

Thyme

Subjects: Plant Sciences | Others

Contributor: Maha Krayem, Dalal Hammoudi Halat, Sanaa Khaled

A perennial wild shrub from the *Lamiaceae* family and native to the Mediterranean region, thyme is considered an important wild edible plant studied for centuries for its unique importance in the food, pharmaceutical, and cosmetic industry. Thyme is loaded with phytonutrients, minerals and vitamins. It is pungent in taste, yet rich in moisture, proteins, crude fiber, minerals and vitamins. Its chemical composition may vary with geographical location but is mainly composed of flavonoids and antioxidants.

Keywords: *Thymus vulgaris* ; thyme essential oil ; thymol ; carvacrol ; antioxidant ; anti-inflammatory ; anticancer ; antimicrobial

1. Introduction

Wild edible plants (WEPs) as defined by the food and agricultural organization (FAO) are “the plants that grow spontaneously in self -maintaining populations in natural or semi-natural ecosystems and can exit independently of direct human actions” [1]. In fact, as summarized by Shumsky and Colleagues [2], WEPs are characterized by being locally available and known traditionally through generations, less expensive, having high advantages for poor populations, available during stressful conditions such as drought or famine periods and finally, being able to resist climate change. Moreover, WEPs have been demonstrated to have an important role in providing plenty of nutritional requirements that are important for improving health, thereby contributing to reduce food insecurity and scarcity, famine, or conflict [3][4]. Therefore, the trend towards implanting WEPs in food dishes and recipes nowadays, seems to have increased and become more popular than few years ago. According to a recent estimate, more than 8000 plant species are distributed all over the world, from these only 100 provide the majority of the world’s food. Among these 100, less than 20 species are used in food preparation [5]. China is characterized by having the oldest and biggest original centers for vegetables in the world, estimated to be around 213 families, 815 genera and 1822 species of plants. In North America, natives consume many WEPs daily; they constitute a good example of the ethnographical use of these natural sources. In Africa, Latin America, and the subcontinent of India, many WEPs are cultivated and consumed [5]. For example, a study was done in the city of Bingol in Turkey and showed that most of the consumers in this area eat these plants in their raw form; others use the flowers and branches for preparing herbal tea. In addition, many use them as spices and for commercial purposes [6].

Specifically, in the Mediterranean region, there are an estimated 25,000 to 30,000 species of WEPs, many of which are endemic to the region. The diversity of species in this region can rely on the ecological conditions, such as the convenient climate and the soil type [5]. In Lebanon, WEPs are estimated at about 2600 species (12% of total species in the Mediterranean region) and are mainly consumed within rural areas for their health and medicinal qualities, either raw without any preliminary preparation, or as snacks, providing important sources of nutrients absent in modern high-fat, high-sugar snacks [7]. In addition, several types of these plants are used in fresh salads. Most well-known cooking methods of such plants are simply fried with onions or used in omelet preparations [7][8]. A study was done in Lebanon by conducting semi-structured interviews in which ethno-pharmacological information was collected. As such, 53 native informants in 13 towns and villages surrounding Mount Hermon were asked about wild plants they use. The results showed that 124 plant species are still used by local communities in traditional medicine as a beneficial source for the treatment of different illnesses [9].

The *Lamiaceae* family is particularly well represented in Lebanon, where 136 species belonging to 29 genera have been inventoried. Some of them can be considered main ingredients in popular Lebanese dishes as spices such as *Origanum syriacum*, *Satureja thymbra*, *Thymbra spicata* and *Thymus vulgaris*. Others are eaten as salads such as *Salvia rosmarinus*, *Coridothymus capitatus*, and *Salvia fruticosa* which are also used in traditional medicine as a cure for different diseases, such as microbial infections [10]. A study done on eleven *Lamiaceae* species involving their chemical composition and the antimicrobial activity of their essential oils, revealed that *Lamiaceae* species are mostly used against

gastrointestinal infections ^[10]. The beneficial effects of many plants and their use as pharmaceutical drugs are demonstrated by clinical and preclinical studies ^[11].

2. Thyme (*Thymus vulgaris*): An Overview

Thymus vulgaris commonly known as “thyme” has been used for many centuries for its flavoring, culinary, and medicinal properties ^[12]. The name thyme derives from the Greek word ‘thymos’ which means courage or strength. In the first century AD, thyme was used mainly as a medicinal plant, which was mentioned in Dioscorides’ work. However, in the Mediterranean region, it was used mainly as spice and then spread all over the world ^[12].

2.1. Systematic Classification and Distribution

The *thymus* genus is a group of aromatic plants, belonging to the *Lamiaceae* family (Labiata). According to Jalas ^[13] and Morales ^[14], 214 species and 36 sub-species are known and divided into eight sections: *Micantes*, *Mastichina*, *Piperella*, *Teucrioides*, *Pseudothymbra*, *Thymus*, *Hyphodromi* and *Serpyllum*. *T. vulgaris* L. and *T. zygis* L. belong to the Western Mediterranean area. *Thymus. T. vulgaris* is native to Southern Europe, from Spain to Italy ^[12]. In Lebanon, *T. vulgaris* is the native species known, according to Talhouk et al. ^[15]. Below, the systematic classification of this species is listed:

- Kingdom: Plantae
- Subkingdom: Tracheobionta
- Superdivision: Spermatophyta
- Division: Magnoliophyta
- Class: Magnoliopsida
- Subclass: Asteridae
- Order: Lamiales
- Family: Lamiaceae
- Genus: *Thymus* L.
- Species: *Thymus vulgaris* L. ^[16]

2.2. Thyme Botanical Aspects

T. vulgaris is a perennial, evergreen subshrub with a generally upright, woody-based stem. The leaves are arranged as whorls around the stem, evergreen and simple ^[15]. They have an ovate shape, fine texture and a pleasant scent. They mainly constitute the edible part for humans. The flowers are of a cyme type, purple and white in color, bisexual and two-lipped with a hairy glandular calyx giving a pleasant scent. Their blooming occurs during spring and summer ^[12]. *T. vulgaris* has a moderate growth rate. At maturity, it reaches 0.5 to 1 m in height and spreads over 0.5 to 1 m and sometimes 15 m on the ground as a green cover. It takes 2 to 5 years to reach its maximum height ^[15]. It can tolerate frost and drought and poor, salty environments. It lives in loamy and sandy soils, having a neutral and alkaline pH. In Lebanon, *T. vulgaris* grows in groups on calcareous rocks. It does not need a lot of water but requires full sunlight. It has no invasive potential and can live for a maximum of 25 years ^[15]. *T. vulgaris* is most affected by root rot disease. Finally, thyme can be propagated from seeds, cuttings or by layering ^[15]. **Figure 1** represents a botanical sketch of thyme.

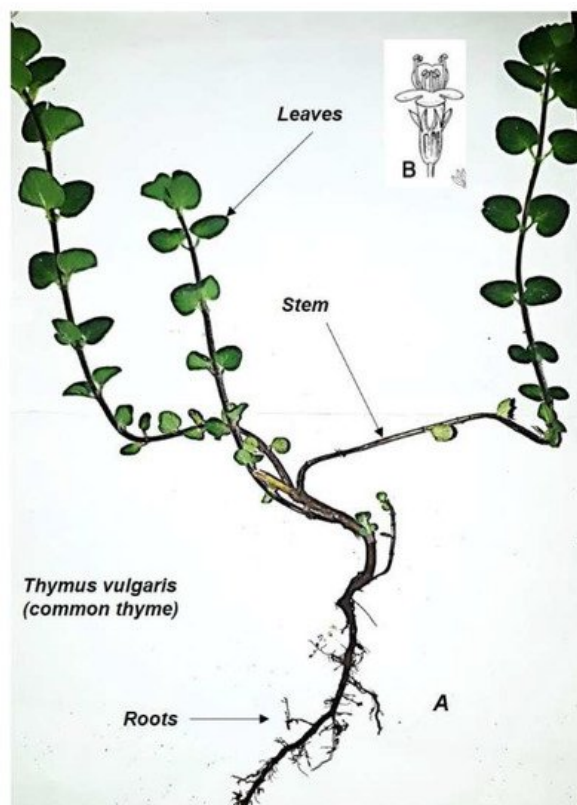


Figure 1. *Thymus vulgaris* (common thyme), sketch drawing, not necessarily to scale. (A) Plant vegetative parts: leaves, stem, and roots. (B) Reproductive part: flower of a cyme type, purple and white color, bisexual and two-lipped with a hairy glandular calyx responsible for a pleasant scent. The sketch is courtesy of the authors.

3. Chemical Composition and Essential Oils of Thyme

Many studies have been conducted on thyme species to identify their chemical composition. A wide variety of chemical compounds as well as essential oils constitute the main composition of thyme that varies with climate and geographical area. Investigations have reported that thyme contains 56.53% monoterpenes, 28.69% monoterpene hydrocarbons, 5.04% sesquiterpene hydrocarbons and 1.84% oxygenated sesquiterpenes [17]. Thyme is rich in many flavonoids and phenolic antioxidants like zeaxanthin, lutein, pigenin, naringenin, luteolin and thymonin [16]. Fresh thyme has one of the highest antioxidant levels being rich in minerals and vitamins that are essential for optimum health. Potassium, iron, calcium, manganese, magnesium and selenium are concentrated in the leaves, and the main constituent of the oil extracted is thymol. Thymol is an important phenolic component mainly responsible for thyme's antioxidant activity [16]. The thyme's flowered stem contains flavonoid derivatives such as apigenol and luteolol, phenolic acids such as caffeic and rosmarinic acids, and tannins [18].

To determine the fractions of essential oils in the thyme herb, standardized and appropriate techniques are always recommended. Extraction followed by analytical characterization are the main steps followed to build the profile of essential oils in thyme. Using capillary electrochromatography coupled to diode array detection (CEC-DAD) and liquid chromatography-tandem mass spectrometry (LC-MS/MS), thymol and carvacrol (Figure 2) were determined as the main constituents of thyme [19]. On the other hand, using gas chromatography-mass spectrometry (GC-MS) and high performance liquid chromatography-ultraviolet (HPLC-UV), it was found that thyme contains 48.19% linalool and 21.3% carvacrol as the major terpenes [20]. Despite the technique used to identify the different fractions of essential oils in thyme, some components are always encountered in all species at variable amounts. This diversity is due to climate, soil, harvest period and the method of preservation [18]. The major classes of chemical compounds found in thyme are monoterpenes, bicyclic monoterpenes, monoterpeneols, and bicyclic monoterpeneols as well as sesquiterpene lactones [19].

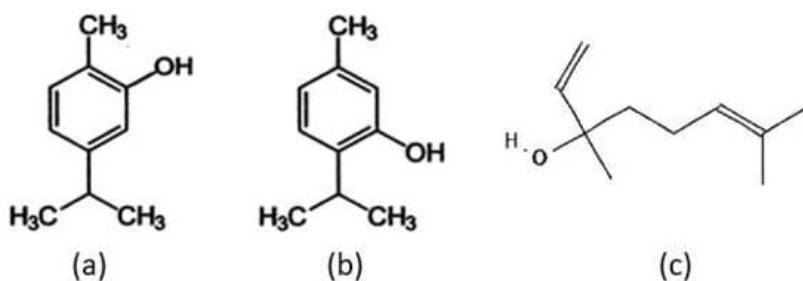


Figure 2. The chemical structure of thymol (a), carvacrol (b), and (c), linalool [16]. Linalool structure was retrieved from data deposited in or computed by PubChem (<https://pubchem.ncbi.nlm.nih.gov>, accessed on 1 January 2020).

Essential oils are natural mixtures of a large variety of components at different concentrations. *T. vulgaris* contains at least six chemotypes of essential oils: thymol as the major constituent, carvacrol, p-cymene, α -terpinene, linalool, β -myrcene and terpinen-4-ol as well as others referred to in **Table 1** [16].

Table 1. Chemical composition of thyme essential oils [16].

Component	Formula	Relative Concentration (%)
3-Hexanol	C ₆ H ₁₂ O	0.10
α -Tujene	C ₁₀ H ₁₆	1.52
α -Pinene	C ₁₀ H ₁₆	1.31
Camphene	C ₁₀ H ₁₆	0.75
Sabinene	C ₁₀ H ₁₆	0.84
3-Otenol	C ₈ H ₁₆ O	0.36
3-Otanone	C ₈ H ₁₆ O	0.20
B-Myrcene	C ₁₀ H ₁₆	0.67
3-Otanol	C ₈ H ₁₈ O	0.21
α -Pellandrene	C ₁₀ H ₁₆	0.10
δ -3-Carene	C ₁₀ H ₁₆	0.11
α -Terpinene	C ₁₀ H ₁₆	2.36
p-Cymene	C ₁₀ H ₁₄	7.61
Sylvestrene	C ₁₀ H ₁₆	0.34
1,8-Cineol	C ₁₀ H ₁₈ O	0.57
cis-Oimene	C ₁₀ H ₁₆	0.22
β -Oimene	C ₁₀ H ₁₆	0.20
γ -Terpinene	C ₁₀ H ₁₆	9.50
cis-Sabinene	C ₁₀ H ₈ O	0.10
Thymol	C ₁₀ H ₁₄ O	54.26
Carvacrol	C ₁₀ H ₁₄ O	4.42
Octadienoic acid	C ₁₈ H ₁₂ O	0.10
Geranic acid	C ₁₀ H ₁₆ O ₂	0.30

4. Thyme Nutritional Value and Health Benefits

Thyme is loaded with phytonutrients, minerals and vitamins that are vital for good health. These nutrients are known for their disease-preventing and health-promoting properties and contribute to the benefits of this herb. Thyme is particularly rich in vitamin A and vitamin C. Vitamin A is an antioxidant known for being vital in maintaining healthy mucus membranes and skin as well as good vision. Vitamin C is essential to resist infectious diseases and protects against harmful pro-inflammatory free radicals. Thyme also contains B-complex vitamins, mainly vitamin B6 (pyridoxine), that assists in maintaining the γ -aminobutyric acid (GABA) levels in the brain and acts as a stress reliever. Vitamin K, vitamin E and folic acid are also present in thyme [16]. According to the US Department of Agriculture National Nutrient database, the oxygen radical absorbance capacity (ORAC) value of thyme is 27,426 μ moles of Trolox Equivalents per 100 g (molTE/100 g) [21]. This value indicates the power and capability of an antioxidant product to neutralize the free radicals.

Thyme is also loaded with minerals that are essential for good health. Its leaves form an excellent source of potassium, calcium, iron, manganese, magnesium and selenium. Potassium is an important component of cells and body fluids and

controls heart rate and blood pressure. Iron is crucial in red blood cell formation, and manganese is a co-factor for the antioxidant enzyme, superoxide dismutase [16]. A summary of the major nutritive components of thyme is shown in **Table 2** [16].

Table 2. The in-depth nutritional profile of *Thymus vulgaris*.

Principle	Nutrient Value per 100 g of Fresh Leaves	Percentage of RDA
Niacin	1.824 mg	11%
Pantothenic acid	0.409 mg	8%
Pyridoxine	0.348 mg	27%
Riboflavin	0.471 mg	36%
Thiamin	0.48 mg	4%
Vitamin-A	4751 IU	158%
Vitamin-C	160.1 mg	266%
Sodium	9 mg	0.5%
Potassium	609 mg	13%
Calcium	405 mg	40.5%
Iron	17.45 mg	218%
Magnesium	160 mg	40%
Manganese	106 mg	15%
Zinc	1.81 mg	16.5%
Carotene-β	2851 mg	-

RDA: Recommended Daily Allowance; -: not estimated.

References

1. Heywood, V.H.; Nations, F.; Food and Agriculture Organization of the United Nations. Use and Potential of Wild Plants in Farm Households; Food & Agriculture Org.: Rome, Italy, 1999; ISBN 978-92-5-104151-2.
2. Shumsky, S.A.; Hickey, G.M.; Pelletier, B.; Johns, T. Understanding the Contribution of Wild Edible Plants to Rural Social-Ecological Resilience in Semi-Arid Kenya. *Ecol. Soc.* 2014, 19, art34.
3. Bhatia, H.; Sharma, Y.P.; Manhas, R.K.; Kumar, K. Traditionally Used Wild Edible Plants of District Udhampur, J&K, India. *J. Ethnobiol. Ethnomed.* 2018, 14, 73.
4. Duguma, H.T. Wild Edible Plant Nutritional Contribution and Consumer Perception in Ethiopia. *Int. J. Food Sci.* 2020, 2020, 2958623.
5. Guil-Guerrero, J.L. Edible Wild Plants. In *Recent Progress in Medicinal Plants*; Chapter: Edible Wild Plants; Majundar, D.K., Govil, J.N., Singh, V.K., Eds.; Sci. Tech Publishing LLC: Houston, TX, USA, 2002; Volume 8, Available online: http://www.researchgate.net/publication/270276886_Edible_Wild_Plants (accessed on 17 January 2022).
6. Polat, R.; Cakilcioglu, U.; Ulasan, M.D.; Paksoy, M. Survey of Wild Food Plants for Human Consumption in Bingöl (Turkey). *Indian J Tradit knowledge.* 2017, 16, 378–384.
7. Batal, M.; Hunter, E. Traditional Lebanese Recipes Based on Wild Plants: An Answer to Diet Simplification? *Food Nutr. Bull.* 2007, 28, S303–S311.
8. Marouf, M.; Batal, M.; Moledor, S.; Talhouk, S.N. Exploring the Practice of Traditional Wild Plant Collection in Lebanon. *Food Cult. Soc.* 2015, 18, 355–378.
9. Baydoun, S.; Chalak, L.; Dalleh, H.; Arnold, N. Ethnopharmacological Survey of Medicinal Plants Used in Traditional Medicine by the Communities of Mount Hermon, Lebanon. *J. Ethnopharmacol.* 2015, 173, 139–156.
10. Khoury, M.; Stien, D.; Eparvier, V.; Ouaini, N.; El Beyrouthy, M. Report on the Medicinal Use of Eleven Lamiaceae Species in Lebanon and Rationalization of Their Antimicrobial Potential by Examination of the Chemical Composition and An

11. Akhtar, M.; Jabeen, Q.; Bashir, S.; Hayat, M.; Muhammad, N.; Khan, H.; Khan, S.U.; Rehman, M.S.; Salma, U.; Mazhar, U.; et al. Antihypertensive and Toxicity Studies of Aqueous Methanolic Extract of *Mentha longifolia* L. J. Anim. Plant Sci. 2013, 23, 1622–1627.
12. Stahl-Biskup, E.; Venskutonis, R.P. Thyme. In Handbook of Herbs and Spices; Elsevier: Amsterdam, The Netherlands, 2012; pp. 499–525. ISBN 978-0-85709-039-3.
13. Jalas, J. Notes on *Thymus* L. (Labiatae) in Europe. I. Supraspecific Classification and Nomenclature. Bot. J. Linn. Soc. 1971, 64, 199–215.
14. Morales. The History, Botany and Taxonomy of the Genus *Thymus*. In Thyme: The Genus *Thymus*; Stahl-Biskup, E., Sáez, F., Eds.; Taylor and Francis, Inc.: London, UK, 2002; pp. 1–43. Available online: <https://www.taylorfrancis.com/chapters/edit/10.1201/9780203216859-5/history-botany-taxonomy-genus-thymus-ram%C3%B3n-morales> (accessed on 18 January 2022).
15. Talhouk, S.N.; Fabian, M.; Dagher, R. Landscape Plant Database. Department of Landscape Design & Ecosystem Management, American University of Beirut. Available online: <https://landscapeplants.aub.edu.lb/Plants/PlantProfile/%20%20%207ccb111d-624a-44e4-8fe0-5c2df080bbb1> (accessed on 6 January 2022).
16. Dauqan, E.M.A.; Abdullah, A. Medicinal and Functional Values of Thyme (*Thymus vulgaris* L.) Herb. J. App. Biol. Biotechnol. 2017, 5, 017–022.
17. Almana, A.; El-Aziz, G.S.A.; Ahmed, M.M.M. The Potential Gastrointestinal Health Benefits of *Thymus vulgaris* Essential Oil: A Review. Biomed. Pharmacol. J. 2019, 12, 1793–1799.
18. Jaafari, A.; Mouse, H.A.; Rakib, E.M.; M'barek, L.A.; Tilaoui, M.; Benbakhta, C.; Boulli, A.; Abbad, A.; Zyad, A. Chemical Composition and Antitumor Activity of Different Wild Varieties of Moroccan Thyme. Rev. Bras. Farm. 2007, 17, 477–491.
19. Micucci, M.; Protti, M.; Aldini, R.; Frosini, M.; Corazza, I.; Marzetti, C.; Mattioli, L.B.; Tocci, G.; Chiarini, A.; Mercolini, L.; et al. *Thymus vulgaris* L. Essential Oil Solid Formulation: Chemical Profile and Spasmolytic and Antimicrobial Effects. Biomolecules 2020, 10, 860.
20. Palmieri, S.; Pellegrini, M.; Ricci, A.; Compagnone, D.; Lo Sterzo, C. Chemical Composition and Antioxidant Activity of Thyme, Hemp and Coriander Extracts: A Comparison Study of Maceration, Soxhlet, UAE and RSLDE Techniques. Foods 2020, 9, 1221.
21. U.S Department of Agriculture, Agricultural Research Service. Oxygen; Radical Absorbance Capacity (ORAC) of Selected Foods, Release 2. Nutrient; Data Laboratory Home Page. 2010. Available online: <http://www.ars.usda.gov/nutrientdata/orac> (accessed on 31 March 2022).