Foeniculum vulgare* are presented as
1. The broad band at 2917.17 cm-1 assigned for pair of <dsp peaks.
2. The strong band at 2849.59 cm-1 assigned for C=O in aldehydes.
3. The band at 3300cm-1 is assigned secondary amines/intermolecular hydrogen bonded OH** (Polymeric Association)
4. The weak band at 1416.76 cm-1 may be due to the presence of tertiary alcohols.
5. The medium band at 1319.69 cm-1 is due to presence of C-H in methyl.
6. The weak band at 1027.30 cm-1 is due to C-O structure in C=C-O-C
7. The band at 1242.66 cm-1 is due to C-O structure in esters.

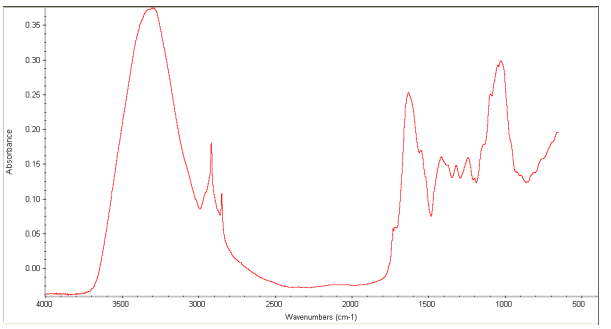

Figure-1

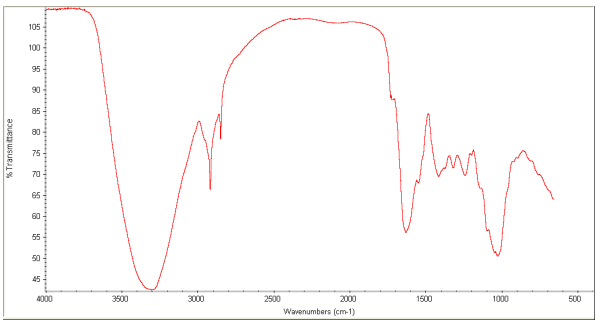

Figure-3

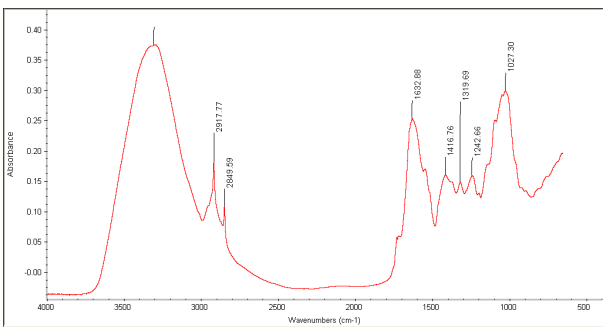

Figure-2

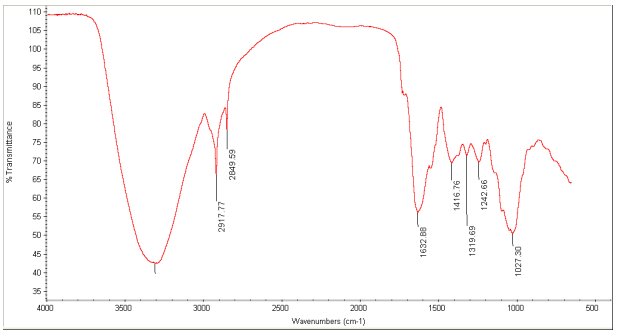

Figure-4

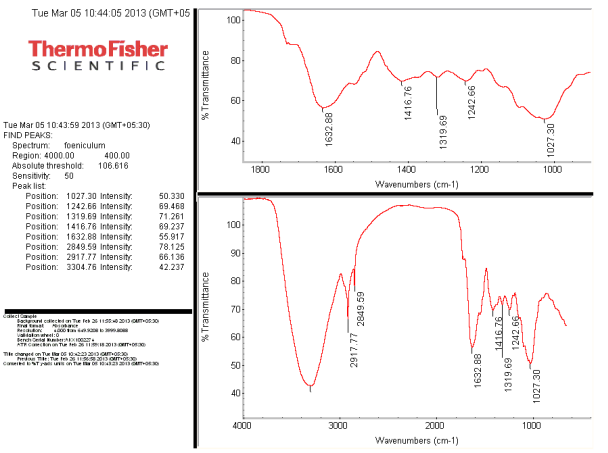

Figure-5

SUMMARY AND CONCLUSION

In the present study we examined the potential of FTIR spectroscopy for easy and rapid discrimination and identification of various functional groups responsible for medicinal properties.

IR spectroscopy is basically a vibrational spectrum. The principle value of this technique relates to the detection of the bands present in organic molecules. Since different bands have different vibrational frequency, the presence of the bands can be detected by identifying the characteristic vibrational frequencies as an absorption band in the IR spectrum.

The presence of characteristic functional groups Carboxylic acids, amines, amides, sulphur derivatives, polysaccharides, organic hydrocarbons, halogens are responsible for various medicinal properties of *foeniculum vulgare*. Further research may help for the identification of new bioactive compounds in these medicinal plants.

ACKNOWLEDGEMENT

We are thankful to our chairman Dr.Nalla.G.Palaniswami, our Madam Secretary Dr.Thavamani.D.Palaniswami and our Principal DR.P.R.Muthuswamy for providing the necessary facilities and encouragement for the entire studies.

REFERENCES

1. Aboelsoud N H, Herbal medicine in ancient Egypt. J Medicinal-Introduction to herbal medicines, (2010), 203: 127-137.
2. Schmincke KH, Medicinal Plants for forest conservation and healthcare. Non- Wood Forest Products. Food and Agriculture Organization of the United Nations. (2003), 58(2): 75-83.
3. Movasaghi Z., Rehman S., Rehman I U, Fourier transform infrared spectroscopy of biological tissues, Applied Spectroscopy Reviews, (2008) 43:134–179. http://dx.doi.org/10.1080/05704920701829043

4. Hammer, Eduardo, Medicinal Plants of the Philippines. Katha Publishing Company. JMC PRESS, Quezon City, Philippines, (2009), 123-173.
5. World Health Organization. Summary of WHO guidelines for the assessment of herbal medicines. Herbal Gram.1993; 28:13-14
6. Muruganantham S., Anbalagan G., Ramamurthy N, , FTIR and SEM-EDS comparative analysis of medicinal plants, Eclipta alba Hassk and Eclipta prostate Linn, Romanian J. Biophs, (2009)., 19(4):285–294.
7. Chen., R J., X U G.Y., Wang H Y., Liu Y M, Study on isolation and structure of polysaccharide XC-1 from Angelica sinesis (olive) diels, Chemistry Bulletin / Huaxue Tongbao, (2001) , 64 (6):372–374.
8. Grieve M., Jing S., Bao R L., Wen J H., Xiao P Q, Invitro anticancer activity of aqueous extracts and ethanol extracts of 15 traditional Chinese medicine on human digestive tumour cell line; .(2005) 21: 1102-1104.
9. Koduru S,, *Allium sativum* (garlic) and cancer prevention. International Journal Vitamin and Nutritional research, (2007) 10: 937-48.
10. S. Muruganantham, G. Anbalagan, N. Ramamurthy-FT-IR and SEM-EDS comparative analysis of medicinal plants, *eclipta alba* hassk and *eclipta prostrata* Romanian J. Biophys., Vol.19, No.4, (2009)P.285-294

Cite this article as:
V. Devika, S. Mohandass, T. Nusrath. Fourier transform infra red (FT-IR) spectral studies of Foeniculum vulgare. Int. Res. J. Pharm. 2013; 4(3):203-206

Source of support: Nil, Conflict of interest: None Declared