STUDY OF PHARMACOLOGICAL EFFECT OF THYMYUS VULGARIS

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ABSTRACT

Thymus vulgaris Linn. is a culinary and medicinal herb native to Southern Europe that has been used for its antimicrobial, cardioprotective, gastroprotective, anti-inflammatory, and immunomodulatory properties since the time of the ancient Egyptians. Antibacterial, antioxidant, anti-inflammatory, antiviral, and anti-cancerous actions are only a few of T. vulgaris L.'s pharmacological effects that have been documented. The review presents a thorough method for examining and summarising the information on the phytochemistry, ethnopharmacology, pharmacology, and toxicology of the plant that is currently available. Injuries including microbiological infections, inflammation, non-communicable diseases like cancer, and sexually transmitted diseases like HIV-1 and Herpes have been evaluated and reported to be treated by the various extracts and essential oils extracted from the plant. In addition, the literature review identified the usage of polysaccharides, steroids, tannins, alkaloids, volatile oils, phenolic acids, terpenoids, and saponins in pharmacotherapy. These substances have been shown to have antidiabetic, anti-Alzheimer's, cardio, neuro and hepatoprotective, anti-osteoporosis, sedative, immunomodulatory, antioxidant, anti-tyrosinase, antispasmodic, antinociceptive, gastroprotective, anticonvulsant, antihypertensive, antidepressant, anti-amnesic, and anti-helminthic activities. On the basis of knowledge gaps, recommendations have also been made for systematic evaluation of T. vulgaris L. for the development of plant-based pharmaceuticals and nutraceuticals, as well as for the evaluation of their clinical efficacy and safety.

KEYWORDS Thymus vulgaris, Thyme, Antidiabetic, Antibacterial, Antioxidant, Anti-inflammatory, Antiviral

INTRODUCTION

Thyme (T. vulgaris L.), also referred to as "garden thyme," is an aromatic perennial flowering plant in the Lamiaceae family. Due to its use as incense, its balsamic aroma, or the fact that it belonged to the class of herbs with pleasant aromas, the Greek term "thyme" means "to fumigate".[1] T. vulgaris L., which is native to Southern Europe, is said to have a range that is global.[2] The soil is coarse, rough, and well-drained, which is typically inappropriate for many plants, and the plant grows well in an arid climate and open regions. It appears as a short, bushy plant covered in numerous tiny flowers.[3] T. vulgaris L. is typically grown for commercial use in many nations for its dried leaves, plant extracts, plant oil, and oleoresins.[4,5] Due to its extensive aromaticity, T. vulgaris L. is used as a flavouring agent in the food industry, as well as for the flowering and ornamental needs of plants [6] as well as for the perfumery and cosmetic industries.[7] Due to its wide pharmacological qualities, T. vulgaris L. is known to have a variety of ethnobotanical uses. Due to its capacity for wound healing and antibacterial characteristics, the plant was mostly utilised for wound care. Regarding the plant's anti-infective function, ancient Europeans used its aerial portions for fumigation, curing skin and respiratory illnesses. Additionally, T. vulgaris L. was employed in monasteries to prepare food. These qualities demonstrate both its culinary and therapeutic usefulness. The entire plant is thought to have been burned by the Romans and Greeks to fumigate their surrounds.[8]

The T. vulgaris L. aqueous extract has also been used to treat a number of foodborne illnesses and skin conditions, including the Black Death in the 1340s. Modern investigations that demonstrated the antibacterial efficiency employing both typical and MDR strains of pathogenic bacteria and fungi [9-11] support this. T. vulgaris L. was advocated for the treatment of respiratory conditions such whooping cough, bronchitis, and catarrh that were brought on by the inflammation of upper respiratory tract mucous membranes in the 1980s. However, clinical research have shown that using thyme (T. vulgaris L.) and primrose (Primula vulgaris) extract to treat bronchitis and other respiratory disease-related symptoms is beneficial.[12] T. vulgaris L. has been suggested by experts as a treatment for bacterial and fungal infections. The plant is anticipated to provide a potential prevention of bacterial adsorption and the development of biofilm matrix.[13]

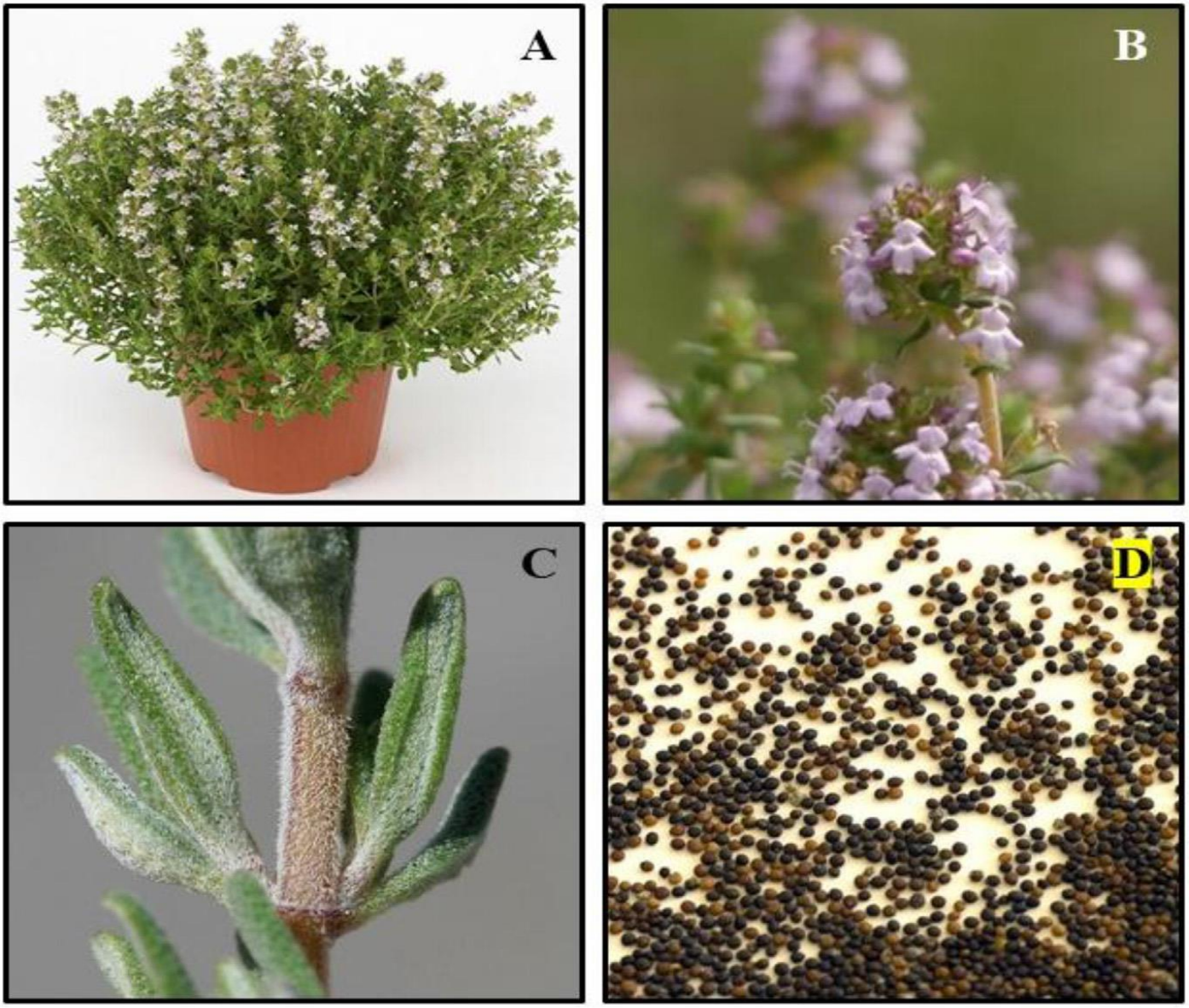

Fig. A) Plant B) flowers C) leaves D) seeds of Thymus vulgaris L.

Materials and Methods

The thyme leaves were cleaned with double-distilled water and then placed outside overnight to completely dry. After being cut into small pieces, the dried leaves were then refluxed for three hours in 600 mL of double-distilled water using 30 g of the sample. The extract mixture was then filtered and kept in a glass container. Drying a sample and weighing the residue in relation to the volume of the sample taken allowed researchers to calculate the stock solution's concentration. Stocks with various extract concentrations were created through dilution.[14]

PHARMACOLOGICAL ACTIVITY

Antioxidant Activity

Liver cells were examined in relation to experimental animals consuming thyme or sage extracts, which showed greater resistance to oxidative stress. The ingestion of S. officinalis and T. vulgaris extracts appears to improve the resistance of rat liver cells to oxidative stress and may have hepatoprotective effects, according to the results.The composition and quantitative estimation of plant extracts, the defence mechanisms of plant extracts against hydrogen peroxide- and 2,3-dimethoxy-1,4-naphthoquinone-induced DNA damage, and the concentrations of enzymatic and non-enzymatic antioxidants (superoxide dismutase, glutathione peroxidase, glutathione) in human HepG2 cells were all examined.[15] In cells pretreated with the plant extracts under investigation, the oxidant-induced DNA damages were dramatically diminished, according to the data. Both an increase in GPx activity in cells that had previously received SO and TV pretreatment and SO and TV's antioxidant activity may have contributed to the observed DNA-protective action.[16]

The study assessed how dietary supplements of spirulina and thyme affected the quality of rabbit meat, nutritional retention, and oxidative stress defence. The results showed that adding spirulina to rabbit meat increased the amount of -linolenic acid in the meat, while thyme improved the oxidative stability of raw and freeze-dried meat.[17] Researchers looked at how thyme's antioxidant properties were affected by shortwave ultraviolet light (UV-C) radiation. Between UV-C treated and untreated samples at the same doses, no appreciable differences in oxidation rates were seen.[18]

The impact of adding Spirulina and Thyme to the rabbit meat during retail display was assessed. The C-T and T groups, which likewise exhibited the highest level of -tocopherol and n-3 fatty acids and the lesser lipid oxidation, considerably reduced drip loss.[19] The findings of the evaluation of the total phenolic compounds (TPC) content and antioxidant activity (AA) of extracts made from ground fresh thyme (FT) and depleted thyme (DT) indicate that enzymatic treatment is an intriguing alternative for making antioxidant extracts from DT.[20]

Antidiabetic Activity

In recent years, scientists have become more interested in using medicinal herbs to treat hyperglycemia. Thyme is one of the plants that has an antidiabetic impact, according to several studies who advised using these herbs for their various biological benefits in conditions like diabetes.[21-23]

In rabbits with hyperglycemia brought on by the drug alloxan, thyme aqueous extract demonstrated antihyperglycemic activity without affecting body weights. Due to the plant's capacity to directly induce peripheral tissues to undergo glycolysis, decrease glucagon or insulin release, increase glucagon or insulin liberation, or inhibit absorption of glucose from the GIT. According to other studies, T. serpyllum and its extracts have an inhibiting effect on -glucosidase in vitro. One of the enzymes that is found in the intestine near the brush edge that transforms polysaccharides into simple sugars is -glucosidase. One of the crucial ways to lower postprandial glucose in circulation and maybe postpone the onset of late diabetic problems is by decreasing the activity of this enzyme. Delaying the increase in blood glucose after consuming a food high in carbohydrates. Thyme's ability to serve as an antioxidant and protect cells from the cytotoxic effects of free radicals created by diabetes or alloxan itself is what gives this plant its anti-diabetic properties.[24-29]

Additionally, thyme aqueous extract might improve haematological characteristics and have hypoglycemic effects in diabetic rabbits without affecting body weight. According to additional research, thyme oil has a significant amount of phenolic and flavonoid components, including carvacrole and thymol. Apart from its ability to counteract the inhibitory effects of alloxan on glucokinase, the glucose sensor of the beta cells, this may be induced by the activity of thymol or carvacrole, which mimics insulin.[30,31]

Anti-cancer Activity

A number of compounds were created, including the flavanone known as Nar, which was found using several spectral approaches. The findings demonstrated that Nar's pro-apoptotic and chemo-sensitizing actions are caused by disruptions in the cell cycle, activation of pro-apoptotic genes and downregulation of anti-

apoptotic genes, as well as suppression of pro-survival signalling pathways.[32] The effectiveness of T. vulgaris extract (TVE) against CRC cells was assessed. It has been discovered through research that TVE inhibits proliferation in a concentration- and time-dependent manner. T. vulgaris might have anticancer properties, and some of its bioactive components might prove to be efficient therapy options for CRC in humans.[33] Thymol play important role in Cancer.

Both T. vulgaris and O. syriacum have antileukemic properties in vitro. Future anticancer drug development may choose to target T. vulgaris as a safe and selective cytostatic target. The leukaemia cell line THP-1, on the other hand, is cytotoxic to O. syriacum.[34] The thyme plant, Thymus vulgaris L., was tested for its ability to kill head and neck squamous cell cancer cells. The development of human HNSCC cells is impeded by thyme essential oil. New understandings of the molecular mechanism behind thyme's anticancer action are provided based on pharmacogenomic techniques.[35]

Thymol, a key synthesised component in T. vulgaris L., and its protective efficacy against oxidative and genotoxic UVA- and UVB damage were assessed. In cells exposed to UVA and UVB radiation, thymol and a T. vulgaris L. extract reduced the production of ROS. MDA production, on the other hand, was only decreased in UVA-treated cells. Contrarily, UVA-treated cells were the only ones in which MDA production was decreased. Due to the severity of the damage (double strands) found, both drugs reduced the DNA damage assessed by the alkaline comet assay but not in the micronucleus and H2AX assays.[36]

Antiviral Activity

The influenza virus was found to be effectively inhibited by thyme oil, both as a liquid and a vapour. However, just a little amount of activity was seen in the vapour phase, while the liquid phase at a concentration of 3.1 l/ml fully prevented viral development, which was superior to the utilised control. (canola oil). The effects on the main viral proteins, hemagglutinin (HA) and neuraminidase (NA), were also assessed by the researchers. A notable suppression of HA was found. Also discovered to be 14.34 l/ml (p 0.05) [37] was the TC50 value, which represents a 50% reduction of the culture.

Thyme oil has been discovered to be effective against viruses that cause sexually transmitted diseases (STDs) such herpes simplex virus (HSV) and human immunodeficiency virus 1 in addition to influenza. (HIV-1). Two are held by HSV. Types 1 (HSV-1) and type 2 (HSV-2) antigenic types cause flu-like symptoms in people. Thyme oil was examined for its antiviral properties along with the main monoterpene components terpinen-4-ol, terpineol, pinene, p-cymene, thymol, citral, and 1,8-cineole.Non-cytotoxic doses were determined using RC-37 kidney cells and ranged from 20 g/ml for citral to 1250 g/ml for 1,8-cineole. The 1,8-cineole IC50 value was 1200 g/ml. All monoterpenes reduced the viral load by >80%, although thyme oil revealed to reduce it by >96% (p 0.05).[38] Another STD for which there is currently no vaccination is the human immunodeficiency virus. The Tat protein, which assists in the transcription of the viral genome, was the focus of a study by Feriotto et al. (2018).

In this investigation, the effect of T. vulgaris L. essential oil on HIV-1 long terminal repeat (LTR) and Tat/TAR-RNA complex transcription was assessed. When compared to the control, this complex's inhibitory potential in an EMSA (electrophoretic mobility shift test) was considerable (3-6 g/ml). Similar to this, a test for reduction activity against Tat-induced HIV-1 LTR transcription produced an RT50 value of 0.83 g/ml, a significant inhibitory potential that decreased viral transcription to 52% (p 0.05).[39] The effectiveness of the plant's methanol extract against HIV-1 subtype A-infected PBMC cells was also examined. On PBMC, a cytotoxicity value (CC50) of 200 g/ml was discovered. The antiviral assay also showed that the EC50 value was greater than 500 g/ml. The mean fluorescence intensity (MFI) of the cells was determined to be 22.72 in PBMC (p 0.05) in the study's focus on CD4 expresses.

Studies have mostly concentrated on calculating cytotoxicity levels using animal models, which might not provide an appropriate representation in the case of human trials. Conducting research using human cell lines is therefore crucial. To demonstrate definitively how an infection affects the human system, human cells can be infected in vitro and then treated with various extracts, oils, and particular chemicals. Because they are

asymptomatic and have a long incubation period, illnesses like influenza and herpes, which include HIV-1, are frequently challenging to diagnose.

Thyme oil use can help determine the extent of herpes' impact on the skin. An organ-specific administration of the modified plant portion might be investigated in a dose-dependent way as the viruses influence the targeted organs.[40]

Antibacterial Activity

Thyme's chemical components, especially the essential oil, play a role in its antibacterial activity. demonstrated the efficiency of thyme essential oil against fungi and bacteria that are associated to food. The presence of phenolic chemicals (thymol) and terpene hydrocarbons (-terpinene), respectively, in thyme essential oil is connected to its antibacterial ability. According to its percentage, the third principal component of thyme is p-Cymene, which when combined with -terpinene and thymol has synergistic antibacterial effects. [41-45]

Both thymol and carvacrol have antibacterial and antifungal properties. Additionally, carvacrol and thymol's antimicrobial properties are based on their capacity to disrupt bacterial outer membranes, which alters pH homeostasis and the equilibrium of inorganic ions, releasing lipopolysaccharides and increasing the cytoplasmic membrane's ATP permeability12. In vitro E. coli growth can be stopped by thyme essential oil. Thymol, according to other researchers, inhibits the growth of S. typhimurium and E. coli. Thymol, the main ingredient in thyme essential oil, is said to have antibacterial activity. The strongest effect against microbes, according to Varga et al. (2015), is found in the essential oils of Thymus serpyllum and Thymus vulgaris, and it directly correlates with their thymol content. Additionally, the essential oil of several varieties of thyme is used in vaporizers to combat a variety of yeasts and human pathogenic Gram-positive and Gram-negative bacteria.[46-48]

According to Cosentino et al. (1999), Thyme oil extracts were ineffectual in killing Klebsiella pneumonia, Salmonella choleraesuis, and Staphylococcus aureus, but were effective in preventing the growth of Candida albicans and Pseudomonas aeruginosa. While Sienkiewicz et al. (2012) discovered that the oil of thyme is effective against common and medical strains of the Staphylococcus species, Enterococcus genus, Escherichia genus, and Pseudomonas genus.[49]

Antifungal Activity

Thymus vulgaris essential oil (TEO) was tested "in vitro" on Aspergillus flavus for its antifungal and antiaflatoxigenic effects. TEO influenced the growth of microbial biomass and the generation of aflatoxin.concentration. A. flavus's growth and aflatoxins' generation might thus be controlled by TEO.[50]

Anti-dysmenorrhea Activity

On the treatment of primary dysmenorrhea, the effectiveness of thymus vulgaris and ibuprofen was compared. Although there was no statistically significant difference in the amount of pain reduced by the two drugs, there was (p 0.001) a significant difference between each medicine and the placebo.The findings imply that both thymus vulgaris and ibuprofen may be useful in easing the degree of pain and spasm in primary dysmenorrhea.[51]

Anti-inflammatory Activity

Three different species of thyme (Thymus vulgaris, Thymus zygis, and Thymus hyemalis) extracts were studied for their properties. Gene expression and production changes were dose-dependent and correlated with each species' thyme content. In light of these findings, it's possible that thyme extracts have anti-inflammatory properties.[52]

Three different experimental models, including ear edema, carrageenan-induced pleurisy, and in vitro chemotaxis, were used to examine the effects of Thymus vulgaris essential oil (TEO) and its separated components thymol and cavacrol (CVL). It is suggested that the prevention of inflammatory edoema and leukocyte migration underlies the anti-inflammatory actions of TEO and CVL.[53]

CONCLUSION

The active ingredients in thyme, such as carvacrol and thymol in combination with other biological components, have been shown to have antioxidant, antidiabetic, antilipidemic, antitumor, and antimicrobial properties. Thyme is a medicinal plant used as a flavouring agent in food.

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