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Thymus serpyllum toxicity, pharmacology, traditional uses, and phytochemical analysis

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Abstract:

In the upper foothills of India, Thymus serpyllum L., an understudied perennial plant in the Lamiaceae family, has long been used to treat respiratory and gastrointestinal conditions. This study aims to fill the gaps in our current knowledge of T. serpyllum's pharmacology, phytochemistry, and traditional uses. Our primary goal is to compile the most recent information on this plant and to encourage more in vitro and in vivo research to support local claims. The essential oil produced from T. serpyllum has attracted a lot of attention as a plant-derived product because of its diverse pharmacological properties, which include antioxidative, antibacterial, anti-inflammatory, and anticancer activity. Ethnomedicinal studies have shown that T. serpyllum has great potential for developing new drugs to address a variety of health sector problems. Pharmacological studies by themselves are not enough to justify T. serpyllum's extensive use. Researchers often use either in vitro or in vivo techniques. More research in the form of well planned pharmacological trials is required to assess these medicinal claims. The evaluation's conclusions will act as a basis for further research. There has been little pharmacological study on T. serpyllum despite its broad traditional use; most studies have been carried either in vitro or in vivo. Additional chemical isolation, in-depth pharmacological research, and possible culinary applications are crucial subjects to investigate.

Keywords: Pharmacological properties, phytochemistry,Thymusserpyllum,toxicity,traditionalapplications

Introduction:

By using medicinal herbs, the modern world is in charge of boosting immune responses and attaining superior health. People have used traditional medicines as an affordable and

convenient way to cure illnesses for millennia, dating back to about 4000 and 5000 B.C. The Chinese were able to get the earliest known herbal medicine composition. The Rig-Veda, which was written between 1600 and 3500 B.C., has the first written account of the usage of herbs as remedies in India. Herbs have long been used in traditional Indian medicine because of their medicinal qualities.[1] Plants may provide novel therapeutic interventions. According to World Health Organisation (WHO) surveys, most people in developed countries rely on traditional medicine for their health.The need for therapeutic plants is increasing in both developed and developing countries.

Thyme has a significant position as a member of the Lamiaceae family and a large genus within it. There is proof that this versatile plant is used as a spice all throughout the world. According to the World Checklist, there are 220 species of thymus L. among the 7534 species in the thyme genus (http://apps.kew.org/wcsp/ incfamilies.do).Third, Richard has successfully identified several Thymus species worldwide.[4] Members of the genus Thyme are widely used in the culinary, cosmetic, perfume, and pharmaceutical industries.[5] Among the numerous conditions that thyme may aid with include the common cold, flu, indigestion, nausea, renal disease, ulceration, headache, diabetes, and asthenia.[6] Thyme oil, which includes terpenes, esters, and phenolic compounds, is the primary subject of research. Thyme is one of the most adored herbs in the world because of its aromatic and therapeutic qualities, and thyme oil is no different. It is regarded by many as one among the top ten essential oils (EOs) worldwide.[7] Thus, the goal of this research is to provide current data on the pharmacological traits, phytochemical constituents, traditional applications, and safety profile of T. serpyllum. This research gathers phytochemical and pharmacological information that might be used to develop successful intervention plans, close knowledge gaps, and investigate novel therapeutic approaches.

Botanical Description and GeographicDistribution

T. serpyllum is a little shrub with a cluster of glossy, blue-green, pointed leaves that become brown over time. It has a nice scent. There are other names for it, such as Breckl and thyme, creeping thyme, and wild thyme. In addition to Asia, Europe, and North America, it may be found in various regions of East Africa. It grows in India, particularly in the Himachal Pradesh, Uttarakhand, and Jammu & Kashmir states.[8]

The height of perennial T. serpyllum bushes may range from 5 to 7 cm. Its hairy, crawling appearance is adorned with clusters of small, pinkish-purple blossoms.[8] The oval-shaped leaves are smooth on both sides, about 4-6 mm long and 2-4 mm wide, and are covered with long trichomes. The central vein is strong, while the lateral veins at the base of the edge are less noticeable. These leaves are present throughout the year. Because of its distinct aroma, the hermaphrodite T. serpyllum plant relies on pollinators including bees, flies, and butterflies. It prefers sandy, rocky, loose, and nutrient-poor soil and thrives in conditions with a medium to dry moisture content and adequate drainage. This species is more prevalent in areas with shade, even though it does well in dry, windy

environments.[9] It develops quickly on regular moist soil and requires more sunshine. Using stem cuttings for propagation is an easy procedure.

Thymus serpyllum: A Traditional Herb with Modern Uses

as well as for therapeutic purposes. They have been used in medicine for a very long time, and they are now an essential part of our cultural and gastronomic heritage.In the past, martyrs and warriors have used it to increase their physical strength and psychic perception since it has the fastest healing and courage capabilities [10].Greek medical professionals have traditionally used the plant's juice to cure coughs and asthma. They also advise using the paste topically to treat arthritis and clean wounds and scrapes.The plant's juice has long been used in Greek medicine to treat coughs and asthma, and its paste has external applications including curing wounds and scrapes and treating arthritis [13]. Furthermore, the leaves and blooming stems relieve a variety of skin issues, including rashes and itching, as well as period cramps and discomfort.[14] An infusion made from T. serpyllum leaves and "jaggery" is well-known for its diuretic properties.The aerial parts of T. serpyllum have antiseptic, antiplasmodic, deodorant, and disinfecting qualities in addition to its use in respiratory and gastrointestinal disorders [15].In the Western Balkans, T. serpyllum has improved blood circulation and is an immunostimulant [16].T. serpyllum has long been used by Indian traditional medicine practitioners to treat menstrual cramps [17].Additionally, it has been used to lessen oedema, eczema, and inflammation [18]. Its antidiarrheal properties have also been recognised by ethnoveterinary medicine.In 2015, the British Pharmacopoeia, Commission Secretariat of the Medicines, and Healthcare Products Regulatory Agency, reported that combining T. serpyllum with blackberry leaves effectively cured acute pharyngitis. Additionally, T. serpyllum is a prominent element in herbal tea.[20]. Apart from being used in mouthwashes and gargles, T. serpyllum essential oil's soothing and disinfecting qualities make it a powerful tool against a range of ailments.[21]

Plant biology

Over the last 20 years, a plethora of studies have investigated the phytoconstituents profile of T. serpyllum EO [Table 1].[22] is a The genus Thymus is classified by a number of chemical substances, including germacrenethymol, carvacrol, □-terpinyl acetate, linalool, geraniol, citral, and (E)-caryophyllene.[23] Thymol levels in essential oils extracted from thyme cultivated in India ranged from 60% to 64.6%, in contrast to those in essential oils extracted from thyme cultivated in Estonia, which ranged from 0% to 0.4%.Thymol (16.5%–18.8%), 4,8-cineole (14.0–18.0%), and thymoquinone (2.6%) were all reported by Aziz et al. [24].The essential oils of T. serpyllum cultivated in Muzaffarabad, Jammu include 1,8-cineole (14.0%-18.0%) and spathulenol (1.3%-2.1%).

Table1: Various classes of phyto compounds present in *Thymusserpyllum*

Categoryofphytocompounds	Phytoconstituents
Phenolicacidsandflavonoids	Gallic acid, rosmarinic acid, caffeic acid, ferulic acid, rosmarinic acid-glucoside, protocatechicacid,protocatechicacid-hexoside,chlorogenicacid,naringin,luteolin-o-diglucuronide, kaempferol-o-glucuronide,rutin,luteolin-o-glucuronide,apigenin-o-glucuronide,methylkaempferol-o-rutinoside,luteolin,luteolin-7-o-rutinoside,luteolin-7-o-glucoside,apigenin-7-o-glucoside, apigenin,quercetin,eriodictyol-7-o-glucuronide,8-prenylnaringenin,taxifolin,catechin,apigenin6,8-di-c-glucoside[28,29]
Triterpenic acid	Oleanolicacid,betulinicacid,ursolicacid,corosolicacid[29]
Monoterpenehydrocarbon	Tricyclene, *α*-Pinene, *o*-cymene, camphene,sabinene, *β*-pinene, *β*-cymene, α-phellandrene, myrcene,thymol, α-terpinene,*p*-cymene,limonene,α-thujene,terpinene,thymolacetate[30,31]
Monoterpeneoxidized	1,8-Cineole, linalool,δ^3-carene,terpenolene,α-thujone,cis-sabinenehydrate,camphor,α-campholene,sabinene hydrate, trans-sabinene hydrate, borneol, isoborneol, *p*-mentha-3,8-diene, terpinen-4-ol,cis-sabinol, p-cymen-8-ol, cis-chrysanthenol, carvacrol acetate, geranial, methyl carvacrol, methylthymol, thymolmethyl ether, menthol, nerol, carvone,fenchylalcohol, carvacrol methyl ether,thymoquinone, geraniol, bornyl acetate, *β*-citronellol, carvacrol, geranyl acetate, linalyl acetate, terpinyl$_{acetate}$[30,31]
Sesquiterpenehydrocarbons	Copaene, *β*-bourbonene, *α*-elinene, *γ*-cadinene, calamenene, *δ*-cadinene, *α*-cadinene, germacreneD,-abolene,epi-sesquiphellandrene,bicyclogermacrene,valencene,*α*-bisabolol,cis-bisabolene, *α*-cymene,-cymene,*β*-ocinene,*α*-ylangene,*β*-longipinene,longifolene,cubebene, *β*-elemene, muurolene,amorphene,aromadendrene,*α*-humulene,allo-aromadendrene,(E)-*β*-farnesene, *β*-caryophyllene,isoledene,iso-caryophyllene,trans-caryophyllene,spathulenol,elemol,trans-nerolidol,

	caryophyllene oxide, cadrol, α-campholene aldehyde, linalylpropanoate, isopulegone, tetradecanal, trans-carbyl propionate, ethyl cinamate, geranyl butyrate, bicyclogerma, piperitol, cadrol,crene,p-mentha-1-(7),8-diene,isoborneol,cubebene,longkyclene,longifolene,isovalericacid,
	cis-dihydrocarvone, p-cymene-2,5-diol, β-bisabolene, heptanoic acid, hexadecanoic acid, 2-nonanone,caffeic acidethylester[30]
Others	1-octen-3-ol,3-octanol,3-octanone,3-penten-2-ol,4-methyl-2-pentanol,6-methyl-5-hepten-2-one[31]

Jammu and Kashmir is a state in India. Aziz et al. [24] reported that the essential oil of T. serpyllum contained safrole, cyclohexane, and spathulenol. Additionally, higher levels of thymol (58.25%), transgeraniol (55.93%), lavandulyl acetate (28.51%), nerol (2.76%), and E-citral (2.58%) were discovered by the Northern Kazakhstani researchers. Trans-geraniol, lavandulyl acetate, nerol, and ecipitral were identified as the main constituents of T. serphyllum essential oil from different regions of Southern Italy.[25] Due to their high concentrations and safety, as confirmed by the World Health Organization's food additive guidelines, thymol and carvacrol are well-known food additives that draw a lot of business.[26]Thymol and T. serpyllum plants may be used as spices, under the FDA standard (www.fda.gov/downloads/ICECI/ComplianceManuals/CompliancePolicyGuidanceManual/UCM142644.pdf; accessed July 5, 2019). However, nonvolatile secondary metabolites of T. serpyllum, including rosmarinic acid, ursolic acid, and oleanolic acid, have attracted a lot of attention.[27] While Table 1 lists the many phytoconstituents present in T. serpyllum essential, Figures 1-4 illustrate the two-dimensional structures of phytocompounds.

Thymus serpyllum: A Pharmacological Tool

Numerous studies have shown the diverse biological activity of T. serpyllum extracts and compounds, which include anti-inflammatory, anti-bacterial, anti-oxidative, and anti-cancer effects. Furthermore, recent studies have investigated the interactions between carvacrol and thymol and the COVID-19 nucleocapsid phosphoprotein.[32] Twenty-five phytocompounds of T. serpyllum essential oil showed inadequate binding to SARS coronavirus 2 (PDB ID: 6VYO), according to another study.[32] However, these in silicoresearches may be further validated by appropriate in vitro and in vivo studies. a some of T. serpyllum's important biological applications.

Features of an antioxidant

The antioxidant potential of T. serpyllum extracts was examined in many studies.Using the 2,2-diphenylpicrylhydrazyl (DPPH) approach, Kulisic et al. [33] demonstrated the antioxidant activity of the essential oil of T. serpyllum flower heads and stalks, with an IC50

of around 0.40 ± 0.05 g/L. The ethanolic and aqueous extracts of T. serpyllum also demonstrated its antioxidant properties; the DPPH test findings showed IC50 values of 13.2 ± 0.3 g/ml and 31.6 ± 0.8 g/ml, respectively.Page 34 Furthermore, Mihailovic-Stanojevic used the ABTS assay (IC50-8.60 ± 0.05 mM Trolox) and the Ferric ion reducing antioxidant power (FRAP) test (IC50-16.59 ± 1.06 mM Fe (II) equivalents) to describe the antioxidant activity of a water extract of T. serpyllum.

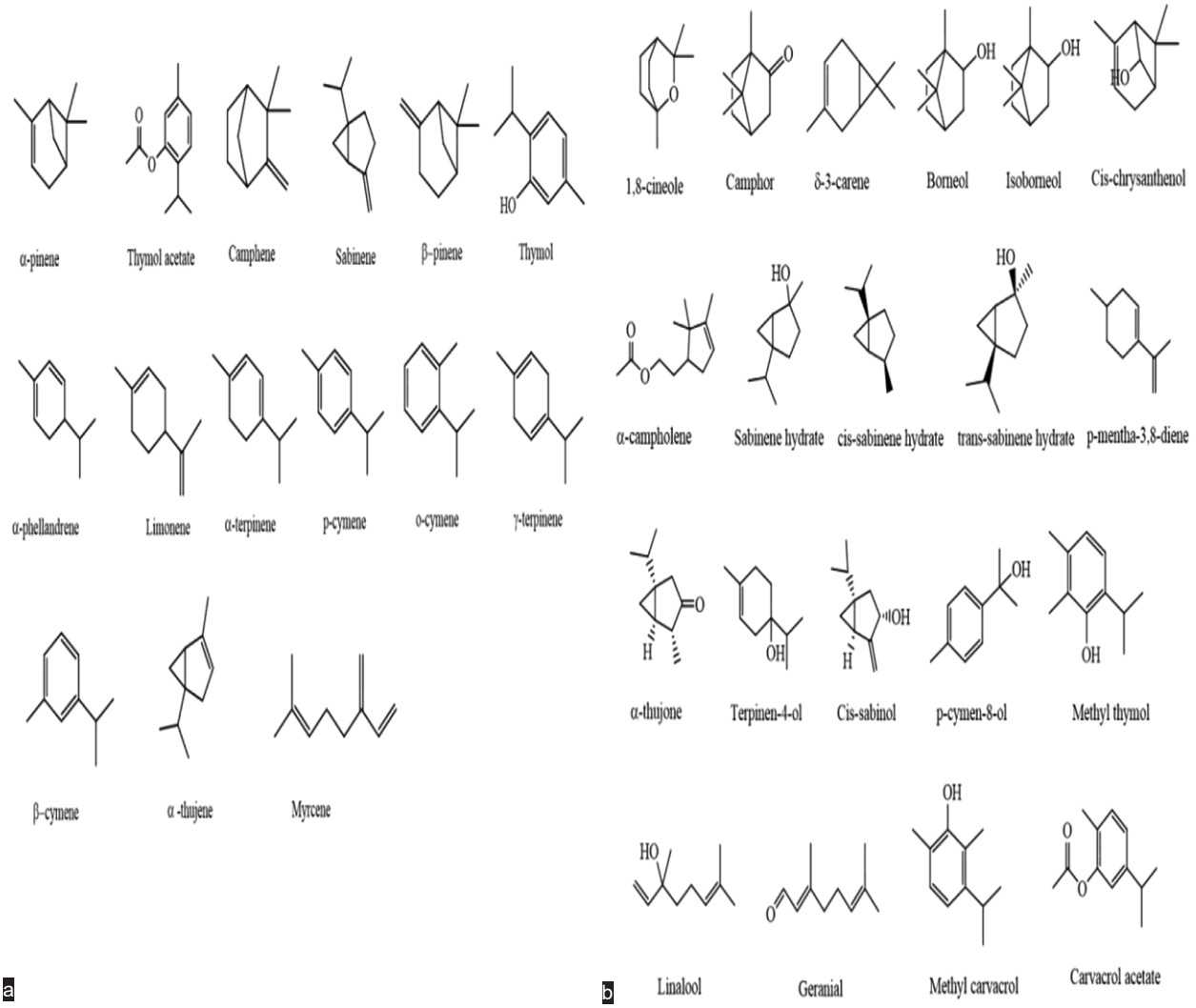
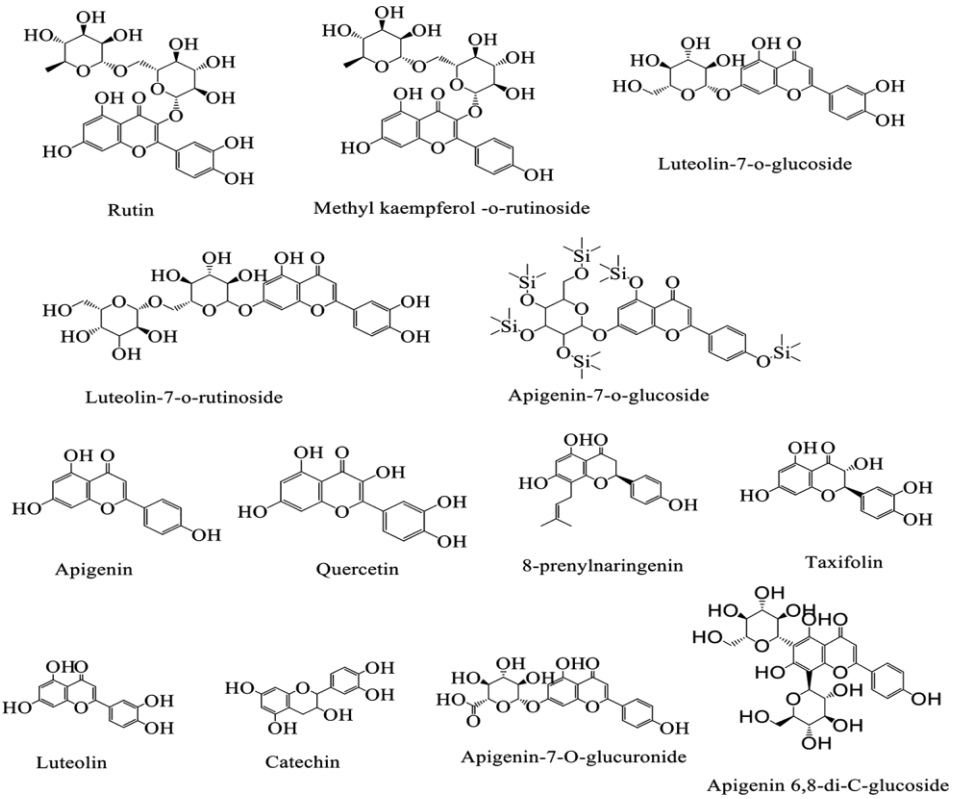


Figure1:2-dimensionalstructures*Thymusserpyllum*phytocompounds:(a)Monoterpenehydrocarbonspresentin*Thym*



*usserpyllum*and(b)Oxidized

Figure2:2-dimensionalstructuresofphenolicsandflavonoidspresentin*Thymusserpyllum*

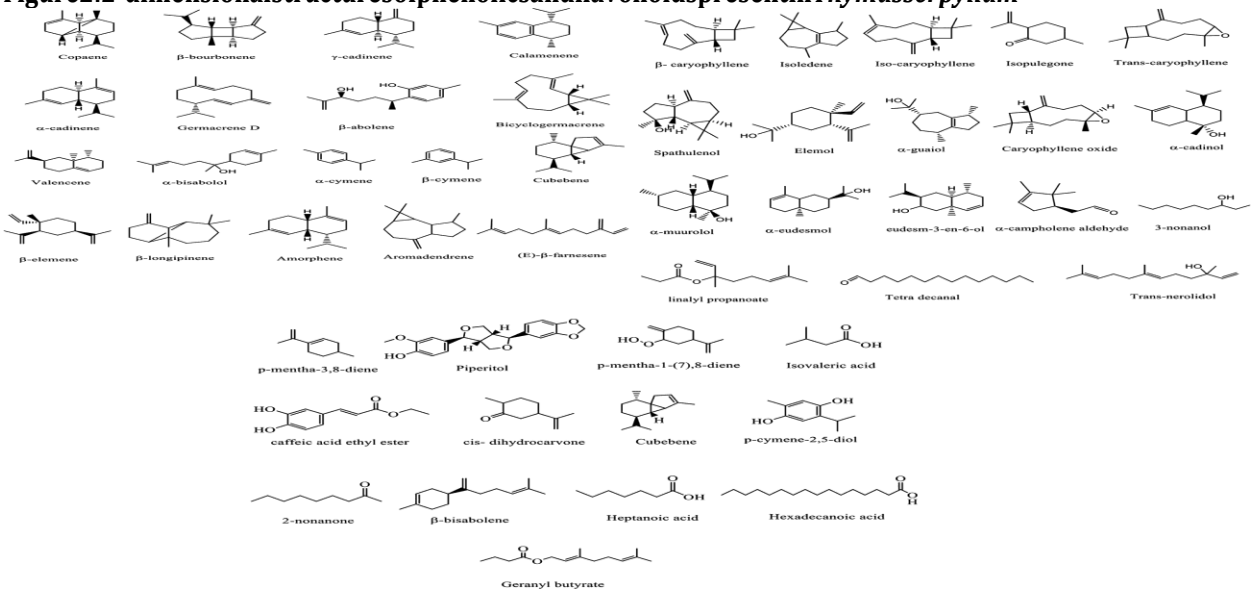


Figure3:2-dimensionalstructuresofsesquiterpenehydrocarbonspresentin*Thymusserpyllum*

with others.The free radical scavenging activity was shown with an IC50 of 3.00-3.17 mg/mL in T. serpyllum extracts that were aided by ultrasound (22). Antioxidant activity of

T. serpyllum EO isolated from entire plants was also shown by Nikolic et al. [15] using the DPPH technique (IC50 0.96 g/mL). The phenolic concentration, together with the rosmarinic and caffeicacids[22], gave this plant its antioxidant efficacy.[36]

Impact on microbes

Numerous studies have shown the antibacterial capabilities of essential oils and extracts from various T. serpyllum species.(15, 28, 30, 37–40) The antibacterial and antifungal activity is presented in Table 1. The study found that T. serpyllum's antibacterial qualities are due to its thymol and carvacrol.[15] Curcumin and T. serpyllum methanolic and ethyl acetate extracts were discovered to possess antifungal and antibacterial qualities (Farrukh et al.). Pseudomonas aeruginosa, Staphylococcus epidermidis, Staphylococcus aureus, Escherichia coli, Aspergillus fumigatus, Candida albicans, Candida parapsilosis, and Aspergillus niger were among the bacteria and yeasts that were tested against these characteristics. The MIC, or minimal inhibitory concentration, varied between 2000 and 4000 g/ml.[42] After 30 minutes of exposure, T. serpyllum EO's bactericidal effectiveness against every strain tested was 100%. According to Varga et al. [28], T. serpyllum's essential oil contains 25.8% carvacrol and 32.2% thymol. Both diluted and concentrated (100%) versions of the EO have been tried.

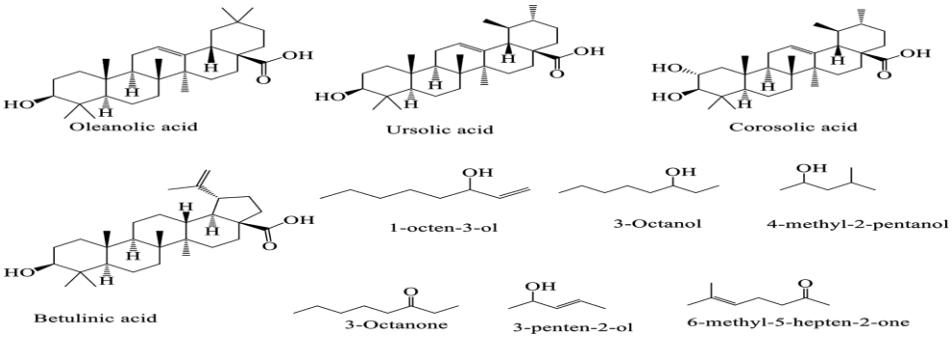


Figure 4: 2-dimensional structure of triterpenic acids and other phytocompoundsin*Thymusserpyllum*

Half of the samples examined for Saccharomyces cerevisiae, Pseudomonas aeruginosa, Streptococcus pyogenes, Listeria innocua, Candida albicans, and Cronobacter akazakii showed 100% cell death in an agar well diffusion experiment. Verma et al. evaluated the chemical and bactericidal properties of T. serpyllum L.'s primary and secondary essential oils [30]. The secondary EOs of T. serpyllum included 92.5% phenolic phytocompounds, compared to 42.1% in the primary EO. Interestingly, the secondary EO demonstrated antibacterial solid activity against every strain of bacteria and fungus tested, with ferric ion reducing antioxidant capabilities (ZOI) ranging from 20 to >35 mm and MIC values ranging from 1/3200 to 1/6400. Ouedrhiri et al. [38] examined the combined effects of essential oils of wild thyme (T. serpyllum), oregano (Origanum compactum), and marjoram (O. majorana). They discovered that the combination had a good synergistic effect against S.

aureus bacteria (P < 0.001). However, combining wild thyme essential oil with oregano had a synergistic impact against S. aureus and E. coli. Salaria et al. recently reported the synergistic potential of T. serpyllum essential oil (EO) with antifungal medications to treat candida infections [40]. The effectiveness of silver nitrate nanoparticles (AgNPs) made from water-based T. serpyllum extracts against bacteria was discovered by Erci and Torlak [39]. In the presence of AgNPs, B. cereus was unable to traverse a 12.23 ± 0.54 mm region. In contrast, the inhibition zone measured 13.86 ± 0.58 mm when treated against S. aureus. Using AgNPs, the diameters of the inhibitory zones for S. typhimurium and E. coli were 10.60 ± 0.53 mm and 9.98 ± 1.02 mm, respectively. These studies clearly showed the therapeutic benefits of wild thyme extracts and essential oils in the fight against microbial infections.

Impact on inflammation reduction

By inhibiting the synthesis of interleukin-6 and Src tyrosine kinase in the splenocytes of Balb/c mice, Kindl et al. investigated T. serpyllum's anti-inflammatory response in vitro.[44] Unlike polyphenols such as luteolin (IC50 = 8 AFSM), luteolin-7-O-glucoside (IC50 = 40 AFSM), and rosmarinic acid, T. serpyllum methanolic extract showed a modest dose-dependent inhibition of Src kinase (IC50 = 115-167 AFSg/ml). Both acid (IC50-61 AFSM at 0.01 AFSM) and staurosporine (a Src tyrosine kinase inhibitor) have IC50-0.005 AFSg/ml. The MTS assay was also used to evaluate the cytotoxic properties of polyphenols and T. serpyllum extract. The addition of T. serpyllum extract and polyphenols (200-0.8 AFSg/ml) reduced the production of IL-6. At a high concentration of T. serpyllum (200 AFSg/ml), the cytokine production in the treated cells was reduced by more than 95%, and the IC50 value for IL-6 production was found to be 49.5 ± 9.6 AFSg/ml. Using T. serpyllum extract (200–0.8 g/ml) showed no signs of cytotoxicity.

Activity against cancer and cytotoxicity

The cytotoxic and anticancer properties of Thymus sp. solvent extracts, essential oils, and phytocompounds have been shown in several studies. The cytotoxic and Hep-2 activity against a mouse leukemia model was shown by Jaafari et al. [45]. In a study conducted by Nikolic et al., [15] it was shown that T. serpyllum essential exhibited anticancer properties against MCF-7, NCI-H460, HCT-15, HeLa, and others. The essential T. serpyllum showed a 50% inhibition of growth (GI 50-52.69 ± 3.28 μg/ml), GI50-37.17 ± 3.18 μg/ml), GI50-7.02 ± 0.07 ± 0.07 ± 0.07 g/ml), and GI50-17.71 ± 3.23 g/ml.

Table2:Antimicrobialactivityofextractsand*Thymusserpyllum*essentialoilagainst differentbacterialandfungalspecies

Part used	Extracts/EO	Method	Testedstrains	Keyresults
Aerial parts	EO	Agarwell diffusion and protndiution method	*K.pneumoniae* *P.aeruginosa* *E. coli* *S.aureus* *B. subtilis*	15–40mm,100%bactericidalafter30min exposure. Ineffectiveagainst*P.aeruginosa*[43]
Aerialpart	Ethanol,butanol, methanol,hexane, ethyl-acetate,and aqueousextracts	Microdilution method	*E.coli,P.aeruginosa,S.aureus, S.epidermidis,C.albicans,C. parapsilosis* *A. fumigatus* *A.niger*	Onlyethyl-acetateandmethanolicextractsexhibited significantactivityagainstalltestedbacteria andfungi, displayingMICvaluesrangingfrom 2000–4000µg/mL[42]
Whole plant	EO	Microdilution method	Ochratoxinaproducingstrains: *A.ochraceus,A.ochraceus,A. carbonarius,*and *A.niger*	MICrangedbetween0.625 and2.5µL/mL[37]
Aerial parts	EO	Agardiffusion method	*P.aeruginosa,C.sakazakii,L. innocuaandS.pyogenes,C. albicans,S.cerevisiae*	Completeinhibitionofthegrowthofallthestrainsby 50% and100% EO[28]
Aerial parts	PrimaryEO and secondaryEO	Diskdiffusion methoda nd microdilution method	*S.aureus,S.epidermidis,E. faecalis,S.mutans,E.aerogenes,K. pneumoniae*andpathogenicfungi: *C.neoformans*and*C.albicans*	Φ-20–>35mm MICrangedbetween1/3200and1/6400[30]
Aerial parts	EO of*T. serpyllum* incombination with EO of*O. compactum* (oregano), and*O. majorana*(marjoram)	Microdilution methoda nd checkerboard assay	*B.subtilis,S.aureus*and*E.coli*	Antibacterialsynergisticeffectwasobservedwith combinationof EO of*T.serpyllum*with EO of marjoramagainst*S.aureus*,whilecombinationofEO oforeganoand EOof*T.serpyllum*showedsignificant synergisticactivityagainst*S.aureus*and *E.coli*[38]
Aerial parts	EO of*T. serpyllum* incombination with EO of*O. majorana* (marjoram)	Microdilution methoda nd checkerboard assay	*E.coli*and*S.aureus*	Synergisticantibacterialeffectof EOof *O.majorana* and *T.serpyllum*withFICindex of 0.725[38]
Leaves	AgNPsofaqueous extracts	Agarwell diffusion	*B. cereus* *S.aureus*	Φ-12.23±0.54mm Φ-13.86±0.58mm

E. coli	Φ-9.98±1.02mm
S. typhimurium	Φ-10.60±0.53mm

K. pneumoniae=Klebsiella pneumoniae, *P. aeruginosa=Pseudomonas aeruginosa*, *E. coli=Escherichia coli*, *S. aureus=Staphylococcus aureus*, *B.* subtilis=Bacillussubtilis,S.epidermidis=Staphylococcusepidermidis,C.albicans=Candidaalbicans,C.parapsilosis=Candidaparapsilosis,A.fumigatus=Aspergillusfumigatus,

A. niger=Aspergillusniger, A. ochraceus=Aspergillusochraceus, A. carbonarius=Aspergilluscarbonarius, C. sakazakii=Cronobactersakazakii, L. innocua=Listeriainnocua,S.pyogenes=Streptococcuspyogenes,S. cerevisiae=Saccharomycescerevisiae, E.faecalis=Enterococcusfaecalis,S. mutans=Streptococcusmutans,

E.aerogenes=Enterobacteraerogenes,C.neoformans=Cryptococcusneoformans,B.cereus=Bacilluscereus,S.typhimurium=Salmonellatyphimurium,

T. serpyllum=Thymus serpyllum, O. majorana=Origanummajorana, O. compactum=Origanum compactum, Φ=Zone of inhibition in mm, MIC=Minimum inhibitoryconcentration, FIC=Fractionalinhibitory concentration,EO=Essential oil,AgNPs=Silver nitratenanoparticles

The half-life of the HepG2 gene is about 34.96 ± 2.90 µg/ml. It was shown that T. serpyllum EO was cytotoxic to the MCF-7, LNCaP, and NIH3T3 fibroblast cell lines. According to research, compounds such the sesquiterpene caryophyllene are partly responsible for the EO's antiproliferative effects.[46] Lazarevic et al. [47] demonstrated that the antiproliferative activity of T. serpyllum EO was limited when applied to oral squamous cell carcinoma cultures and the SCC-25 cell line. Against MCF-7, LNCaP, and NIH-3T3 cell lines, the oil showed similar effects with IC50 values of 95.8, 105.0, and 105.0 mg/ml, respectively.[46] According to Berdowska et al. [48], the aqueous extract from T. serpyllum was evaluated for cytotoxicity against both wild-type MCF-7 (wt) cells and cancer cells (MCF-7/Adr). Thymol, a major constituent of T. serpyllum essential oil, has been shown to have antiproliferative action in acute promyelotic leukaemia (HL-60) cells.[49] Thymol and carvacrol demonstrated dose-dependent cytotoxicity against colorectal cancer, breast cancer, and the P815 mastocytoma cell proliferation model. Similarly, Jaafari et al. found a correlation between the carvacrol concentration and the cytotoxic activity of T. serpyllum EO.[45] Therefore, research into the potential therapeutic benefits of thyme essential oils and phytocompounds in the treatment of cancer in humans is feasible.

Activity against malaria

Researchers Hussain et al.[31] used an antihembiocrystallization test to look at the antimalarial effects of T. serpyllum essential oil. The antimalarial activity of T. serpyllum oil was found to be 46.1% at a concentration of 10 mg/ml. The antimalarial potential of T. serpyllum EO and its components has to be further investigated in in-depth investigations using different doses and model systems.

Safety Investigations

The US Food and Drug Administration has declared thyme "food safe" when consumed in the authorised therapeutic dosages. For six months, mice were able to breathe in thymol hydrofluoroalkane at concentrations ranging from 0.1% to 0.5% without suffering any adverse effects on their lungs or respiratory systems, according to research by Xie et al. [50]. However, there is little information on the negative effects of administering T. serpyllum EO. It is crucial to do thorough research that focus on the toxicity features using various doses and model systems in order to better understand the safety profile of T. serpyllum EO.

Alternative Uses of Biotechnology

Activity of food preservatives

By preventing the growth of food microbes, the phytocompounds found in T. serpyllum EO, such as thymol, carvacrol, terpenoids, and others, have been shown to be beneficial in enhancing food safety and quality. These phytocompounds either prevent bacteria from destroying food products or serve as antimicrobials to fight food-borne illnesses.[51] Wild thyme is an essential medicinal plant due to its antibacterial and antioxidant properties.[15] Cakes fermented with T. serpyllum EO were reported to help prevent fungal infections by Hagan et al. [52].

Pest control ability

Thymol, the main active component of T. serpyllum's essential oil, has been shown to be resistant against common housefly (Musca domestica) larvae and pupae. According to recent data, T. serpyllumthymol may result in contact and fumigant toxic responses. Both thymol and T. serpyllum EO are toxic to housefly larvae and pupae, according to these findings, which may make them effective strategies for controlling housefly populations. Szczepanik et al. have previously documented the insecticidal properties of T. vulgare's carvacrol and thymol [53]. Regretfully, no research has yet been done on T. serpyllum EO's insecticidal properties. However, no prior research has been done on T. serpyllum EO's insecticidal effects.

Environmental protection

T. serpyllum has a variety of pharmacological actions. In an effort to develop novel herbal treatments, T. serpyllum has aroused the interest of both scientists and the general population.

T. serpyllum is primarily found in North American, East African, Nepalese, Pakistanese, Indian, and Chinese cuisines.[8] Due of its limited availability and high medicinal importance, researchers are trying to cultivate T. serpyllum in vitro utilising tissue culture techniques. In order to meet the industrial need for this herb, Dear Sir/Madam Rajan Rolta, Advisor at Tridev Aushadhi Utpadhan Society, Rohal, Chirgaon, District Shimla, Himachal Pradesh, India, is also attempting to produce T. serpyllum in its natural environment. In Rohal, Chirgaon, District Shimla, Himachal Pradesh, India, an adviser at the TridevAushadhiUtpadhan Society is another person working to address the industrial need for T. serpyllum.

Considerations for the Future and Final Thoughts

T. serpyllum aerial portions have been utilised to treat urinary tract, stomach, and esophageal infections. Due to its pharmacological relevance, essential oils from this species have gained popularity in modern medicine. Growth stage, location, and harvesting season are among of the factors that determine the phytocompound composition and production of T. serpyllum EO, which is important for industrial, cosmetic, and medical purposes. According to recent research, T. serpyllum essential oil exhibits potent antioxidant and antibacterial properties. However, further study is needed to determine if thymol, carvacrol, and other ingredients may be used to combat cytotoxicity, inflammation, malaria, and hypertension. The food sector finds the plant appealing due to its potential use as a nutritional supplement and antioxidant, while the pharmaceutical industry finds it beneficial due to its diverse pharmacological properties.

References:

1. Tulsi (Ocimum sanctum Linn) and its medicinal benefits, including a brief overview of eugenol and its pharmacological effects, by Prakash P and Gupta N. Indian Journal of Physiology and Pharmacology, 2005, 49: 125–131.

2. The Traditional Medicine Strategy of the World Health Organization from 2002 to 2005. Publishing: Geneva, Switzerland: World Health Organization (WHO); 2002. WHO/EDM/202. 1.

3. The authors of the article include Harley RM, Atkins S, Budantsev AL, Cantino PD, Conn BJ, Grayer R, and others. Labiatae family. Section: Dichotoledons (Flowering Plants). Springer Berlin, Heidelberg, 2004. Pages 167–275.

4. Baritaux, Richard H., Bejilali B., and Banquoir, N. O. Analyzing the several Moroccan thyme essential oils. "Landeskrankheitstechnologie in Lebensmitteln" (1985): 105–10.

5.This is the fifth work by Cornara, La Rocca, Marsili, and Mariotti. Plants and their traditional applications along Italy's Liguria coast. In 2009, the Journal of Ethnopharmacology published an article with the DOI 125:16-30.

6. Sixth, Rowshan, Bahmanzadegan, and Saharkhiz MJ. Thymus daenensiscelak essential oil composition as affected by storage conditions. Retrieved from "Ind Crops Prod" (2013), volume 49, pages 97 to 101.

7. Sáez F. and Stahl-Biskup E., editors. One species of thyme is Thymus.

8. Section 300 of Taylor & Francis Group's 6000 Broken Sound Parkway NW The authors of the manuscript are Jarić, Mitrović, and Pavlović. Evid Based Complement Alternat Med (2015): 101978: A review of ethnobotanical, phytochemical, and pharmacological studies on Thymus serpyllum L.

9. In 2001, Zhu published an article in Trends in Plant Science, volume 10, pages 1360–1385.

10. Ramiro-Sharifi, Jaszaruk, Polito, Morais-Braga, Rocha, Coutinho, et al. Antimicrobial compounds derived from the Matricaria genus: agricultural, pharmaceutical, and culinary uses. "Microbiological Research" published in 2018 with the DOI 215:76–88.

11. Eriksson Ä. Thymus serpyllum regional distribution: limits on dispersion and history of management. Ecography, 1998, vol. 21, pp. 35–43.

12. Heilmeyer, M. Herbs of antiquity. Address: 1200 Getty Centre Drive Suite 500, Los Angeles, California 90049-1682, ISBN-13:978-0-89236-884-6, published by Getty Publications in 2007.

13. Karaharova E, Lebanova H, Getov I, Benbassat N, and Napier J. were the authors of the article. A descriptive examination of the current state of Bulgarian traditional medicinal plant knowledge. Published in 2013 by Afr J Pharm Pharmacol, the journal has a focus on pharmaceutical research.

14. This is the fourteenth work by Dandlen, Miguel, Duarte, Faleiro, Sousa, Lima, and others. Portuguese thymus essential oils reduce acetylcholinesterase activity. Journal of Essential Oil Bearing Plants 2011;14:140-50.

15. The authors include Nikolaić, Glamočlija, Ferreira, Calhelha, Fernandes, Marković, and others. Thymus serpyllum L. and Thymus algeriensisBoiss chemical composition, antibacterial, antioxidant, and anticancer properties.

16. Reut and Thymus vulgaris L. essential oils, moreover. The authors of the article "Ind Crops Prod 2014;52:183-90" are Mustafa B, Hajdari A, Krasniqi F, Hoxha E, Ademi H, Quave CL, and sixteen others.

17.Albatian Alps ethnobotany for medicinal use in Kosovo. In a 2012 article published in the Journal of Ethnobiology (Ethnomed), the authors (Mustafa, Hajdari, Pieroni, Pulaj, Koro, and Quave) discussed. Folk plant usage among Albanians, Bosniaks, Gorani, and Turks in south Kosovo: a cross-cultural comparison. The article "J EthnobiolEthnomed 2015:11:39" was published in 2015.

18. The authors are Gairola, Sharma, and Bedi. An examination of medicinal plant use in Jammu & Kashmir, Ladakh, and India from a cross-cultural perspective. Journal of Ethnopharmacology 2014;155:925–86.

19. The authors of the study are Carrió, Rigat, Garnatje, Mayans, Parada, and Vallès (19). Comparison of plant ethnoveterinary techniques with human ethnobotanical medicine in two Balearic island regions and two Pyrenean territories of Catalonia (Iberian Peninsula). Reference: Evid Based Complement Alternat Med 2012;2012:896295.

20. Zarzuelo A and Crespo E. 20. A look into thyme's applications, both medical and otherwise. As published in Thyme in 2002. (pg. 277–306) CRC Press eBook with the ISBN 9780429218651.

21. Research on the chemical components of Thymus serpyllum (Aziz S., n.d.).“Turkish Journal of Chemistry” 2008; 32: 605–14.

22. The authors of the article are Mihailovic-Stanojevic N, Belščak-Cvitanović A, Grujić-Milanović J, Ivanov M, JovovićDj, Bugarski D, along with others. Thymus serpyllum L. extract's antioxidant and antihypertensive effects in a controlled laboratory setting. The article is published in the Plant Foods Hum Nutr journal and has the citation: 2013;68:235-40.

23.Genetic polymorphism in thyme: population structure and regional dynamics (Thomson, J.D.). Found in Thyme 2002: pages 58–88. Copyright © CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL 334872742.

24.Irshad M, Aziz S, Hussain H, Habib-ur-Rehman, Habib-ur-Rehman, Ahmed I. Essential oils of Thymus serpyllum cultivated in Jammu and Kashmir: phytotoxic and antifungal effects. The citation is from the 2010 Journal of Essential Oil Bearing Plants, volume 13, pages 224–249, page

25.The authors of the article are Kirillov V, Stikhareva T, Mukanov B, Chebotko N, Ryazantsev O, Atazhanova G, and Adekenov S. The chemical make-up of the Thymus serpyllum L. essential oil sourced from the northern region of Kazakhstan. Article published in 2016 in the Journal of Essential Oil Bearing Plants, volume 19, pages 212–22.

26.The authors of the article are Stahl-Biskup E and Venskutonis RP. I love thyme. The Herbal Remedieswith seasonings, Page number: 499-525 from Taylor and Francis Group's 2012 publication by Woodhead Publishing, located at 6000 Broken Sound Parkway NW, Suite 300 in Boca Raton, FL.Yan X, Fan S, Li X, Wang X, Shen M, He T, and others.

27.Plants belonging to the genus Thymus and its traditional applications, chemical components, and biological activity. The article is published in the journal Chemistry & biodiversity and has the DOI: 1900254.G.

28. Horvath, A. Bardocz, B. Boros, E. Varga, A. Maraz, A. Belak, and A. Felinger. Analysis of the chemical make-up, antimicrobial properties, and polyphenolic content of various Thymus extracts, as well as essential oils of thyme. The journal Thymus published an article in 2015 with the DOI: 0.6363.

29.Saudone L, Raudonis R, Gaivelytė K, Vainorienė R, and Janulis V were the authors of the 29th publication. Phenolic and triterpene profiles of Thymus vulgaris species grown in a controlled environment. The sentence is a collection of abstracts from an international symposium on phytochemicals that took place from September 17th to the 19th, 2017 in Francavilla al Mare, Chieti, Italy. The symposium was organized by the Italian Society of Phytochemistry and Medicinal and Food Plant Sciences, and it was written by Profumo and others. Chieti CH: "G. d'Annunzio" Department of Pharmacy Chieti-Pescara, 2017.

30. With the help of Rahman LU, Verma RK, Singh A, Yadav A, Chanotiya CS, and others..... Thymus serpyllum essential oil blend from the Kumaon area of India's western Himalayas. Journal of natural products. 2009;4:1934578X0900400723.

31.The authors of the report are Hussain AI, Anwar F, Chatha SA, Latif S, Sherazi ST, Ahmad A, Worthington J, and Sarker SD. Investigations on the bioactivity and chemical makeup of two essential oils extracted from Thymus species native to Pakistani plants. The article "LWT—Food Science and Technology" was published in 2013 in volume 50, pages 185–92.

32: Rolta R, Yadav R, Salaria D, Trivedi S, Imran M, Sourirajan A, and others. One way to stop the COVID-19 virus from assembling is to use in silico screening to find one hundred phytocompounds from ten medicinal plants that might block the virus's nucleocapsid phosphoprotein. "Journal of Biomolecular Structural Dynamics" published in 2021, volume 39, pages 7017–34.

33. Kulismic T, Radonic A, Milos M. Essential oil fractions inhibit lard oxidation. Grasas y Aceites 56.285–291 (2005).

34.Mata AT, Proença C, Ferreira AR, Serralheiro ML, Nogueira JM, and Araújo ME came up with the formula. Five plants used as spices in Portuguese cuisine were tested for their antioxidant and antiacetylcholinesterase effects. Published in 2007 in the Journal of Food Chemistry, volume 103, pages 778–78.

35. The authors of the article are Jovanović A, Đorđević V, Zdunić G, Šavikin K, Pljevljakusić D, and Bugarski B. Exploring the antioxidant activity of Thymus serpyllum polyphenols using ultrasound-assisted extraction. The journal HemijskaIndustrija published an article in 2016 with the DOI number 70: 391–90.

36. The authors of the article are Hazzit, Baaliouamer, Veríssimo, Faleiro, and Miguel. The chemical make-up and biological effects of thymus oils from Algeria. Scientific American, 2009, 116, 714–721.