Volume 10, Issue 2 (2022) pp. 173-184 **DOI**: 10.22034/ijabbr.2022.551874.1393

*Original Article*

# Evaluation of *Thymus Vulgaris*, *Salvia Officinalis*, *Mentha Piperita* and *Hyssopus Officinalis* Plants with Benefits on the Respiratory Organs

**Yousef Askari[1]* | Raham Mohtashami[2]**

[1]Assistant professor, Research Division of Forest, rangeland and watershed, Kohgiluyeh and Boyerahmad Agriculture and Natural Resources Research and Education Center, AREEO, Yasouj, Iran

[2]Department of Plant Improvement Research, Kohgiluyeh and Boyerahmad Agricultural and Natural Resources Research Center, Agricultural Research Education and Extension Organization (AREEO), Yasouj, Iran

*Corresponding Author E-mail: yousef.askari@gmail.com

Received: 12 April 2022, Revised: 20 May 2022, Accepted: 02 June 2022

## Abstract

**Background:** Respiratory diseases are often caused by the lack of lung energy flow manifested in shortness of breath, generalized weakness, extreme fatigue, and even reluctance to speak. This study evaluates four plants for the respiratory system from a pharmacological perspective. Thyme (Thymus vulgaris L.), sage (*Salvia officinalis* L), peppermint (*Mentha piperita* L.) and hyssop (*Hyssopus officinalis* L.) are discussed from a modern pharmacological perspective, including their scientific name and family, the used parts, active ingredients, therapeutic properties, pharmacological effects, indications, and available medicines. Botany features such as plant shape, description, distribution, and cultivation, including suitable places, range, and cultivation method, are further investigated.

**Methods:** Information such as the used plant parts, therapeutic properties, pharmacological effects, indications, and medicine forms were gathered through data collection, library resources, written articles, and reference books. Other information such as plant shape and description, planting method, time, and more were obtained by planting seedlings in a research departments affiliated with the Kohgiluyeh and Boyer-Ahmad Agriculture and Natural Resources Research and Education Center.

**Results:** These medicinal plants, such as *Salvia officinalis*, contain "Terpene", "Selenium" and other substances, and clean the sinuses and relieve respiratory and lung disorders. Due to its high "polyphenols" content, this plant protects lung tissue against bacteria which may pose risk and cause infection in the respiratory system. Respiratory diseases are often caused by low energy manifested in short inhalation and exhalation, generalized weakness, extreme fatigue, and even reluctance to speak. Natural substances and plants are useful for treating respiratory problems.

**Conclusion:** Due to its significance for sustaining human life, even minor respiratory disruptions such as smoking, vitamin deficiency, and other factors cause diseases such

as seasonal allergies, bronchitis, tuberculosis, asthma, pulmonary edema, lung problems, pneumonia, and lung cancer.

**Keywords:** Cultivation, Diseases, Pharmacological, Plant, Thyme.

## 1. Introduction

Respiratory disease is a common and significant cause of illness and death around the world. In 2012, respiratory conditions were the most frequent reasons for hospital stays among children. The most common problems of the respiratory system are: asthma, bronchitis, common cold, cough, and whooping cough [1]. Given the increasing drug resistance of microorganisms, medicinal plants are used for therapeutic purposes due to their role in combating pathogens and distinct effectiveness against microbes. Regarding their biological, medicinal, and therapeutic potential, these plants can effectively treat or prevent diseases. For instance, some antioxidant medicinal plants prevent diseases while others intervene in microbial activity, in many cases treating diseases without side effects.

Nowadays, patients refer to primary care centers due to inflammatory respiratory diseases [2]. The respiratory system is constantly exposed to environmental pollutants, respiratory pathogens, and toxins in aerosols dispersed around our environment [3]. Since mucociliary clearance (MCC) is the primary defense mechanism in the upper and lower respiratory tracts, acquired or inherited disruption of this process predisposes individuals to the chronic sinusitis, paranasal sinuses, and respiratory tract infections. For centuries, drugs influencing respiratory tract secretions have been used to help clear respiratory tracts in various countries. These mucoactive drugs are categorized based on their mechanism of action (MOA). Some of these medicines directly affect the production or composition of airway mucus secretions, improving mucociliary clearance. Although other drugs do not significantly affect the mucus, they aim to correct the pathophysiological mechanisms involved in producing abnormal secretions with their benefits for the respiratory tract structure and function [4]. There are various parameters (chemical properties, physical properties, mucus production, phospholipid surfactant production, and mucociliary clearance) involved in the dynamics and mobility of airway mucus secretions [5].

For many years, many nations, including European countries, have extensively used symptomatic treatments of respiratory tract diseases using medicinal plants and their derivatives. These products have proven their effectiveness and safety for over 50 years [1]. Numerous studies and systematic reviews suggest that these drugs are effective in different populations [6, 7]. Few studies have investigated the MOA (mechanism of action) of these drugs. Sage, mint, hyssop, and thyme are the most important medicinal plants with different respiratory effects and improvements. Plants of the *Lamiaceae* family are widely used in herbal medicine. Their main application is aimed at the treatment of the respiratory and cardiovascular systems and the gastrointestinal tract as well as the prevention of skin diseases, nervous system disorders, allergies, and metabolic disorders [8].

This study aims to evaluate these medicinal plants from a modern pharmacological perspective, including the scientific name and family, the used parts, active ingredients, therapeutic

properties, pharmacological effects, indications and contraindications, and available medicines. Botanical features such as plant shape, description, distribution, and cultivation, including suitable places, range, and cultivation method, are further investigated.

## 2. Material and Methods

Information such as the used plant parts, therapeutic properties, pharmacological effects, indications, and medicine forms were gathered through data collection, library resources, written articles, and reference books. Other information such as plant shape and description, planting method, time, etc. were obtained by planting seedlings in a research departments affiliated with the Kohgiluyeh and Boyer-Ahmad Agriculture and Natural Resources Research and Education Center. Chamkhani area at Kohgiluyeh and Boyer-ahmad province, Southwest Iran (30°41′N, 51°31′E and 1830 m above sea level).

## 3. Results

### 3.1. Thyme (*Thymus vulgaris* L.), Family: Lamiaceae

#### 3.1.1. Botanical description and ecology

This plant mainly grows in various Mediterranean regions, including France, Portugal, Spain, Italy and Greece. It also grows in the wild for several thousand hectares in New Zealand's arid regions. In Iran, this species has not been seen in the wild, but it has been imported and is cultivated. Thyme is a perennial roughage plant with a straight quadrangular wood stem with 20-40 cm of height depending on the growing area's climate (Figure 1). Its shrubs have small opposing gray-green leaves, are somewhat spear-shaped, and do not have petioles. The leaves are covered with gray hairs and contain herbal essential oils. The flowers are small and white, pink, or purple and are arranged to match the upper leaves. This plant's fruit is hazelnut and its flowering time is between June and August. The entire plant has a fragrant and pleasant taste and smell [9].


**Figure 1.** Image of planting species in the study area (left) and its schematic (right)

Thyme is native to the Mediterranean, needs warm weather and light to grow, and is sometimes found in the wild. This plant is drought-tolerant and can easily withstand dehydration and drought. Thyme is sensitive to waterlogging, which makes it dry out. It can be cultivated in light soils containing calcium compounds. Soil pH of 5-8 is suitable for growing thyme. This

Mediterranean plant requires sufficient light during the growth period, especially in its early stages, and is very sensitive to shade. Therefore, it is best to cultivate thyme on sloping fields in sunny or southern regions [10].

### 3.1.2. Planting and harvesting times

Late autumn is the ideal time for directly sowing thyme seeds, and seedlings are transplanted to the land in May for indirect seeding. It is best to harvest thyme at the flowering stage beginning in early-May. Harvesting the plant body under sunlight radiation will increase its essential oil yield. It is harvested once in the first year, but up to three harvests are feasible starting from the second year. The harvested aerial organ is 10-15 cm above ground, and the thick woody stem will increase in shorter lengths, adversely affecting essential oil quality and reducing product value, as well.

### 3.1.3. Health benefits

Various forms of thyme are used, such as dried, fresh, oil, distillate, tea, and creams. Despite its different applications as a medicinal plant, its important uses include treatment of lung diseases, flu, nasal congestion and colds, bronchitis, pertussis, and asthma. Despite its different applications as a medicinal plant, thyme's important uses include treatment of lung diseases, flu, nasal congestion and colds, bronchitis, pertussis, and asthma. Thyme also dries out the excess moisture accumulated in the airways, which irritate and cause coughing and phlegm, eliminating a very annoying problem with a cold [11].

## 3.2. Hyssop (*Hyssopus officinalis* L.), Family: Lamiaceae

### 3.2.1. Botanical description and ecology

It is reported to originate in Asia Minor, the Black Sea, and the sandy regions of the Mediterranean. In Iran, it is seen in the wild in East and West Azerbaijan provinces, some areas of Baluchistan, and the Caspian Sea. Hyssop is a 50-70 cm perennial woody plant with a short quadrangular stem. It is mostly found as bushes with a wooden stem base and straight roots with many branches (Figure 2). Moreover, its leaves are smooth, small, narrow, pointed, fragrant, and without petioles, and protrude from different parts of the stem. Hyssop's 40-45 cm high flowers in white, pink, blue, or mixed are formed in the stem's upper part as integrated cycles with 7 to 9 flowers each. The hyssop fruit is a four-part black or dark brown hazelnut. Initially, the hyssop plant grows slowly, and the flowers appear in early June and early July of the first year [12].

Hyssop can be cultivated in hot dry regions and southern hills. Despite its drought tolerance, it needs sufficient water to start growing after the initial harvest. With suitable climatic conditions and enough water, the plants will flower again (in late summer) after the first harvest. Hyssop can grow independently of soil type and even sandy soils without nutrients. This plant can be cultivated in deserts. Medium-textured soils containing calcium compounds should be used for the large-scale cultivation. Very soft (dune) sands and water-saturated soils are not suitable for hyssop cultivation. Suitable soils for hyssop cultivation should have 5-7.5 pH. This plant can be irrigation-farmed across the Chaharmahal and Bakhtiari Province [13].


**Figure 2.** Image of planting species in the study area (left) and its schematic (right)

### 3.2.2. Planting and harvesting times

The good time to plant hyssop seeds is late March or early spring, and delayed sowing is wrong and reduces seed germination. For indirect cultivation (plant nursery), seedlings are transplanted in spring (May). According to the regional cultivation and climate conditions, the product can be harvested three times a year. If hyssop is planted for using its vegetative body for spices, it should be harvested early in flowering. However, plants cultivated for essential oil extraction should be harvested at complete flowering (early summer). The plant's necessary parts are harvested from the woody stem's upper area. The woody stems mixed with other parts will significantly reduce essential oil quality.

### 3.2.3. Health benefits

Hyssop has a similar smell to fennel and helps lung health. It contains ingredients for making expectorant syrup for eliminating nasal congestion from sinusitis and other viral diseases. It also has antioxidant, anti-inflammatory, and lubrication properties, reduces fever, and its syrup calms coughing. Hyssop was used historically to treat asthma, heartburn, and nasal congestion. It is now recognized for its anti-viral properties and relaxing blood vessels [14].

### 3.3. *Salvia officinalis* L., Family: Lamiaceae

### 3.3.1. Botanical description and ecology

This plant mainly grows in the Mediterranean, Europe, and North Africa, and is also planted in various parts of Asia. In Iran, it grows in Azarbaijan, Semnan, and Tehran, as well as Chaharmahal and Bakhtiari.

*Salvia officinalis* is a 30-60 cm tall shrub with a bushy appearance (Figure 3). The leaves are light green (due to their short white hairs), opposing, and thick with a network of nervures. They are prominent and distinct on the lower leaf blade surface. The plant's fruit is a light brown or dark brown capsule [12].


**Figure 3.** Image of planting species in the study area (left) and its schematic (right)

*Salvia officinalis* is a Mediterranean plant requiring dry heat during its growth (it is highly resistant to heat). Seedlings require plenty of water. In winter, this plant suffers from frost at below -15 °C temperatures and dries in 5 to 6 days. *Salvia officinalis* does not require a particular soil and grows well in almost any soil. This plant can be cultivated in warm weather and medium-texture soils (sandy-clay soils) with adequate calcium compounds, which greatly increase its active ingredients. Very soft (dune) sands with little nutrients, hollow grounds, and cold and humid areas limit this plant's growth and significantly reduce the quantity and quality of active ingredients. Suitable soil pH for sage cultivation is 6.4-7 [14].

### 3.3.2. Planting and harvesting times

Late autumn is the ideal time for directly sowing *Salvia officinalis* seeds, and seedlings are transplanted to the land in May for indirect seeding. The *Salvia officinalis* plant can be harvested at least three times a year depending on the growing season, with the first harvest done in late-May before flowering. The plant herb is harvested from between the stem's woody and green parts using a scythe while keeping in mind that the woody stem harvested with the other parts visibly affects the plant medicine's quality. During the third harvest, the plants should be harvested from the lower areas closer to the ground to ensure it doesn't frost and dry in winter. After harvesting, the harvested body should be dried in the shade.

### 3.3.3. Health benefits

Given its ingredients such as "Terpenes" and "Selenium", sage cleans sinuses and helps with respiratory and lung diseases. Due to its high "polyphenols" content, this plant protects lung tissue against bacteria which may pose risk and cause infection in the respiratory system. This medicinal plant is useful for producing herbal medicines and cosmetics and industrial, health, and food products. This plant is widely used in the pharmaceutical industry due to its antimicrobial, antispasmodic, anti-astringent, antiseptic, antibiotic, and sedative properties, as well as stimulating the liver and improving digestion. It is also beneficial for reducing blood glucose, anxiety-induced dizziness, analgesic effects, neurological headaches, colds, and abdominal pain [14].

### 3.4. Peppermint (*Mentha piperita* L.), Family: Lamiaceae

### 3.4.1. Botanical description and ecology

As a widely-used medicinal plant, researchers believe that peppermint originated in Asia or the United Kingdom. It is usually cultivated worldwide and is seen in the wild in northern Iran and around Tehran. It is also cultivated in provinces such as Chaharmahal and Bakhtiari and Kohgiluyeh and Boyer-Ahmad.

Peppermint is a perennial herbaceous plant with a quadrangular stem and light purple flowers in complex clusters (Figure 4). The fruit is a small, dark red nonvegetative capsule. The essential oil in the vegetative body gives it a pleasant smell and cool and somewhat spicy tastes [12].


**Figure 4.** Image of planting species in the study area (left) and its schematic (right)

Although it can be grown in most areas, very cold areas are ill-suited and abundant nutrients and sufficient water are essential.

The plant starts to grow at 2-3 °C, but peppermint cultivation temperature is 10 °C. To accelerate plant growth and essential oil yield, 18-20 °C of temperature is required. Peppermint is a short-night plant whose long-day cultivation (in terms of light radiation) increases yield and improves its essential oil synthesis. Therefore, it is recommended to cultivate this plant on the southern hillsides. Sandy loam soil with a large quantities of humic substances and compounds are suitable for growing this plant. Peppermint can also be grown on black peat soils with suitable structure and sufficient nutrients. The suitable soil pH for peppermint cultivation is 5-8. Generally, acidic and drained soils are desirable for growing peppermint [15].

### 3.4.2. Planting and harvesting times

Peppermint is cultivated through underground organs (rhizomes) in early autumn (October) or mid-spring (late May-early June) to the main farmland. According to the regional cultivation and climate conditions, the product can be harvested 3-4 times a year. For harvesting, the plants are scythed 4-5 cm from soil surface before flowering. Early morning is the right time to harvest and sell leaves to the market wet or dry depending on demand.

### 3.4.3. Health benefits

Peppermint in tea or chewing gum relieves nasal, throat, and lung congestion, preventing the prolongation of respiratory disorders beginning with asthma and cold. Therefore, ointments

include mint as a natural treatment for nasal congestion. Various inflammations block airways during a cold, possibly damaging the neck and chest muscles by coughing, which could disrupt the individual's routine activities and even sleep. Consuming some mint will relieve the respiratory system's inflamed and swollen areas with its anti-inflammatory and sedative effects on muscle activity, and will improve the patient's breathing [15].

Table 1 indicates the used part and main active compounds for the studied species.

**Table 1.** Chemical composition of plant species studied [16]

| Plant species | Part used | Main Active Compounds |
|---|---|---|
| *Thymus vulgaris* L. | aerial part | Flavonoids, EO (monoterpenes) |
| *Salvia officinalis* L. | leaves | Flavonoids, phenolcarboxilic acids, EO (monoterpenes) |
| *Mentha piperita* L. | leaves, aerial parts | Flavonoids, phenolcarboxilic acids, EO (monoterpenes) |
| *Hyssopus officinalis* L. | aerial part | Polyphenols, saponins, EO (monoterpenes) |

## 4. Discussion

Respiratory tract infections continue to be a major health challenge worldwide especially due to the increasingly fast development of resistance to the drugs currently in use. Many plant species are traditionally used for respiratory illness treatment, and some have been investigated for their efficacy with positive results. An often-limiting factor to these investigations is the lack of comprehensive ethnobotanical data to help choose plant candidates for potency/efficacy tests. Since the plant parts utilized in preparation of remedies are reported in this survey, it serves as an indication of species which may need further ecological assessment on their regeneration status [17].

The results of this study reveal that both indigenous and introduced species are used for the treatment of respiratory system disorders. The information gained on frequently used traditional remedies might give some leads for future targets for further analysis in order to develop new drugs. However, more detailed scientific studies are desperately needed to evaluate the efficacy and safety of the remedies employed traditionally. The study at west Azerbaijan indicates the respiratory disease cured by traditional medicinal plants showing a similar study. Some 20 plants used in treating disease, the species of*Mentha*, have the same uses as our study [18]. The study of ethnobotanical plants in *manisia* where the plant has similar uses and modes of preparation through *Glycyrrhiza glabra*, but there is a contrast in the use of plants *Mentha x piperita* L and *Foeniculum vulgare* Mill. Thus, there is the usage novelty of plants against respiratory disorder [19]. The Lamiaceae family, one of the most important herbal families, incorporates a wide variety of plants with biological and medical applications. The most known members of this family are a variety of aromatic spices like thyme, mint, oregano, basil, sage, savory, rosemary, self-heal, hyssop, lemon balm, and some others with more limited use [20].

The area of Bahawalpur, Pakistan, was reported with 123 plants out of these 7 species, which uses *Achyranthes aspera*, *Mangifera indica*, *Phoenix dactylifera*, *Mentha longifolia*, *Acacia nilotica*, *Withania somnifera*, and *Phyla nodiflora*, with properties to cure respiratory diseases [1].

A similar study in the Northern region shows 120 plants with 5 plants having comparable uses and modes of preparation including *Acacia nilotica* (L.), *Glycyrrhiza glabra* L. *Justicia adhatoda*, *Achyranthes aspera*, and *Abelmoschus esculentus* (L.) [21] studied 85 medicinal plants *Mentha longifolia*, *Achyranthes aspera*, *Withania somnifera*, and *Ficus religiosa* tally with plants used in the present study, while some plants having a dissimilar use are *Mangifera indica* and *Acacia arabica* [22, 23]. A study in Uganda, 2 plants out of 88 plants, *Mangifera indica L* and *Achyranthes* aspera L, are used for respiratory disease, but its usage in tuberculosis is more emphasized [24].

A previous study contains 129 plants in which 4 plants with have the same use including *Justicia adhatoda*, *Achyranthes aspera*, *Withania somnifera*, and *Ficus religiosa* are included, but 2 plants have a dissimilar use and these plants are *Mangifera indica* and *Acacia nilotica* [25]. 384 medicinal plants from which 8 plants have been studied with similar use. The plant's similar use for respiratory diseases is *Glycyrrhiza glabra*, *Onosma bracteatum*, *Zingiber officinalis*, *Viola odorata* L., *Mangifera indica*, *Ficus religiosa* L, *Phoenix dactylifera*, and*Phyla nodiflora* [26].

It was reported, in India, that 57 medicinal plants belong to 37 families and 53 genera [27]. The plants, used for respiratory disease, are *Acacia nilotica (L.) Curcuma longa*, *Withania somnifera*, and*Zingiber officinale*while the plants *Achyranthes aspera*, *Ficus religiosa*, and *Mangifera indica*have a dissimilar use with the present study. 100 plants were studied and no one has similar uses, but these plants have other expectorant and diuretic viz. *Acacia nilotica*, *Achyranthes aspera*, and *Mentha longifolia* [28].

In this study, the useful parts of peppermint are its leaves and flowering branches. The majority of respiratory disorder herbal preparations were prepared from the leaves of plants (27.69%), while the whole plant (18.46%), flowers (13.85%), and stems (17.69%) were used less frequently [29]. This indicates that the local healers count on a very well developed knowledge about the properties of different plant parts. In al most 55% of the cases fresh plant material was used to prepare remedies, which differs little from the average herbal preparation mode in Northern Peru. About 86% of the remedies were applied orally, while the remaining ones were applied topically [30]. Over half of all remedies were prepared as the mixtures of multiple ingredients by boiling plant material either in water or in sugarcane spirit. Natural substances and plants are useful for treating respiratory problems. Although antibiotics help save millions of lives, these compounds have obvious side effects and destroy the body's natural flora. Respiratory diseases are often caused by low energy manifested in short inhalation and exhalation, generalized weakness, extreme fatigue, and even reluctance to speak. These medicinal plants, including *Salvia officinalis*, contain "Terpene", "Selenium" and other substances, and also clean the sinuses and relieve respiratory and lung disorders.

## 5. Conclusion

Due to its importance for sustaining human life, even minor respiratory disruptions such as smoking, vitamin deficiency, and other factors cause diseases such as seasonal allergies, bronchitis, tuberculosis, asthma, pulmonary edema, lung problems, pneumonia, and lung cancer. Due to its high "polyphenols" content, this plant protects lung tissue against bacteria which may pose risk and cause infection in the respiratory system.

## Abbreviation

MCC: Mucociliary Clearance
MOA: Mechanism of Action (MOA)

## Conflict of interest

There is no competing interests.

## Consent for publications

Author had read and approved the final manuscript for publication.

## Availability of data and material

Author declare that all data are embedded in the manuscript.

## Authors contibutions

Y.A., designed the study, carried out experiments, analyzed the data, performed the statistical analysis, and revised the manuscript before submission, edited and submitted it to the journal.

## Funding

No fund was received.

## Ethics approval and consent to participate

In this study, no animal or human samples were used and the whole process was performed under the protocol of the Research Division of Forest, rangeland and watershed and University.

## Acknowledgement

I would like to thanks Dr. Kavoos Keshavarz, Dr. Reza Chaker alhosseini, Dr. Majid Khazaei, Mr. Mazkor Mortazavi, and Mr. Abdolkhalegh Sayedi for his help in field study and providing the equipment and materials.

## Orcid

*Yousef Askari:* *https://www.orcid.org/0000-0002-9468-150X*
*Raham Mohtashami:* *https://www.orcid.org/0000-0002-1595-7708*

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**How to cite this article:**
Yousef Askari*, Raham Mohtashami. **Evaluation of Thymus Vulgaris, Salvia Officinalis, Mentha Piperita and Hyssopus Officinalis Plants with Benefits on the Respiratory Organs**. *International Journal of Advanced Biological and Biomedical Research*, 2022, 10(2), 173-184. Link: http://www.ijabbr.com/article_252556.html