Therapeutic potential of *Thymus vulgaris*: A Review

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Abstract

Thymus vulgaris belongs to the family of Lamiaceae, which are flowering plants with aroma. Plant of Thyme grows in the Mediterranean region. Due to essential oils extracted from the leaves of the thyme, which gives aromatic and therapeutic properties. Besides many other health benefits, thyme possesses many medicinal properties. Essential oils of thyme are also crucial in pharmaceutical, cosmeceuticals, and nutraceuticals sectors. Significant oil components contain carvacrol, p-cymene, thymol, and γ -terpinene of thyme's most important ones. Thymol is a naturally-occurring constituent of thyme. It is a 10-64% major part of the thyme oil. It is a monoterpene derivative of cymene and isomer of carvacrol. These constituents have potent anti-fungal, anti-bacterial, and antioxidant activities. These are also beneficial in treating cancers, reduces inflammation, antimicrobial, antispasmodic, immunomodulator, and growth enhancers. It also helps to improve mouth infection. The essential oil of *Thymus* is safe and used as a natural preservative. Essential oils present in thyme are extracted through many different extraction techniques. Hydro-distillation, steam distillation, hydro diffusion or solvent extraction, and microwave-assisted extraction are the most common extraction techniques. Plants aroma isolates are used in many food and fragrance companies. The most widely used means of producing this aroma is constituting organic solvent.

Keywords

Thymus Vulgaris, Thymol, Antimicrobial, Therapeutic Properties

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List of Abbreviations**LDL**= Low-Density Lipoproteins**MIC**= Minimum Inhibitory Concentration**AD**= Aqueous Decoctions**HE**= Hydro-Ethanollic Extracts**MIC**= Minimum Inhibitory Concentration**FCR**=Feed Conversion Ratio**EAE**=Experimental Autoimmune
Encephalomyelitis**GGT**=Gamma-Glutamyl Transferase**ALT**=Alanine AminoTransferase**INTRODUCTION:**

Thyme; scientific name (*Thymus vulgaris* L.) is the name of Lamiaceae family of Labiatae of the plant kingdom. It is a family of flowering plants with aroma. Basil, rosemary, savory, oregano, sage, lavender, mentha, mint, perilla are other plants of the same species, including thyme. Thyme possesses many medicinal properties. Essential oils of thyme also have many medicinal properties. Major components of oil extraction have carvacrol, p-cymene, thymol, and γ -terpinene. These have strong enough anti-bacterial, anti-fungal, and antioxidant activities. Thymus extracts and essential oil prevents from spoilage of foods, thus increasing the deuteriation of food. The essential oil of Thymus is safe and used as a natural preservative. The mixture of the compounds in plant oil shows a different antimicrobial properties mechanism, thus showing resistance to microbes [1].

Thyme Plant:

Plant of Thyme grows in the Mediterranean region. Plants grow in several regions of the world, especially throughout regions of Iran in different provinces. Name in Persian of Thyme are Avishan or Azorbe. It is composed of fourteen

species, growing in several regions of Iran [2]. Many of its species are also grown in Oman. Kekik is the local name of thyme. This plant is a small shrub and is about twenty-five cm high. Its branches and stems are involving four teams competing against each other. This plant's leaves are six to twelve millimetres long, oval in shape, thickly dotted with many oil glands. The flowers of this plant blossoms from June to July. Bees and flies are attracted to the plant due to its aroma. The main extracted oils from the plants are the monoterpenes thymol and carvacrol. The locally grown plant also had a high thymol concentration, about 20-54% [3].

Due to essential oils extracted, thyme leaves, which gives aromatic and therapeutic properties. Thyme is used to feed marine animals and poultry. It is also used as flavouring liqueur in herbal teas to treat flues and colds and soups and vegetables. Thyme and oils extracted from thyme are used as antiseptic, in mouthwashes, antioxidants, and fumigants. Flavonoids, carvacrol, and thymol present in thyme plant show anti-flatulent, anti-bacterial, and anti-worm properties. Essential oils are extracted through different analytical methods showing characterized properties of Thyme [4]. A naturally-occurring constituent of thyme is thymol. It is a 10-64% major part of the essential oil of thyme. Cymene is a monoterpene derivative and isomer of carvacrol. It is essential for its therapeutic and medicinal characteristics. Today it is being used widely in nutraceutical, cosmeceuticals, as well as pharmaceutical companies. Numerous researches have assessed the potential therapeutic benefits of thyme and shown effective results in treating nervous, respiratory, and cardiovascular-related disorders. However, it is beneficially used as antioxidant, anticarcinogenic, antimicrobial, anti-inflammatory, antispasmodic, immunomodulator, and growth enhancer [5].

Extraction Techniques:

Essential oils present in thyme are extracted through many different extraction techniques. Hydro-distillation [6], steam distillation, hydro diffusion or by solvent extraction (Man A et al., 2019), and microwave-assisted extraction [7] are the techniques used for the extraction of oils. Gedikoğlu A used hydro-distillation and microwave-assisted extraction technique to obtain thymol and other components from thyme. Analysis through Gas chromatography-mass spectrometry showed the highest concentration of p-cymene (11.2%) and thymol (55.35%) in thyme when hydro-distillation and microwave-assisted extraction technique was applied. Whereas, the amount of γ -terpinene (13.25%) and carvacrol (68.20%) were found highest in zahter when using hydro-distillation and microwave-assisted extraction. The plant shows antimicrobial property against the chosen bacteria *Staphylococcus aureus* ATCC 9144 [8].

Essential oil extraction and polyphenols can be done by microwave hydro-diffusion and gravity. Results obtained are similar to those of traditional methods, which are microwave-assisted hydro-distillation and conventional hydro-distillation. Treatment of plant before polyphenol extraction, the MHG extraction technique is also an effective method for plant material pretreatment before polyphenol extraction. Phenolic contents in total increased from 23 to 38 mg GAE/g DM for Thyme [9].

Plants aroma isolates are utilized in many foods and scent companies. The use of organic solvent obtains the aroma from these plants. Some solvents left behind are not desirable. Ultrasound with sunflower oil was used as a new green extraction technique. This natural solvent is used to prepare green absolute from thyme. This solvent offers shorter extraction time and increase absolute yield up to 47%. The highest recovery of carvacrol and thymol (86.2%) is obtained. The absolute was free from waxes, any solvent residue, and have the highest antioxidative property. In results, it concluded that it is an

excellent alternative technique and can be used at an industrial scale [10].

Chemical Composition of Thyme:

Active compounds in thyme are oils, saponins, and tannins. The composition of tannins is 9.7%, volatile oils are 21.1%, and saponins are 59.2% in thyme extracts [11]. Steroids are present in leaf extracts of *T. Vulgaris*. Flavonoids are present in the methanol and butanol extracts. Also, saponins are present in ethyl acetate as well as butanol extracts [12]. Through the study of gas chromatography-mass spectrometry, it was identified that twenty-five compounds in thyme are present. Few were at higher importance, and the others less than 0.05% or less were not considered for identification. Thymol (55.3%), carvacrol (8.7%), p-cymene (11.2%), and β -caryophyllene (4.2%) are the major components of the essential oils. The other essential compounds were isoborneol (2.3%), γ -terpinene (3.4%), acetovanillone (1.7%), and linalool (1.7%) when using hydro-distillation and microwave assistant extraction [13].

Thymol active compound of thyme:

Thymol was the first time extracted by Caspar Neumann in 1719. With ethyl acetate, dimethyl carbonate, or acetic acid, thyme forms colourless, bright, and translucent white crystals, giving thyme's odour. Thyme has a spicy herbal odour and also some medicinal. Taste of Thyme is caustic, medicinal, spicy, pungent, and sweet. The purest form was obtained some 134 years later by Lallemant in 1853. Thousands of years ago, thymol was also used by Egyptians to preserve mummies [14].

THERAPEUTIC POTENTIAL OF THYME VULGARIS:

The Thymus is used for expectorant, antihelminthic, antispasmodic, antioxidative, sedative, antiseptic, antispasmodic, antirheumatic, antibacterial, carminative, antifungal, antiviral, diaphoretic, antimicrobial,

Figure 1: Thymus vulgaris therapeutic importance

antihypertensive and other beneficial effects [15]. The importance of thyme is mentioned in other studies also. It helps heal wounds, treat nausea, tiredness, water retention, respiratory system issues, colds, and coughs. It is also beneficial during menstrual periods and in treating menopausal issues. Oily skin and scars and even depression can be managed by regular thyme consumption. It helps prevent hair fall; acne also strengthens memory and concentrates more [16].

Essential oil extracted thyme helps to improve mouth infection. Many insects such as fleas, lice, mosquitoes, and moths can be kept away with this. Its oil is used in commercial industries as a preservative and antioxidants [17]. A higher concentration of polyphenols present in thyme is monoterpenes. Most significant are thymol, carvacrol, p-cymene, borneol, and camphor [18]. Thymol is the most predominant essential oil of thyme. It is a derivative of cymene. It is the isomer of carvacrol. Besides other properties, these active compounds have antioxidative, antitussive, antispasmodic, antimicrobial, expectorant, and anti-bacterial effects [19].

These compounds also contribute to pharmaceutical importance. It is also helpful in treating heart-related disorders and respiratory

disorders. It also exhibits anti-inflammatory properties, growth enhancers, and immunomodulators nervous [20]. Oils are used as medical antiseptics in wound healing. According to the Food and Drug Administration, it is also recognized as safe to be used as a food additive, helpful in food preservation, and as a flavoring agent [21]. It is responsible for disinfecting pesticides and safe to be used as a surface sanitizer, lab reagents, microscopy, and perfumery. Beneficial to be used in mouthwashes to kill bacteria when combined with alcohol, volatiles, and glycerin [22].

Thyme is also used to heal wounds, cure chest congestion due to heart problems and chest infection; mouth issues help treat worms in children since ancient times. The thyme plant is used in cooking to induce flavor [23]. It has been presented that the constituent's carvacrol and thymol of essential oil of thyme show an anti-inflammatory response, thus showing a hepatoprotective effect [24]. Therapeutic importance of *Thymus vulgaris* was shown in the Figure 1.

Anti-diabetic Properties:

Thymus Vulgaris have an anti-diabetic effect. A research was conducted to investigate the anti-diabetic drugs in which two groups were

randomly divided. Group 1 was receiving usual drugs, and Group 2 was receiving an extract of aqueous Thymus. K 20 gr/day with conventional therapy. The duration of the intervention was three months. The addition of Thymus. K 20gr/day in common drugs reduced the Fasting Blood Glucose and Hb A1C levels and increases in the beta-cell function index (HOMA-Beta), whereas significantly reducing is Low-Density Lipoproteins -C levels [25].

Anti-bacterial Properties:

Essential oils of thyme have anti-bacterial effects. Oramadike E et al., assessed the study in 2017 examined anti-bacterial activity and resistance of many of the antibiotics parahaemolyticus and fluvialis were isolated from shrimps. The results show that the ethanol extract was 20 antimicrobial activities on the test performed and 23 mm zone of inhibition on parahaemolyticus and fluvialis respectively. Microbial load in 150 and 60 min were completely inhibited through the intervention of T. vulgaris [26].

Anti-fungal Properties:

Thymus vulgaris L has potential anti-fungal effects. Thyme essential oils and their components are identified against 17 micromycetes food poisoning agents, fruit, animal, and human pathogens. Furthermore, Kim JH *et al.*, in 2017 was evaluated the effect of oils and clotrimazole. These drugs are commonly used for the anti-fungal treatment of external candidiasis. The experimental study showed that essential oil of T. magnus moderately minor inhibition of fungal growth compared to clotrimazole. T. Magnus oil might be a capable drug to control vaginal candidiasis [27]. Kamdem MS *et al.*, in 2015, were used to determine the growth inhibition of yeasts, molds, and dermatophytes. Apium graveolens were 0.14%, and Thymus vulgaris essential oils were 0.32%, respectively. Essential oils of Apium graveolens and Thymus vulgaris in which 0.41 and 0.06 g/L showed anti-radical properties on SC50. Only

Thymus vulgaris of 0.19 g/L give an anti-inflammatory activity, anti-radical effect on IC50. Cryptococcus neoformans were the most susceptible fungal strain, whereas C. Albicans was the most modest [28]. Valizadeh S et al., in 2016 were extracted essential oils from Thymus vulgaris and dried Cuminum Cyminum. Thymol 64.45% and cuminaldehyde 29.02% were the main components of the essential oil of Thymus vulgaris and Cuminum Cyminum. 0.09% of Thymus Vulgaris was beneficially against all the four Candida strains. The essential oil of Thymus vulgaris was showing lower effect, while the Cuminum Cyminum essential oil presented the higher anti-fungal activity of the essential oil of Thymus vulgaris [29].

Anti-Osteoporotic Properties:

Beneficial results for anti-osteoporotic have been shown by the combined extract of Thymus Vulgaris and Bisphosphonate drug. Abu-Serie M *et al.*, in 2018 was investigated the effect of Thymus Vulgaris Water Extract (TVE) and Bee's Honey (BH), and their combined extract. Thymus Vulgaris Water Extract and Bee's Honey, moreover their phenolics compounds like flavonoids, anthocyanins, and flavonols are essential vitamins and minerals for bone health. The TV-BH has a synergistic effect on HC-induced bone cell damage, increase utilization of the osteocalcin, phosphorous, hydroxyapatite and collagen contents. TV-BH intervention improved oxidative stress, inflammation, and glucocorticoid-induced bone damage [30]. Noh YH et al., in 2019, examined the effect of both the extracts of thyme and Cirsium japonicum. It activates the estrogen receptors, thus increasing its effectiveness. This clinical study showed that the intervention of dosage five hundred mg per day for three months had a significant decrease in osteocalcin and Alkaline Phosphatase Levels. Moreover, 18.8% improved psychosocial, vasomotor, sexual, and physical health among menopausal females. Results suggested that the MS-10 herbal material may improve bone health and the symptoms of menopause [31].

Antioxidant and Anti-Inflammatory Properties:

Habashy NH et al., in 2018, examined the potential effect of the extracts. They observed the oxidative stress and detoxification of Lipopolysaccharide-induced inflammation. Different kinds of activities were performed to Thymus Vulgaris water and oil extracts. Ethanolic extract of Chlorella Vulgaris was evaluated too. The results showed higher synergetic antioxidant effects than the individual extracts. At the same time, thyme shows both the antioxidant and anti-inflammatory activities. Effect of thymol and carvacrol on inflammatory transcription factors [32]. Gholijani N et al. determined the effects of the critical components of Thymus vulgaris mineral oil, thymol, and carvacrol in 2016 [33].

Antimicrobial Activity Against Oral Disease:

Thymus vulgaris essential oil has an antimicrobial effect against main oral pathogens. Fani M et al., in 2017, performed research to examine the antimicrobial activity of Thymus vulgaris oil. The preparation of thymus vulgaris oil uses the hydro-distillation process. Oil of Thymus vulgaris at conc. of 16 to 256 mg/mL was showing strong inhibition activity. Streptococcus pyogenes and Streptococcus mutans were the subtlest isolates with MIC of 1.9 and 3.6 mg/mL. The Minimum Inhibitory Concentration (MIC) values for C albicans, A. actinomycetemcomitans, and P gingivalis were 16.3, 32, and 32 mg/mL, respectively [34]. Manconi M et al., in 2018, was to formulating Thymus capitatus essential oil. The oil was proven to inhibit bacterial growth such as Lactobacillus acidophilus, cariogenic Streptococcus mutans, and commensal Streptococcus sanguinis. The mixture of both oils can be useful for treating oral cavity diseases [35].

Anti-Pathogenic Properties Against Respiratory Diseases:

Thymus capitatus anti-pathogenic effect against various respiratory diseases. Iauk L et.al., in 2015

study, examined the fractions of thyme leaves with both the methanol and n-hexane fraction. The methanol fraction showed a positive effect on Moraxella catarrhalis and Streptococcus pneumoniae. In the test of hypoglycemic, the inhibitory activity of amylase was observed with the HF. The most active Thyme capitatus might be a source of natural bioactive compounds [36].

Neuroprotective properties:

Aqueous decoctions (AD) of T.pulegioides, hydro-ethanolic extracts affect antioxidant, proliferation, neuroprotection, aging, and diabetic activities. Taghouti M et al., in 2018, were studied to examine the phenolic constituent profiles. Rosmarinic acids were 35.2% or 47.8%. Thyme and hydroethanolic extracts were 58.5 and 151.9 mg. A combination of both the extracts showed a positive effect against Caco-2 cells. It also reduced the hepatotoxic effect on liver cells. Extracts of Thymus pulegioides showed a lower effect on aging and diabetes, whereas it shows a positive effect on neuroprotective activity [37].

Hepatoprotective Properties:

Thymus vulgaris have hepatoprotective effect. S.officinalis and T.vulgaris extract effects of liver cells against oxidative stress. This study's purpose to investigate intake extracts of sage or thyme will increase resistance against oxidative stress by Horváthová E et al. in 2016 [38]. The intervention of thyme and sage extracts given by adult rats. The duration of treatment was two weeks. After treatment, the results showed that the GPx activity was increased, and the DNA damage induced by oxidants was reduced. Furthermore, the sage extract was increased content of glutathione. The intervention of both extracts showed synergetic effects on rat liver cells against oxidative stress and may have hepato-protective potential [39].

Immune Protective Properties:

Thymus vulgaris extract beneficially for autoimmune encephalomyelitis, an experimental study proposed by Mahmoodi M et.al., in 2018 in

which Myelin oligodendrocyte glycoprotein (MOG35–55) peptide induced by Experimental Autoimmune Encephalomyelitis (EAE). The Control group of mice was treated with phosphate-buffered saline; another was thyme treated EAE group in which those were receiving thyme extract of 50 or 100 mg/kg of body weight per day. The result suggested that the histopathological production of Interferon- γ (IFN- γ) and Interleukin 6 (IL-6) by splenocytes and the CNS scores were lower than the thyme-treated Experimental Autoimmune Encephalomyelitis control group. Moreover, thyme treated group production of transforming growth factor- β (TGF- β) and interleukin-10 (IL-10) increases in mice compared to the control group [40]. An experimental study was conducted in 2016 in which the diet of growing rabbits was 5% Spirulina (*Arthrospira platensis*), and 3% was thyme powder single or combination of both (ST). After immunization, there was a significant increase in Aspartate Aminotransferase (ALT) from +45 to 74% and Gamma-Glutamyl Transferase (GGT) from +87 to 102% activity. Both extracts showed a synergetic effect and increased IgG levels when compared to control. Spirulina supplementation alone leads to higher IgG production, but none of the affected Phyto-biotics and antioxidant status of blood [41].

Protective role against Skin Damage:

The protection of Ultraviolet-induced skin damages is recommended for compounds rich in polyphenols, including thymus vulgaris leaf extract and thymol. Cornaghi L *et.al.*, in 2016 was investigated the mechanism of thymol, and T. vulgaris L. extract against the damage induced by Ultraviolet radiation. The samples were divided into two groups, UVA was 16 or 24 J/cm², and UVB was 0.24 or 0.72 J/cm². The effect of both T. vulgaris L. extract, which was 1.82 μ g/ml or

thymol, was 1 μ g/ml. Thymus had a protective action for all of the endpoints evaluated; the influence of the extract was less prominent in relation to epidermal proliferation, and morphological. The findings provided in this research may provide evidence for thymol and Thymus vulgaris extract beneficial against Ultraviolet radiation-induced injury against human skin [42].

Beneficially role in Dyspnea and Cough:

Schönknecht K *et al.*, in 2016, were determined by the treatment of the cough associated with infection. Extracts were a combination of thyme, primrose, and thymol [43]. Thyme, primrose, and thymol were the very effective improvement of dyspnea, cough, Shortness of Breath, and precise disease length. The efficiency of the drug, which comprises the extracts of thyme, primrose with the adding of thymol, was similar to synthetic ambroxol, and its lack of side effects recently proven [44]. The dietary intervention of Thymus vulgaris, its effects and outcomes are shown in the Table 1.

Safety and Toxicity:

By the Food and Drug Administration, thymus Vulgaris is generally recommended as safe. This plant is safe for human consumption and accepted by consumers without any limitations on intake. When tested orally, the oil showed a high lethal dose of 50 value (4mg/kg), generally recommended safe and non-toxic. For topical use, its oils are stored. It may cause vomiting, dizziness, and breathing issues when taken internally. High blood pressure patients must avoid it. In holistic healing treatment, certain compounds rich in thymol and carvacrol are toxic and must be avoided [49].

Table 1: Dietary interventions of Thymus vulgaris and its outcomes

Author	Dietary Intervention	Effect	Outcomes	References
Taleb AM et al., in 2017	Extract of Thymus aqueous was 20 g per day	Anti-diabetic	Decreased the level of Fasting Blood Glucose and Hb A1C	[25]
Oramadike CE et al., in 2017	Thymus vulgaris	Anti-bacterial	Load of microbial V. parahaemolyticus and V. fluvialis showed inhibition through T.vulgaris	[26]
Kim JH et.al., in 2017	T. magnus oil	Anti-fungal	Inhibit the vaginal candidiasis	[27]
Kamdem MS et.al., in 2015	Apium graveolens oil was 0.14% and Thymus vulgaris essential was 0.32%	Antiradical, anti-inflammatory, and anti-fungal	Antiradical SC50 showed 0.41 and 0.06 g/L for Apium graveolens and Thymus vulgaris. Anti-inflammatory activity IC50 was 0.19 g/L. Cryptococcus neoformans was the most prone fungal	[28]
Valizadeh S et al., in 2016	Thymus vulgaris and Cuminum Cyminum	Anti-bacterial and anti-fungal	Thymus vulgaris 0.09% was against all the four Candida strains.	[29]
Abu-Serie MM et.al., in 2018	Extract of Thymus Vulgaris and Bisphosphonate combined	Anti-osteoporotic	Thymus Vulgaris Water Extract (TVE) and Bee's Honey (BH) improved inflammation or damage the bone induced-glucocorticoid	[30]
Noh YH et.al., in 2019	Extract of Cirsium japonicum and Thymus vulgaris MS- 10 were 500 mg per day	Bone health of menopausal women	18.8% was improved menopausal symptoms, and also including bone health	[31]
Habashy NH et.al., in 2018	Oils of Chlorella Vulgaris Ethanolic Extract (CVE) and Thymus vulgaris (TV)	Antioxidant and anti-inflammatory	Both extracts showed greater antioxidant effects than individual extracts, whereas Thymus vulgaris extracts showed both antioxidant and anti-inflammatory activities	[32]

Gholijani N et.al., in 2016	The essential oil of thymol and carvacrol	Anti- inflammatory	Both essential oils reduced IL-1b and TNFa at the protein and mRNA levels; thymol also significantly reduced IL- 1b expression.	[46]
Fani M et al., in 2017	Thymus vulgaris oil	Antimicrobial activity	Thymus vulgaris oil at 16 to 256 mg/mL showed potent inhibitory activity.	[34]
Manconi M et.al., in 2018	The essential oil was Thymus capitatus	Antioxidant/ bacterial pathogen-related oral cavity treatment	The mixture of both essential oils might have beneficial oral cavity treatment	[35]
Iauk L et.al., in 2015	Thymus capitatus leaves fraction by Methanol Fraction (MF) and n-hexane fraction	Respiratory diseases associated with Pathogenic bacteria	Efficacious effect on Streptococcus pneumoniae and Moraxella catarrhalis.	[36]
Taghouti M et.al., in 2018	T. pulegioides Aqueous Decoctions (AD) and hydro- ethanolic extracts (HE) was 47.8%.	Antioxidant, proliferation against Caco-2 cells, neuroprotective, anti-aging or diabetic	A combination of Aqueous Decoctions AD and Hydro-Ethanolic Extracts HE extracts showed a positive effect against Caco-2 cells. Acetylcholinesterase showing 80% hindrance activity and 94% on tyrosinase using by activity 0.5 mg mL ⁻¹ . T. pulegioides extracts showed a low effect on diabetes the aging but showed high in neuroprotective activity.	[37]
Horváthová E et.al., in 2016	Extracts were S.officinalis and T.vulgaris	Liver cells against oxidative stress	Both extracts showed positive effects on oxidative stress against rat liver cells and might have hepatoprotective potential.	[38]
Komaki A et.al., in 2016	Extract of T. vulgaris	EPM behavior in the rats	T. vulgaris could have an anxiolytic profile.	[39]
Mahmoodi M et.al., in 2018	Thyme extract was 50 or 100 mg/kg of body weight.	Autoimmune encephalomyelitis	Thyme treated showed a lower reduction of IFN- γ and IL-6 and Central Nervous System by	[40]

			splenocytes when compared EAE control group.	
Juan RA et.al., in 2015	Thymus vulgaris oil was 200 mg/kg.	Anti-Trypanosoma cruzi	It decreased the activity of parasitemia trypomastigotes/mL.	[41]
Cornaghi L et.al., in 2016	Extract of thymol and T. vulgaris L.	Human skin protects against U.v rays	The action of thyme extract was less evident on epidermal proliferation and morphological features	[42]
Schönknecht K et.al., in 2016	Thymol and Thyme	Respiratory tract infections	Thyme and thymol containing the drug were equal to synthetic ambroxol, and its safety has been proved.	[43]
Souri H et.al., in 2015	Thymus vulgaris extract and Satureja khuzestanica ethanolic	Broiler chickens Performance and immune response	T. vulgaris was 1%, and 2% was S. khuzestanica extract improved pH in breast meat and reduce H/L may be beneficial to broiler chickens' immunity.	[42]
Pournazari M et.al., in 2017	Diets contained 1 or 2 g/kg Fermacto, or 1 or 2 g/kg Bio plus 2B, and 0.5 or 1 g/kg was thyme essential oil.	Broilers performance, carcass traits, and blood variables	Thyme oil increases body weight gain. 1 g/kg oil also improved Feed Conversion Ratio (FCR) and carcass, organs, and plasma constituents.	[43]
Hassan FA et.al., in 2017	Thymus vulgaris L. was 5 g/kg	Broiler diets and efficiency of cytokines (Gene expression profile)	5 g/kg improved body weight, feed intake, augmented White Blood Cells and lymphocyte count, and IgG and Nitric Oxide levels and showed a positive impact of the broiler's performance and immune status.	[44]
Kovács M et.al., in 2016	5% was Spirulina (Arthrospira platensis), and 3% was Thyme (Thymus vulgaris L)	Serum biochemistry, immune response	Consumption of both extracts showed a higher IgG level as compared to control. Also, affected the antioxidant status of blood	[45]
Marhamatizadeh MH et.al., in 2016	Thymus vulgaris extract	Aflatoxin M1 concentration in kefir beverage	Thymus extracts and probiotic bacteria could	[47]

	and probiotic bacteria		be reduced Aflatoxin M1 in kefir drink.	
Boubaker H et.al in 2016	Four essential oils of Thymus species	Anti-fungal activities	Spore germination of <i>G. citri-aurantii</i> and <i>P. digitatum</i> and <i>P. italicum</i> . <i>T. riatarum</i> was completely hindered by <i>T. leptobotrys</i> essential oil and inhibition of germination of <i>G.</i>	[48]

CONCLUSION:

Thyme plant exhibits genetic variation resulting in the occurrence of several different forms of monoterpenes. Thymol, carvacrol, geraniol, linalool, α -terpineol are the few essential monoterpenes. Thyme's extracts and essential oil possess growth inhibitor property, thus preventing bacterial and fungal growth that causes food spoilage. It is also used as a natural food preservative, thus increasing the shelf life of foods. A synthetic preservation procedure can

replace this natural food preservative. It is also vital in pharmacy, cosmetics, and has nutraceuticals worth. Essential oils show inhibition of phytopathogenic microorganisms and can be used for postharvest preservation. Thyme is known to be healthy in general, but under certain situations, it can be harmful.

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