Advanced Herbal Medicine, 2017; 3(2): 47-53.

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# The development of Thyme plant as a medicinal herb: A review article

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Received: 20/Jun/2016 Accepted: 28/Jun/2016

## ABSTRACT

**Background and aims:** *Thymus vulgaris* L. (Thyme) is an aromatic plant belonging to the Lamiaceae family, used for medicinal and spice purposes almost everywhere in the world. The aim of this study is to evaluate the botanical, microscopic characteristics, cultivation, biochemical compounds, and pharmacological effects.

**Methods:** In review article, we reviewed published papers in Medline database, Scopus, PubMed, Science Direct, SID, Civilica and Magiran.

**Results:** There are approximately 100 species of Thyme. The aroma mostly comes from the leaves, which is the part of the herb most commonly used. The leaves are generally used fresh or dried. *Thymus vulgaris* L. has a chemical polymorphism with 6 different chemotypes that show marked spatial segregation in nature. In general, phenolic chemotypes of Thymol and Carvacrol, which occur at the end of the biosynthetic chain, have a significantly lower proportion of their oil composed of their dominant monoterpene than nonphenolic chemotypes Geraniol, alpha-Terpineol, and Linalool. This is due to the presence of high amounts of precursors gamma-Terpinene and p-Cymene in the oil of phenolic chemotypes, Flavones (e.g. Apigenin, Luteolin, 6-Hydroxyluteolin) and their glycosides methylated flavones (e.g. Cirsilineol, Eriodictyol, Thymonin). Thyme pharmacological effects are such as antifungal and antibacterial, spasmolytic and antitussive, expectorant and secretomotor.

**Conclusions:** In this review study, it was showed that Thyme plant considered as an important medicinal herb and used in pharmaceutical considerable commercial value.

**Keywords:** *Thymus vulgaris* L., Thymol, Carvacrol, Flavones.

Review article

## INTRODUCTION

*Thymus vulgaris* L. (Thyme) is an aromatic plant belonging to the Lamiaceae family, used for medicinal and spice purposes almost everywhere in the world.[1] *Thymus vulgaris* L. shows a polymorphic variation in monoterpene production, the presence of intra specific chemotype variation being common in the genus Thymus. Each of the 6 chemotypes, Geraniol, alpha-Terpineol, Thuyanol-4, Linalool, Carvacrol, and Thymol,

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is named after its dominant monoterpene.[2,3] Thyme essential oil constitutes raw material in perfumery and cosmetics due to a special and characteristic aroma.[4,5] In addition, Thyme has been proven with pharmacological effects such as antifungal and antibacterial, spasmolytic and antitussive, expectorant and secretomotor. The aim of this study was to evaluate the botanical, microscopic characteristics, cultivation, biochemical Compounds, and pharmacological effects.

## METHODS

In review article, it was systematically reviewed published papers in Medline database, Scopus, PubMed, Scopus, Sienence Direct, SID, Civilica and Magiran. The search terms were "Thyme" and "*Thymus vulgaris L*" that searched in Persian and English books on medicinal plants.

## RESULTS

The name of Thyme, in its Greek form, was first given to the plant by the Greeks as a derivative of a word which meant 'to fumigate,' either because they used it as incense, for its balsamic odour, or because it was taken as a type of all sweet smelling herbs. Others derive the name from the Greek words *Thyo*, meaning perfume or *Thumus*, signifying courage, the plant being held in ancient and medieval days to be a great source of invigoration, its pleasant qualities inspiring courage. Another source quotes its use by the Sumerians as long ago as 3500 BC and to the ancient Egyptians who called it *Tham.*[6]

Scientific name of Thyme is *Thymus vulgaris* L., and its common names are: Wild Thyme, common Thyme, garden Thyme, creeping Thyme and mountain Thyme from family of Lamiaceae.

There are approximately 100 species of Thyme. However, three of these species are most prominent: garden Thyme, European wild Thyme, and lemon Thyme.[7] Thyme is very aromatic and generally reaches a height of 4 to 8 inches high. The aroma mostly comes from the leaves, which is the part of the herb most commonly used. The leaves are generally used fresh or dried. They can be added to a dish for flavoring as a sprig of Thyme, to later be removed before eating. The leaves are generally less than a half an inch long and are an oval shape.[5]

Its leaf has 4-12 mm long and up to 3mm wide; it is sessile or has a very short petiole. The lamina is tough, entire, lance late to ovate, covered on both surfaces by a grey to greenish grey indumentum. Their edges are markedly rolled up towards the abaxial surface. The midrib is depressed on the adaxial surface and is very prominent on the abaxial surface. The calyx is green, often with violet spots, and is tubular; at the end are 2 lips of which the upper is bent back and has 3 lobes on its end; the lower is longer and has 2 hairy teeth. After flowering, the calyx tube is closed by a crown of long, stiff hairs. The corolla, about twice as long as the calyx, is usually brownish in the dry state and is slightly bilabiate.[8,9]

In leaf upper epidermis, cells tangentially elongated in transverse section with a thick cuticle and few stomata, somewhat polygonal in surface section with beaded vertical walls and striated cuticle, the stoma being at a right angle to the 2 parallel neighbouring cells. Numerous unicellular, non-glandular hairs up to 30 μm in length with papillose wall and apical cell, straight, or pointed, curved, or hooked. Numerous glandular hairs of 2 kinds, one with a short stalk embedded in the epidermal layer and a unicellular head, the other with an 8 to 12 celled head and no stalk. Palisade parenchyma of 2 layers of columnar cells containing many chloroplastids; occasionally

an interrupted third layer is present. Spongy parenchyma of about 6 layers of irregular-shaped chlorenchyma cells and intercellular air-spaces has formed.[8,9]

If planting from seed Thyme should be planted in late March or early April, its seeds should be placed 8-9 inches from each other about a half in deep. Thyme thrives in dry stony soils that are warm. The roots can also be divided and replanted throughout the months of May to September.[5]

Essential oil; *Thymus vulgaris* L. has a chemical polymorphism with 6 different chemotypes that show marked spatial segregation in nature.[2] In general, phenolic chemotypes, Thymol (Figure 1) and Carvacrol (Figure 2), which occur at the end of the biosynthetic chain, have a significantly lower proportion of their oil composed of their dominant monoterpene than nonphenolic chemotypes Geraniol (Figure 3), alpha-Terpineol (Figure 4), and Linalool (Figure 5). This is due to the presence of high amounts of precursors gamma-Terpinene (Figure 6) and p-Cymene (Figure 7) in the oil of phenolic chemotypes.[2]

Boruga, et al studied and identified fifteen components representing 99.91% of the total detected constituents. The major components were p-Cymene (8.41%), γ-Terpinene (30.90%) and Thymol (47.59%), which suggests that the EO analyzed belongs to the Thymol chemotype.

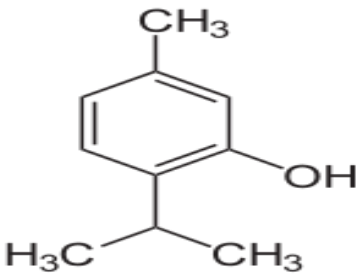


**Figure 1:** Structure of Thymol

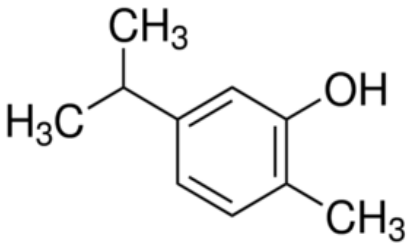


**Figure 2:** Structure of Carvacrol

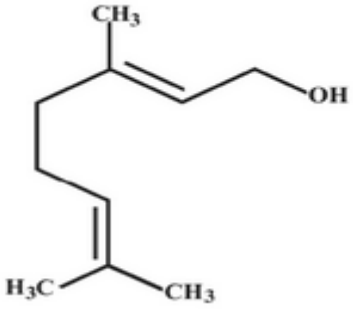


**Figure 3:** Structure of Geraniol

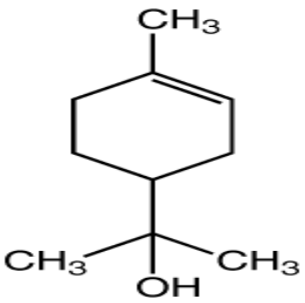


**Figure 4:** Structure of alpha-Terpineol

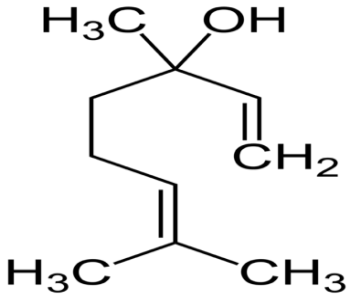


**Figure 5:** Structure of Linalool

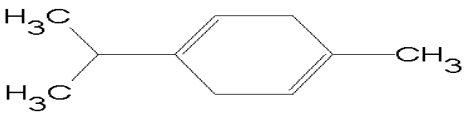

**Figure 6:** Structure of γ-Terpinene

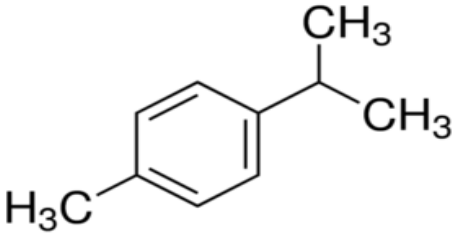

**Figure 7:** Structure of p-Cymene

Flavonoids: Flavones (e.g. Apigenin, Luteolin, 6-Hydroxyluteolin) and their glycosides, methylated flavones (e.g. Cirsilineol, Eriodictyol, Thymonin). The content of luteolin was found to be 1.12 mg/g in the herbal substance, 3.9 mg/g in a dry extract (not specified) and 0.466 mg/g in the liquid extract prepared according to the German Pharmacopoeia (herbal preparation C).[12]

Caffeic acid, Rosmarinic acid: Total phenolics (calculated as Caffeic acid) are best extracted with 60% ethanol (approximately 50 mg/gram plant dry matter), 30% ethanol yields app. 40 mg/g, while extraction with ethanol 96% resulted in 24 mg/g.[13] These findings are in agreement with the results published.[14] However, the investigations reveal that the temperature during extraction has considerably more influence on the amount of extracted 'tannins' (only an unselective analytical method was used). An increase in temperature from 20° to 60° (ethanol 50% and 70%) resulted approximately in a triplication of the extracted amount, while increase of the duration of the extraction had only a minor influence.

Essential oil quality and yield depend on many factors and choosing a suitable extraction method is very important. In a study by Grigore et al. it was shown that the *Thymus vulgaris* used for the present study belongs to Thymol chemotype. Volatile oil obtained by steam distillation contains high amounts of Thymol and p-Cymene. For the sample obtained by non-polar solvent extraction, the above mentioned terpenes are the only volatile compounds detected by GC. Both samples exhibit antioxidant activity, slightly higher for volatile oil obtained by steam distillation. The study proved that the scavenging activity is not entirely due to volatile compounds but also to other liposoluble substances. Mancini et al. which showed that greater antioxidant potential of several *Thymus* species' essential oils could be related to the nature of the phenolic compounds and their hydrogen ability.

The antimicrobial activity of Thyme oil is partly based on additive effects, which might especially enhance the rapidity of the antimicrobial action. In addition, a mixture of several active ingredients that varies in its composition from year to year and from lot to lot as is the case with herbal remedies may be more stable concerning the antimicrobial activity than mixtures containing just a single active component.[16] Antibacterial activity observed against several strains of 2 Gram-positive (Brochothrix thermosphacta and Staphylococcus aureus) and 4 Gram-negative food-borne bacteria (Escherichia coli, Salmonella abony, Pseudomonas aeruginosa and P. fragi).[17]

*In vitro* studies have shown that both thyme essential oil and Thymol have antifungal activity against a number of fungi, including *Cryptococcus neoformans*, *Aspergillus*, *Saprolegnia*, and *Zygorhynchus*

species.[18-20] Both the essential oil and Thymol had antibacterial activity against *Salmonella typhimurium*, *Staphylococcus aureus*, *Escherichia coli*, and a number of other bacterial species.[21] As an antibiotic, Thymol is 25 times as effective as phenol, but less toxic.[22]

The antimicrobial activity of EOs depends on their chemical constituents.[11] Apparently, the antimicrobial activity of the EO analyzed is related to the presence of phenolic compounds (Thymol) and terpene hydrocarbons (γ-Terpinene), respectively.[11,23,24] p-Cymene, the third major element according to percentage, does not show antibacterial efficacy when used alone.[24] However, synergistic effects are attributed to it in relation to Thymol and γ-Terpinene, respectively, which might represent another cause of the recorded antimicrobial activity.[25,26] On the other hand, a number of studies have shown that EOS exhibit stronger antimicrobial activity than that of their major constituents or their mixtures, respectively, which suggests synergistic effects of the minor components, but also the importance of all components in relation to the biological activity of EOs.[11,27]

Thymol oil, antimicrobial activity was observed for the combination of the 2 mono substances: Carvacrol plus Linalool and Thymol plus Linalool as well as with the combination of the two essential oils of the Carvacrol and Linalool chemotypes. An increase of the Carvacrol oil concentration from one to two times the MIC resulted in a considerable acceleration of the kill-rate.[16]

The spasmolytic and antitussive activity of Thyme has been most often attributed to the phenolic constituents Thymol and Carvacrol, which make up a large percentage of the volatile oil.[8,29] Although these compounds have been shown to prevent contractions induced in the ileum and the trachea of the guinea-pig, by histamine, acetylcholine and other reagents, the concentration of phenolics in aqueous preparations of the drug is insufficient to account for this activity.[30,31] Experimental evidence suggests that the *in vitro* spasmolytic activity of Thyme preparations is due to the presence of poly methoxy flavones.[31] *In vitro* studies have shown that flavones and thyme extracts inhibit responses to agonists of specific receptors such as acetylcholine, histamine and L-norepinephrine, as well as agents whose actions do not require specific receptors, such as barium chloride.[32] The flavones of Thyme were found to act as noncompetitive and non-specific antagonists; they were also shown to be $Ca_2$_antagonists and musculotropic agents that act directly on smooth muscle.[8,30,31]

Experimental evidence suggests that Thyme oil has secretomotoric activity.[33] This activity has been associated with a saponin extract from *T. vulgaris*.[34] Stimulation of ciliary movements in the pharynx mucosa of frogs treated with diluted solutions of thyme oil, Thymol or Carvacrol has also been reported.[35] Furthermore, an increase in mucus secretion of the bronchi after treatment with Thyme extracts has been observed.[8,36]

## CONCLUSIONS

In this review study, it was showed that Thyme plant considered as an important medicinal herb and used in pharmaceutical considerable commercial value. Essential oil of Thyme with the major of compounds such as Thymol and Carvacrol causes its most use in medicine. Also, sources of the flavonoids and their glycosides have been determined. Thyme pharmacological effects are such as antifungal and antibacterial, spasmolytic and antitussive, expectorant and secretomotor. The Thymus composition and medicinal properties lead to need for further and more research.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interests.

## ACKNOWLEDGEMENT

The authors are grateful to thank those researchers who generated useful findings for this study.

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**How to cite the article:** Khosravipour B, Direkvand-Moghadam F. The development of Thyme plant as a medicinal herb: A review article. Adv Herb Med. 2017; 3(2): 47-53.