

Biological Significance Of Thymus Vulgaris In Dentistry

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Abstract

Thymus vulgaris (T. vulgaris), commonly known as garden thyme is an aromatic herb used as a natural replacement during dental treatments. Components present in T. vulgaris are known for their antimicrobial, anti-inflammatory and anti-oxidant properties. The aim was to compile evidence-based studies on the effectiveness of T.vulgaris in the treatment of various oral diseases and dental procedures and thus highlight the biological significance of T.vulgaris in dentistry. According to the evidence based studies, T.vulgaris can be used as an antibacterial agent, antifungal agent and pulp medicament based on their favourable results. Different extracts of T.vulgaris were used in the studies. Many untoward effects such as antibacterial resistance are experienced on usage of artificial products during dental procedures. Literature shows natural product such as ayurvedic herbs prove as an effective solution. One among them, T.vulgaris can be a potential candidate with a need for more evidence based clinical trials.

Introduction

Ayurvedic medicine is one of the oldest medical systems that has its origin in India nearly 5,000 years ago¹. It is a part of complementary alternative medicine which is said to maintain the mind, body, and spirit². The role of Ayurveda in dentistry is being explored with much research undertaken towards the treatment of oral lesions. Due to the rise in antibacterial resistance, the inability of long-term usage, and toxicity of the conventional dental treatments, there is a subtle but sure shift towards its natural replacement.

Many herbs have been researched as natural replacements for the treatment of oral lesions and dental procedures. One of them is *Thymus vulgaris* commonly known as Garden thyme. The word 'Thymus' has Greek origin in which 'thuδ' means fumigation, or 'thio' meaning perfume. The species 'vulgaris' has a Latin origin meaning 'common'³. It is an aromatic perennial herb belonging to the Lamiaceae family⁴. This herb has been used for medicinal purposes such as treating burns and poisoning. The important constituents of essential oil from T.vulgaris are thymol (23%–60%), carvacrol (2%–8%), α-terpineol (18%–50%), p-cymene (8%–44%), and linalool (3%–4%)⁵. T.vulgaris is one among many herb species with

the highest essential oil diversity due to its numerous chemotypes. These components of T.vulgaris are known for their antimicrobial property. Other properties include antispasmodic, diuretic, antioxidant, anti-inflammatory, and anesthetic properties⁶. It has a high likelihood of patient approval ascribing to its favourable taste⁷. Thus, T. vulgaris essential oil has medicinal applications that led to research in dentistry. The article reviews different properties of T.vulgaris and its use in dentistry. The aim was to compile evidence-based studies on the effectiveness of T.vulgaris in the treatment of various oral diseases and dental procedures.

Biological Significance

Most of the evidence-based studies involving T. vulgaris focus on its antimicrobial properties. Anti-oxidant and anti-inflammatory properties are also studied and different extracts of T. vulgaris are used in different studies.

Components

The main components of T. vulgaris essential oil that contribute to antimicrobial properties are thymol and carvacrol⁸. Carvacrol, an iso-thymol, increases the ATPase

activity and inhibits the enzyme that allows non-specific permeability of the microbial cell membrane increasing their sensitivity to extraneous components entering the cell⁹. Components of *T. vulgaris* extract include¹⁰:

- **ESSENTIAL OIL:** Borneol, Carvacrol, Cymene, Linalool, and Thymol
- **FLAVONOIDS:** Apigenin and Luteolin
- **TANNINS**
- **TERPENIC ACID DERIVATIVES**

Different Properties of *T.vulgaris*

Antimicrobial

T. vulgaris extract is effective in restricting microbial biofilm formation of *C. albicans*, *S.aureus*, *E. faecalis*, *S. mutans*, and *P. aeruginosa* and polymicrobial biofilm formation between *C.albicans* with *S.aureus*, *E.faecalis*, *S.mutans* or *P.aeruginosa* as evident by significant reduction in CFU/ml¹¹.

Antibacterial

T.vulgaris essential oils show significant bacteriostatic and bactericidal activity against approximately 15 types of Gram-positive and negative bacteria in which the activity is marked against Gram-positive bacteria¹². The main inhibitory activity is against *S. mutans* in the oral cavity. It also inhibits the adherence of *S. mutans* to buccal epithelial cells. It also provides an adjuvant effect to the macrophages by the activation of specific proteins present in the macrophages, such as the Adenosine Monophosphate Protein Kinase (AMPK). This stimulates an inflammatory response and modulates the expression of cytokine and the release of Nitric Oxide (NO) to control the agent that triggered the process¹³.

Mechanism of action:

It has two ways: a) affects the cell membrane of bacteria and b) affects the enzymatic system

- Affects the cell membrane of bacteria: Disintegration of outer cell membrane of Gram- negative bacteria releases lipopolysaccharides and increases the permeability of the cytoplasmic membrane to ATP. Phenolic compounds, saponins, and flavonoids affect the microbial plasma membrane.
- Affects the enzymatic system of bacteria: The components especially phenols and tannins affect the plasmid replication. Increase in ATPase activity by carvacrol and inhibition of the enzyme activity responsible for non-specific permeability of the microbial cell membrane. Also, Carvacrol shows increased sensitivity to external components entering the

cell¹⁴. Phenolic compounds, saponins, and flavonoids inhibit structural cell membrane enzymes.

Anti-inflammatory

In-vitro study involving LPS-stimulated RAW 264.7 cell line shows anti-inflammatory effect by *T. vulgaris* through the control of pro inflammatory cytokine levels like IL-1 β and TNF- α . It also exerts its action by increasing anti-inflammatory cytokine (IL-10)¹⁵.

Antifungal

Evidence based studies show *Thymus vulgaris* (*T. vulgaris*) essential oils to be fungitoxic. *T.vulgaris* exerts its action mainly against antifungal-resistant *Candida albicans* strains⁹.

Antioxidant & Antitumoural Properties

T.vulgaris shows antitumoural properties by inhibiting the production of carcinogen induced Reactive Oxygen Species (ROS), free radicals and lipid peroxidation¹⁶.

Cell Viability

Results from in vitro study shows that *T. vulgaris* extract at 25, 50, and 100 mg/mL concentrations promoted cell viability above 50% in cell lines such as RAW 264.7, FMM-1, MCF -7, and HeLa. The absence of genotoxicity is also evident when the *T.vulgaris* extract is analyzed in the cell lineages¹⁵.

Clinical Applications In Dentistry

Plaque Control Agent

Oral rinsing with *T.vulgaris* aqueous extract as found to be equally effective as chlorhexidine mouthwash due to its antibacterial and anti-adherent properties. Thus, it proves as a potential plaque control agent with fewer adverse effects¹⁷.

Restorative Material

In-vitro study by Ashour et al. shows that it can be used as a component in restorative materials such as GIC in the form of nanoparticles to prevent biofilm formation. Comparative increase in the antimicrobial activity against resistant bacterial strains is an added advantage of this novel biomaterial¹⁸.

Orthodontic Appliance Disinfectant

An evidence based study by Naseri et al proved the invitro antifungal activity by *T.vulgaris* essential oil on disinfection of removable orthodontic appliances in comparison with CHX⁹.

Treatment Of Oral Dysplastic Lesions

In-vitro study by Ozle et al. shows that an herbal mixture containing *T. vulgaris* extract has a chemopreventive effect against DMBA-induced oral epithelial dysplasia¹⁶.

Endodontic Irrigant

Herbal irrigants act as substitute for commonly used endodontic irrigant sodium hypochlorite.

The antibacterial property of herbal irrigants against endodontic pathogens led to the usage in root canal therapy. This was proven by in-vitro studies involving *Thymus* essential oil with antibacterial and antifungal properties for irrigation of root canals during endodontic treatment in comparison to chemical irrigating solutions¹⁹.

Pulpotomy

The in-vivo study by H Alolofi et al. shows that thymus extract can be used in vital pulp therapy and is a promising alternative to formocresol. Anti-inflammatory, antibacterial, and hemostatic properties of thymus components such as thymol, flavonoids, carvacrol, and apigenin led to its application in pulpotomy. It is also non-irritant to the pulpal tissue and can be directly placed on the dental pulp²⁰.

T. Vulgaris As Nanoparticles

Thymus Leaf oil extract has been used in the biosynthesis of nanoparticles. Also, selenium, silver, or copper nanoparticles along with *T.vulgaris* extract have synergistic antibacterial properties¹⁷. In dentistry, they are included as a component in the restorative material to prevent biofilm formation. Nanoparticle biosynthesis using plants does not require high energy or high temperatures. Large-scale synthesis is also possible for natural alternatives. It is also cost-effective and possesses anti-inflammatory and antioxidant potential^{18,19}.

Conclusion

There have been very few clinical trials regarding the use of *T. vulgaris* in dentistry so far. None of the studies had been performed in India related to dentistry. There is a need to conduct more clinical trials for standardization of its usage. The safety of *T.vulgaris* has been established in a few trials which will be beneficial for its usage on a large scale. Well-controlled clinical trials are required to validate the use of *T.vulgaris* in the dental field.

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