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Phytochemical Analysis of *Oregano majorana* L. by Using FTIR Spectroscopic Technique

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Authors' contributions

This work was carried out in collaboration among all authors. Author MAT managed the literature searches, experiment and characterization work. Author MSAA designed the project and wrote the first manuscript. Author SM contributed in technical discussion. This manuscript was finalized by mutual efforts of all the authors.

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Short Communication

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ABSTRACT

The purpose of present research work is to evaluate the phytochemical contents of *Oregano majorana* L. specie endemic to north eastern Punjab region of Pakistan. *Oregano majorana* L was cultivated in our botanical garden under normal atmospheric conditions. Its flowering body parts and stems were plucked and kept in the absence of light for 45 days to avoid any damage or changes which may be possible due to Sun light or other indoor light. Both samples were grinded as fine powder to analyze phytochemical profile of *Oregano majorana* L using FTIR spectroscopic technique. FTIR is most suitable nondestructive, cost efficient, and eco-friendly technique which provides the right platform for researchers. Spectral lines of flowers and non-flowering portion have shown different characteristic peaks. Appropriate correlations of peaks to functional groups present were discussed.

Keywords: Oregano majorana L.; FTIR; phytochemical study; terpenoids; flavonoids.

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1. INTRODUCTION

Plants and their parts have been used as diet and medicine since start of human being [1]. Parts of plants i.e. roots, stems, bark, leaves, flowers, fruits and seeds are used as diet and medicines for human and animals' [2]. Phytochemical contents of plants are their habitat dependent [3]. Phytochemicals of plants are good source of natural phyto-medicins. Herbal medicines (herbal plants based) work slowly but always more effective than synthetic drugs.

The plants are good source of bioactive compounds used as antioxidant, anti-inflammatory and anticancer [4]. Therapeutic action of herbal plants is attributed to the presence of total ester, terpenoids and flavonoids contents [5]. Extracts of herbal plants possess well known bio-medical applications in diseases like respiratory, gastro intestinal and skin etc. [6]. *Oregano majorana* L, is also a well-known for its medicinal, herbal and culinary use [7]. *Oregano majorana* L. contains active compounds against B. subtilis and E. coli, Gram-positive, Gram-negative and E. coli bacteria [8]. Due to medicinal importance of *Oregano majorana* L, its phytochemical analysis was conducted by FTIR. *Oregano* plant, its flowering twig and dried flowering part are showing in Fig. 1.

In literature searches, Plants for hepatic diseases with Secoiridoids Using FTIR technique has been reported [9]. A variety of bioactive compounds present in leafs of *Calotropis gigantea* have been investigated [10]. Saponin, flavonoids and phenolic compounds have been screened out in several Indian plants [11]. Leafs, stem and roots of, *Eclipta Alba* are good source of bioactive compounds [12]. Similarly, *menthe spicata, aloe vera, croton, portulaca*, *Aervalanata, Ichnocarpus frutescens and Ampelocissus latifolia* are well known medicinal plants [13-19].

Current work is a simple effort to assess presence of phytochemicals in *Oregano majorana* L. by taking Infrared spectra on Varian 640-IR using KBr palettes techniques. FTIR spectroscopic technique is becoming more popular and expanding in research areas due to its nondestructive analysis of biological specimens [20]. Fingerprint region of spectral lines (600-1450 cm^{-1}) is most important for cross-examining biological specimen's [21].

2. MATERIALS AND METHODS

Based on leaf morphology and flowering body structure (inflorescence) the plant is recognized as *Oregano majorana* L. The plant is collected from sub-urban region of city Rawalpindi where it is grown wild. To maintain its conservation, few plants were collected from wild and re-grown in herbs garden for further studies.

Flowering bodies were harvested in the month of August; the elongated flowering body or heads (inflorescence) were separated from main plant and set for drying. The flowering heads were isolated manually from shade dried main flowing body. Both flowering heads and remaining parts were grinded to powder and were subjected to analysis. The analysis was performed by KBr pellet method using Varian 640 IR FTIR spectroscopy keeping scan range between 4,000 – 400 cm^{-1}.

In the start of March, white flowers were again grown on *Oregano majorana* L and flowers were plucked and separated successfully from green part (head) for further study as shown in Fig. 2.

Fig. 1. *Oregano majorana* L and flowering parts

Fig. 2. White flowers of *Oregano majorana* L.

3. RESULTS AND DISCUSSION

The FTIR spectra of flowers and non-flowering portion of inflorescence part of plant are presented in Figs. 3 and 4. Important absorption lines of both samples are tabulated in Table 1. Both FTIR spectra of flowering and non-flowering were appeared similar. The case is surprisingly different from our previous observation of FTIR study of other plant species [13]. the reason could be the very small size of flowers compared to green non-flowering part. So we may assume that presence of phytochemical in green non-flowering portion have contributed much to the signals in relevant FTIR spectra.

On the basis of FTIR spectra, expected phytochemical class of compounds are tabulated in following Table 1.

Both spectra confirm the samples were free from moisture. Absence of strong absorption band in the spectrum region between 3400 cm^{-1} and 3100 cm^{-1} indicates the absence of hydrogen bonded OH [22]. IR spectrum of powdered flowers (Fig. 3) and non-flowering part (Fig. 4) was found similar to each other due to possible reason as discussed above.

So collectively it can be inferred easily that peaks at 1000 cm^{-1} are characteristic peaks of alkene (Carvacrol, Caryophyllene, 1,3-pentadiene, resorcine, terpine, linalool etc.) [23]. Peaks at 820 cm^{-1} are also related to R_2C-CHR (alpha-terpineol, pinene etc. type of compounds) [24]. Peaks of high frequency value i.e. 1250 cm^{-1} corresponds to an alcohol and proline while lower peak values nearby 1235 cm^{-1} belonging to acids and ethers (R= C–O-C) [25].

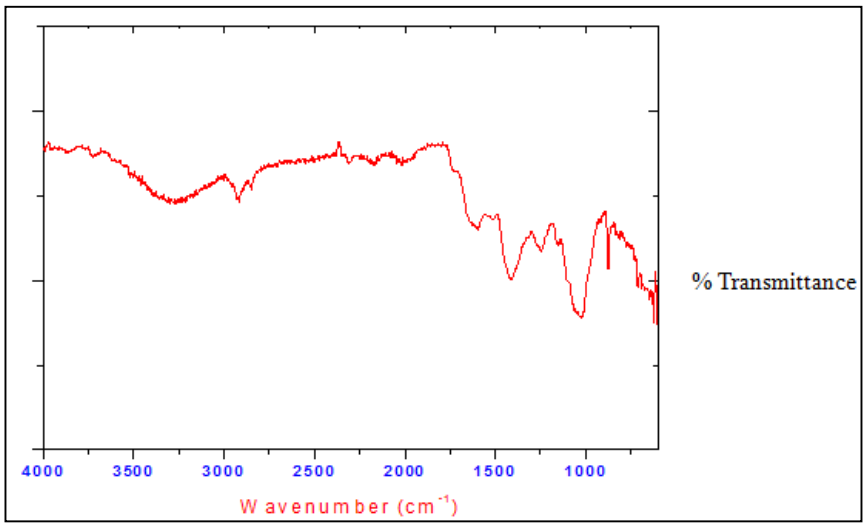

Fig. 3. FTIR spectrum of flowers of *Oregano majorana* L.

Table 1. On the basis of FTIR spectra, expected phytochemical class of compounds are tabulated

Sr. no.	Wave No. cm^{-1} (Test sample)	Wave No. cm^{-1} (Reference)	Appearance	Group assigned	Expected phytochemical class
1.	2937	3200-2700	Weak broad	O-H stretching	Alcohols
		3000-2800	strong	N-H stretching	Amine salts
2.	2875	3000-2840	medium	C-H stretching	Alkanes
3.	1625	1650-1600	medium	C=C stretching	Conjugated alkenes
4.	1416	1420-1330	medium	O-H bending	Alcohols
5.	1235	1250-1020	medium	C-N stretching	Amines
6.	1250	1275-1200	strong	C-O stretching	Aromatic esters
7.	1000	650-1000	strong	C=C bending	Alkenes
8.	829	840-790	strong	C=C bending	Alkenes

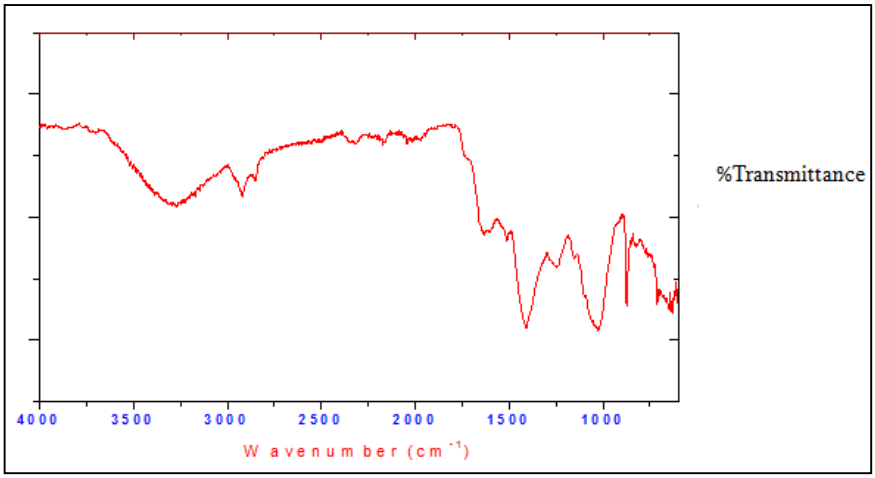

Fig. 4. FTIR spectrum of non-flowering part of flowering twig of *Oregano majorana* L.

Peaks near 1416 cm^{-1} are related to saturated alkyls, Peaks at 1625 cm^{-1} shows the presence of C=C belonging to aromatic compounds. FTIR of both flowering and non-flowering twig have shown broad signal of medium intensity in the region between 3600 cm^{-1} and 3100 cm^{-1} that corresponds to the presence of non-hydrogen bonded OH, along with weak but characteristic signals of small intensity between 2937 cm^{-1} and 2875 cm^{-1} specific to sp^3-C-H stretch indicating bicyclic, phenolic and many other classes of compounds.

4. CONCLUSION

The plant species belong to genus Croton are known to contain important phytochemicals which belong predominantly to family of cyclic terpenoids, chiefly di-terpenoids types like monocyclic and aliphatic aromatic along with organic phenols mainly gallic acid, caffeic acid, vanillic acid and syringic acid. Clear FTIR spectra of both flowers and non-flowering portion revealed that fine powdered samples of delicate plant parts can be tested precisely using this technique if they are well shade dried and moisture free. Presence of active functional groups is in close agreement with the signals especially non-hydrogen bonded –OH, saturated hydrocarbon functionalities and alkenes etc. The study highlights the medicinal importance of the plant and explores new visions for further advanced spectroscopic techniques for structural elucidation of the compounds present in oregano.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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