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Spectroscopic Analysis Medicinal Herbs of *Mentha longifolia* (L.) Huds by Fourier Transform Infrared Spectroscopy

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Abstract

Objective: Each medicinal herb contains one or more effective materials that are defined for therapeutic use according to the active ingredient of the plant. Since chemical drugs have side effects the value of medicinal plants is still preserved after several centuries. One of these spectroscopic methods for identifying functional groups in medicinal plants is (FTIR).

Material and Methods: This study aimed to identify the functional groups of Mentha longifolia medicinal plants native to Ilam by Fourier-transform infrared spectroscopy (FTIR) method so that by recognizing the main and effective compounds of plants we can more easily step towards, recognizing and producing biomolecules and herbal medicines.

Results: According to the results of spectroscopy, it was found that this plant has 15 spectra, including groups O-H, C-H, C = C, N-O, C-O, S = O, C-Br, and C-I.

Conclusion: The results of the present study show the phytochemical of this plant. Further advanced studies are recommended to determine the composition of this plant.

Introduction

Mentha longifolia (L.) Huds is one of these medicinal plants that have a long history of use in the traditional medicine of Iran and various nations and has been mentioned for its remarkable healing properties. This plant has the highest distribution among other medicinal plants in our country [1-3]. Horse mint, which in Persian has other names such as pudneh, pong, fudge, or padneh, and the scientific name of *M. longifolia* from the Lamiaceae family. *M. longifolia* is native to Europe, North Africa, and the Middle East. This medicinal plant has different cultivars and species

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in different parts of the world. *M. longifolia* has a mint-like appearance but with brighter, more elongated leaves, it has a spicy and strong smell and the plant is more resistant than mint. This plant reproduces by propagating creeping underground stems (rhizomes). Aromatic flowers of purple or white Pennyroyal grow in clusters along the axis of the terminal stem [4-7]. Medicinal plant Pennyroyal in temperate regions of Iran usually grows in the margins of gardens around springs and along streams. The highest distribution of this aromatic and medicinal plant is in the cities of Fars, Kerman, Khuzestan, Kohkiluyeh and Boyer Ahmad, Ilam, Bushehr, Hormozgan, Sistan and Baluchestan, Qazvin, Tehran, and Semnan provinces [8]. *M. longifolia* herbaceous plant is a perennial plant, flagellum with underground stems. According to the morphologically, the stem stands at a height of 30-30 cm and often with a rectangular stem. Leaves fluffy and all without petioles or Leaf-bottomed leaves 5-10 cm long. Leaves with flowers are leaf-like and linear flagellate. Flower cup 5-4 mm long, red or purple. The flags are placed inside the flower cup. The seeds are 0.8-0.5 mm long and have looked like an egg [9-11].

M. longifolia is a plant that has windbreak, ant bilious, expectorant, and antiseptic effects. This plant is used to eliminate pertussis, asthma, hysteria, bloating, and gout and is a regularizer, tonic, stomach tonic, and digestive [12]. *M. longifolia* products including sweat, tea, air freshener, essential oil and dried Pennyroyal leaf powder are available in the market. Dried mint leaves are used to flavor yogurt, curd, buttermilk, noodle, soups, and other traditional foods [13-14].

Although the use of medicinal plants is limited by the development of the chemical industry, the prospect of using these plants is increasing. Scientific research has proven the effectiveness and safety of several complementary medicine methods, including herbs, in the treatment of some diseases. The use of medicinal plants compared to chemical drugs in addition to reducing costs can have better effectiveness and fewer side effects [15].

The most useful use of this plant is in pharmaceutical and food industries such as cooking and confectionery, so knowing their compounds, especially its functional groups are of particular importance. Therefore, the purpose of this study was to identify the functional groups of medicinal plants native to Ilam. Fourier-transform infrared spectroscopy (FTIR).

Materials and Method

Plant preparation

In this study, the medicinal plant *M. longifolia* of Bishe Deraz village of Dehloran city in Ilam province is prepared. Identification and approval of plant species were done in Biotechnology and Medicinal Plants Research Center, Ilam University of Medical Sciences.

Figure 1: *Plant M. longifolia*



The characteristics and collection area of the mint plant are specified in Table 1.

Plant	Scientific name	Herbal family	Location	Geographical coordinates
Pouneh	Mentha longifolia	Lamiaceae	Dehloran	32° 41' 28" North, 47° 15' 58" East

Plant drying

The collected *M. longifolia* plant was cleaned and dried in the shade at room temperature.

Planting powder

The plant was dried and pulverized by a mixer and used for FTIR analysis. FTIR spectroscopy will be used to identify the functional groups of chemical compounds and to qualitatively detect the type of bonds of the mentioned extract. In this research the sample used in this study will be

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in powder form, the KBR (potassium bromide) tablet preparation method will be used.

To prepare the sample by KBR (potassium bromide) tablet method, the solid sample is completely powdered and mixed with powdered potassium bromide, and then under the pressure of 10 tons of the device, this mixture will turn into a small tablet. The reason for using potassium bromide is that it does not create any peaks in the range of 650 to 3900-cm. Finally, the sample is exposed to radiation and the spectrum obtained from the Fourier transform is obtained (7). Therefore, only peaks of plant extracts will be known in spectroscopy (7). Finally, factor groups such as O-H, N-H, C = O, N-O, S = O, C-O, C-Cl, C-Br, C-H, etc. are identified and reported based on the different spectra obtained.

Results and discussion

Based on the results obtained from spectroscopy of the *M. longifolia* plant, it was found that this plant has 15 peaks for the functional groups. Details of the functional groups obtained from this plant are specified in Table 2 and Figure 2.

Table 2. *Spectroscopy of Pennyroyal plant, wavelength, functional group, and its type*

Type	Functional group vibration	Range	Wavelength (cm^{-1})
Stretching - alcohol	O-H	3550-3200	3411
Stretching - Alkan	C-H	3000-2840	2927
Stretching - Alkan	C-H	3000-2840	2860
Bending - Aromatic compounds	C-H	2000-1650	1734
Stretching - Alkene conjugated	C=C	1650-1600	1618
Stretching - Nitro composition	N-O	1550-1500	1516
Bending - Alkan	C-H	1450	1447
Bending - Alkan	C-H	1375	1375
Stretching - Aromatic ester	C-O	1275-1200	1260
Stretching - Type II alcohol	C-O	1124-1087	1105
Stretching - Sulfoxide	S=O	1070-1030	1064
Stretching - Sulfoxide	S=O	1070-1030	1034
Stretching - Holiday composition	C-Br	690-515	670
Stretching - Holiday composition	C-Br	690-515	610
Stretching - Holiday composition	C-I	600-500	532

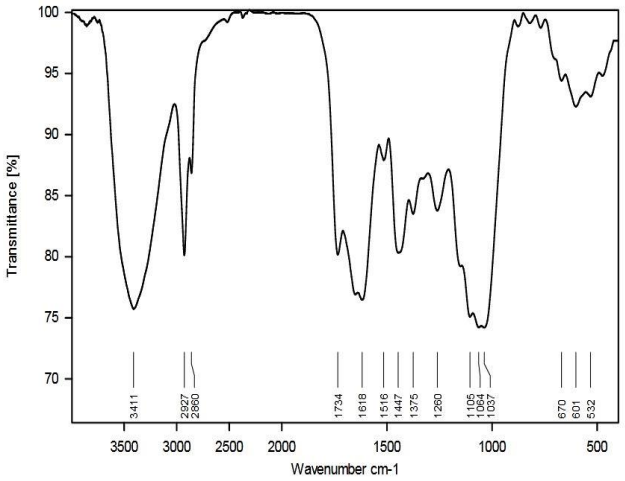

Figure 2. *Chromatogram of M. longifolia plant*

As can be seen from Table 2 and its chromatogram, oregano has 15 points for the functional groups. Zone 1 with wavelength 3411 (OH), Zone 2 with wavelength 2927 (CH), Zone 3 with wavelength 2680 (CH), Zone 4 with wavelength 1334 (C = O), Zone 5 with wavelength 1618 (C = C), Zone 6 with wavelength 1516 (NO), Zone 7 with wavelength 1447 (CH), Zone 8 with wavelength 1375 (CH), Zone 9 with wavelength 1260 (CO), Zone 10 with wavelength 1105 (CH)

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CO), region 11 with wavelength 1064 (S = O), region 12 with wavelength 1034 (S = O), region 13 with wavelength 670 (C-Br), region 14 with wavelength 610 (C-Br) And region 15 with wavelength 532 (CI).

M. longifolia is a plant from the mint family that contains volatile essential or menthol oil, contains a large amount of vitamins A, B, and C and calcium, some tannins, resins [16]. Pennyroyal has been used as an herbal medicine for centuries. Pennyroyal is traditionally used as a sedative to treat colds, respiratory problems, bladder problems, liver disease, bloating, stomach pain, miscarriage, or the onset of menstruation [17]. There are reports of antimicrobial effects of *M. longifolia* [8]. Also, its antiviral and antioxidant effects have been studied [16-19].

The main constituents previously isolated from the constituents of *Mentha longifolia* (L.) Hudson includes terpenoids and flavonoids [19]. In this study, it was found that the Pennyroyal Ilam plant has chemical compounds such as alcoholic compounds, alkanes, aromatic compounds, alkane conjugate, nitro compound, aromatic ester, sulfoxide, and halide compounds. Using the FT-IR spectrum, the presence of various functional compounds can be confirmed to be used in the extraction and production of herbal medicines. The medicinal effects of the *M. longifolia* (L.) Ilam plant are due to the presence of the mentioned secondary compounds.

The results of the study of Mahmoudi et al. (2011) showed that the essential oil of peppermint has 22 chemical compounds of which Pulegon, 1,8-cineole, Menthoforan, Cis- Isopulego are its main constituents [20]. In Mahmoudi's study, 22 chemical compounds were identified by GC/MS method, while in our study, 15 peaks were identified by FTIR method. They reported the chemical compounds while we identified the functional groups in the plant that cover a range of chemicals.

One of the most important advantages of FTIR analysis is the high speed of this technique due to the simultaneous measurement of all frequencies in a few seconds. In HS-SPME and/or GC/MS methods, plant essential oil is required for phytochemical analysis, while in FTIR method, it is used for a variety of samples with different physical states. One of the advantages of this is screening method over other methods

The results of the present study show the phytochemical of this plant. Further advanced studies are recommended to determine the composition of this plant.

Authors' contribution

All authors contributed equally to the manuscript.

Conflicts of interest

The authors declared no competing interests.

Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication, etc.) have been completely observed by the author.

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