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The Potential Gastrointestinal Health Benefits of Thymus Vulgaris Essential Oil: A Review

Abdulaziz Almanea[1]*, Gamal S. Abd El-Aziz[2] and Mohamed Morsi M. Ahmed[1,3]

[1]Department of Biological Sciences, Faculty of Science,
King Abdulaziz University, Jeddah, Saudi Arabia.
[2]Department of Anatomy, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia.
[3]Nucleic Acids Research Department, Genetic Engineering and Biotechnology Research Institute (GEBRI), City for Scientific Research and Technological Applications, Alexandria, Egypt.
*Corresponding author E-mail: azooz040@hotmail.com

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In recent times, medicinal plants have received great attention worldwide due to their effective pharmacological properties and therapeutic benefits. Numerous chemical compounds extracted from various medicinal plants have manifold biological activities. Thymus vulgaris (TV) is a flowering plant with an aromatic odor that has been broadly applied in conventional medicine, food additives, and phyto-pharmaceutical preparations. It is recognized to have promising therapeutic potential for curing various types of diseases. The essential oil extracted from TV, which contains a high quantity of flavonoids, possess antioxidant and antimicrobial activities. Consequently, it could be utilized as a good source in developing novel natural antioxidants and antibiotics. This review explores some of the potential health benefits of TVessential oil (TVEO) on the gastrointestinal tract.

Keywords: Thymus Vulgaris, health benefits, gastrointestinal tract.

Thymus vulgaris (TV) or "thyme" is considered as a famous species of the genus "Thymus" (family Lamiaceae), which represents one of the distinguishable plants in many parts of the world, especially throughout the Mediterranean area, North Africa, Asia and Europe.[1,2]Thymusfamilyiswell known for its biological and natural activitieslike a food additive and its usage inthetraditional medicine and pharmaceutical preparations.[3,4,5]

The TVis recognized as common thyme, which perhaps originated from its utility as incense, has been used for centuries as spice, home remedy, drug, perfume, and insecticide.It is considered one of the most eminent herbs based on its history, aromatic and medicinal properties. Inancient times, Thyme was used by the Sumerian and Egyptian morals for various medical purposes to save the people from death. Romans overcooked thyme not only to keep the dangerous animals away but also to give the cheese its flavor. Furthermore, TV has been utilized for several years as a treatment for various diseases such as dental plaque, dermatophyte poisons, pneumonia, anti-inûammatory and intestinal disorders.[6,7,8,9,10]

WHO[11] has indicated that the therapeutic features of TV can be attributed to its essential oil, which is utilized in foods for the flavor, aroma, and preservation and additionally in folk medicine. Moreover, essential oil is one of the

most commonly used essential oils in the food industry and in cosmetics as preservatives and antioxidants.[12,13,14,15]

Numerous studies have been done for exploring the biological activities of the essential oil. [16,17,18,19] Based on these studies, this review was designed to explore some of the potential health benefits of TV essential oil (TVEO) in particular on the gastrointestinal tract.

Origin and history of TV

Approximately, 300 varieties of aromatic herbs and subshrubs are included in the genus Thymus; they are found in several parts of the world such as countries with a coastline on the Mediterranean Sea, Asia, Southern Europe, and North Africa. The name of TV belongs tothefamily*"Lamiaceae*". Thymoma is an old Greek expression for enraging that was offered to gods in temples because of its aroma.[2]From ancient times, Thymus species have been used asmedicinal plants due to their pharmacological and biological features, where their leaves have been broadly utilized as herbal tea, stimulant, antiflatulent, cough depressant, treatment of common cold and antibacterial agent.[20]In the Yemeni traditional prescription, the fresh and dehydrated leaves of TV can be utilized as dry particles in warm milk or sesame oil to help in the treatment of various diseases such as gastritis, tonsillitis, pharyngitis and renal colic.[21]

Plant description of TV

The TV is a small, evergreen shrub growing to 0.2 m at a medium rate, with a groundcover that can be about 40 cm tall.[22]Its stem becomes woody with the age. The leaves are tiny, approximately 2.5 to 5 mm long and differ considerably in the form and hair covering (Figure 1). The leaves are characterized by ovoid to quadrilateral shape and slightly fleshy aerial constituents are utilized for producing oil, primarily by condensationprocess. Thyme can grow throughout sunny weather. In addition, [23] and[24] demonstrated that thyme needs well-drained soils and 5 – 8pH to grow.

Chemical composition of TVEO

Different thyme plants contain about 0.5 to 2.5% oil, which is made up of 45–47% thymol, 32–34% p-cymene, 4–5% carvacrol, ã-terpinene, linalool, and á-pinene.[25]However, the oil extracted from certainspecies of thyme may contain up to 60% carvacrol.[26]Thymol and carvacrol (phenolic compounds) are important ingredients withstrong antiseptic properties.[25]Also, the essential oil from TVwas investigated by *Al-Maqtari et al.*[21]who reported that it contains 56.53% monoterpenes, 28.69% monoterpene hydrocarbons, 5.04% sesquiterpene hydrocarbons and 1.84% oxygenated sesquiterpenes.It was reported that TV essential oil is a rich source of flavonoid phenolic antioxidants such as zeaxanthin, apigenin, lutein, luteolin and thymine.[27]

Furthermore, thyme and its oil are also a good source of some vitamins. They are chiefly rich in Vitamin A and Vitamin C. Vitamin A is necessary for maintaining healthy mucus membranes and skin as well as good vision. Vitamin C provides resistance against microbial infections and combats the harmful pro-inflammatory free radicals. In addition, it is a good source of Vitamin B6 or pyridoxine, which assists in maintaining GABA levels in the brain and acts as a stress buster. Other vitamins found in this herb include Vitamin K, Vitamin E and folic acid.[28,29]In addition, thymeand its oil are considered excellent sources of some important minerals, which are vital for optimal health e.g. potassium, being an important component of cells and body fluids, controls heart rate and blood pressure,manganese is a co-factor for the antioxidant enzyme superoxide dismutase andiron is involved in red blood cell formation.[30]

Antimicrobial activity of TVEO

Essential oil extracted from TV and its principle component thymol possess a wide range of activity against different types of bacteria and fungi compared with the other oils both in vitro and in vivo studies.[31,32,33,34]Several studies had indicated that thyme and thymol have strong antimicrobial activities against various types of bacteria such

Fig. 1. Thymus vulgaris

as Helicobacter pylori, Salmonella typhimurium, Staphylococcus aureus, Selenomonasartemidis, Porphyromonasgingivalis, Streptococcus mutans and Streptococcus sobrinus.[35,36]The antimicrobial effect was related to the ability of thyme to penetrate the bacterial plasma membrane;causing efflux of intracellular constituents and hence leads to cell death. Likewise, other studies reported a strong antibacterial activity of thymol against certain types of fungi and yeast such as *Aspergillusflavus*, *Aspergillusparasiticus*and*Candida albicans*.[37,38]

Moreover,*Marino et al.*[39] analyzed the thyme oils for their growth inhibition properties against certain strains of both Gram-negative and Gram-positive bacteria. It was observed that all examined thyme essential oils had a strong antimicrobial effect against both types of bacteria. The TV essential oil isconsidered highlyeffectivein inhibiting the growth of various species of bacteria. An additional study conducted by *Nolkemper et al.*[40]demonstrated thatthis oil exhibited inhibitory effect against various types of viruses such as Herpes simplex virus type 1 (HSV-1) and an acyclovir-resistant strain of HSV-1.

Antioxidant and anti-inflammatory effects of TVEO

In animal models and *in vitro* studies, thyme oil and thymol have been shown to exhibit strong antioxidant activities.Moreover, the contained flavonoidswereshown to prevent the release of superoxide anion and to protect erythrocytes from oxidative stress. Thymol and caracole also exerted anti-inflammatory effects by inhibiting thesynthesis of prostaglandin.[41, 42, 43, 44]

Gastrointestinal effects of TVEO

Several studies have demonstrated that thyme and its oil are active in both gastric and intestinal environments. A previous study conducted by Mossaet al.[45]suggested that thyme extract could be administrated orally to treat indigestion. Individual thyme constituents also affect gut health in vivo. It was demonstrated that feeding an equal amount of thymol and carvacrol to animals led to the increase in activities of intestinal and pancreatic trypsin, lipase and protease. They may also improve liver function and act as an appetite stimulant.[46,47,14]

Also, as indicated previously by *Höferlet al.*[48], thymol and carvacrol have spasmolytic effects. In experimental animal models, *Van den Broucke and Lemli*[49]and*Van den Broucke*[50] demonstrated that flavonoids in thyme could relax smooth muscles of ileum by blocking the histamine and acetylcholine receptors, and/or antagonism of the calcium channel.

TVEOis incredibly useful in cases of intestinal infections and infestations like hookworms, ascarids, gram-positive and gram-negative bacteria, fungi and yeasts such as Candida albicans. Its active constituent, thymol, is active against enterobacteria and coccid bacteria. It was speculated that thyme oil may improve intestinal health even without substantially improving the population of beneficial gut microbes.[36]Although it appears to have no major effects on gut microbes, the effect of thyme on the gut microflora needs to be better characterized, particularly in light of the growing importance of the gut microbiome as a factor modifying risk for infectious and chronic diseases that impact human health.[51,52]

In the stomach, thyme oil constituents demonstrated beneficial effects. Compared to controls, carvacrol administered orally (10 ml/kg of 8.3-33.3 mm solutions) to rats prior to induction of acute gastric lesions inhibited damage to the gastric epithelium.[53] This protection was evident even when different methods of inducing gastric damage were used. Carvacrol significantly increased gastric mucus content but did not alter the gastric juice volume or total acidity. Also, carvacrol given at oral doses of 25-100 mg/kg,decreased the severity of chemically induced gastric damages in rodents after 14 days of treatment, compared to controls.[54] Similarly, alpha-terpineol was gastroprotective, when administered orally (10 to 50 mg/kg) prior to dosing with ulcer-inducing agents. This effect apparently was not mediated by inhibition of gastric acid secretion or changes in prostaglandin synthesis.[55]

Another study carried out by *Silvia and collaborators* [54] assessed the anti-ulcer and anti-inflammatory actions of carvacrol. It was reported that carvacrol at concentration 50 mg/kg decreased the edema in numerous types of inflammation. Additionally, it was found that after 14 days of treatment, carvacrol exhibited curative effect on the gastric lesions caused by acetic acid.

Moreover, Carvacrol exhibited very low toxicity in experimental rats and is known as the most common food additive and flavoring

agent in drinks. [56] An *in vitro* study carried out by *Landaet al.*[57] indicated that carvacrol displays anti-inflammatory activity, antinociceptive and antioxidant actions.[58]

It was observed that acetic acid-causedimpairment in the human gastricmucosa leading to gastric ulcer disease, and the degree of injury is controlled by numerous aspects, such as prostaglandins and cytokines.[59,60]Moreover,*Shahin et al.*[61] have reported that carvacrol doses of 25, 50, and 100 mg/kg, exhibited curative effect on the gastric lesions caused by acetic acid by 60%, 91%, and 81%, respectively. They add that this effect of carvacrol may result from the suppression of inflammatory response.

The mechanism of gastro-protective effects of carvacrol in various rat models was evaluated by *Silva and collaborators*[54] and it was revealed that 25 mg/kg of carvacrol exhibited gastro-protective effects that were facilitated by endogenous prostaglandins and increased mucus production. It was also demonstrated that carvacrol inhibited the COX-2 antioxidant activity and pro-inflammatory cytokine TNF-á production.[58,62]

An obvious application for the use of thyme oil for curing of ulcerative colitis and Crohn's disease has been submitted in the European. In a study involving young pigs, thymol was orally administered (50 mg/kg) after the morning meal.[63]At 12-hour post-dosing, tissue samples from the oxyntic gland and pyloric mucosa of the stomach were collected. RNA was then isolated and changes in gene expression were determined by microarray analysis. The outcome was that acute thymol dosing activates genes associated with mitosis, regulation of cell division and the digestive function of the stomach.

CONCLUSION

In conclusion, Thymus vulgaris is an important medicinal and aromatic plant that has been used for centuries in phytopharmaceutical preparations, food preservatives and as an aromatic ingredient. Its essential oil contains bioactive monoterpenes such as thymol, carvacrol, and linalool, which have antioxidative, anti-inflammatory, antibacterial and antifungal effects. Thyme essential oil showed antibacterial and antifungal activity.

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