

The anti-inflammatory, anti-infectious and anti-cancerous effects of *Thymus vulgaris*

Nicolae Bacalbasa^{1,2}, Irina Balescu³, Claudia Stoica^{4,5}, Lucian Pop⁶, Valentin Varlas^{1,7}, Cristina Martac⁸, Andrei Voichitoiu^{1,6}, Bogdan Gaspar^{9,10}

¹Department of Obstetrics and Gynecology, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

²Department of Visceral Surgery, Center of Excellence in Translational Medicine, Fundeni Clinical Institute, Bucharest, Romania

³Department of Visceral Surgery, Ponderas Academic Hospital, Bucharest, Romania

⁴Department of Anatomy, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

⁵Department of Surgery, Ilfov County Emergency Hospital, Bucharest, Romania

⁶Department of Obstetrics and Gynecology, "Alessandrescu-Rusescu" National Institute of Mother and Child Care, Bucharest, Romania

⁷Department of Obstetrics and Gynecology, Filantropia Clinical Hospital, Bucharest, Romania

⁸Department of Anesthesiology, Fundeni Clinical Institute, Bucharest, Romania

⁹Department of Visceral Surgery, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

¹⁰Department of Visceral Surgery, Floreasca Clinical Emergency Hospital, Bucharest, Romania

ABSTRACT

Thymus vulgaris represents a medical herb from the southern region of Europe with anti-infectious, anti-inflammatory and immunomodulatory effects. More recently an antiviral and anti-cancerous activity has been demonstrated. Therefore multiple products have been imagined in order to put in value all these properties. The aim of this paper is to discuss the mechanisms of action, properties and means of administration of this product.

Keywords: *Thymus vulgaris*, immunomodulation, anti-cancerous

INTRODUCTION

Originating from the areas of southern Europe, *Thymus vulgaris* is now present worldwide, especially in the areas with arid climate and well drained soil [1]. Initially used for commercial purposes, especially in food industry due to its intense aromaticity, nowadays it proved to have significant medical properties such as anti-tumorigen, anti-inflammatory, anti-infectious and immunomodulatory effects [2,3]. Therefore, these properties have been widely studied and *Thymus vulgaris* extracts have been proposed in order to treat different disorders. Moreover, it seems that this plant has a protective effect against poisoning, nowadays Thymus extracts of thymol and carvacrol being used like an antidote in different suspicions of poisoning [4,5].

The aim of the current paper is to discuss about the most important properties and their applications in the daily practice.

THE ANTI-BACTERIAL EFFECT OF THYMUS VULGARIS

This plant seems to be particularly efficient in destroying the microorganisms which can be found at the level of the rectum and which can further colonize the genital tract; the most commonly investigated micro-organisms on which *thymus vulgaris* seems to be efficient are represented by *Escherichia coli*, *Klebsiella pneumoniae*, *Yersinia enterocolitica*, *Staphylococcus aureus*, *Listeria monocytogenes* and *Enterococcus faecalis*; meanwhile it seems to have a protective antifungal effect [6]. The antibacterial effect of the *Thymus vulgaris* extract, especially when used as essential oil is related to the solubility of these oils in microbial membrane leading to membrane disruption and leakage of the intracellular components [7-9].

Corresponding author:

Nicolae Bacalbasa

E-mail: nicolae_bacalbasa@yahoo.ro

Article History:

Received: 14 July 2022

Accepted: 1 August 2022

THE ANTI-INFLAMMATORY EFFECTS OF THYMUS VULGARIS

Another significant action of *Thymus vulgaris* is related to the anti-inflammatory capacity which is offered by reducing the effect of free radicals [9]. Therefore, administration of *Thymus vulgaris* extract in rabbits proved to increase the activity of antioxidant enzymes like glutathione-S-transferase, superoxide dismutase or catalase leading therefore to a decreased amount of free radicals without impeding the hepatic or renal function [10]. Oppositely to the anti-infectious effect, the anti-inflammatory effect seems to be a maximal one if ethanolic or aqueous extract are prepared [11]. The anti-inflammatory effects of *Thymus vulgaris* were also evaluated by measuring the intracellular amounts of nitric oxide; therefore, it is well known the fact that during pro-inflammatory phases an increased amount on nitric oxide is produced; after administration of different anti-inflammatory substances a significant decrease of these particles is to be expected. Interestingly, after administration of *Thymus vulgaris* in murine, a decrease of the intracellular levels of nitric oxide by 80% was observed, similarly to the one obtained after dexamethasone administration [12]. The anti-oxidant effect has been clearly demonstrated in humans in cases with cholestasis, chronic hepatitis and hepatic fibrosis [11,12].

THE ANTI-FUNGAL ACTIVITY OF THYMUS VULGARIS

Besides the anti-bacterial effect, *Thymus vulgaris* extracts also seem to have an anti-fungal activity against *Phytophthora parasitica*, *Sclerotinia sclerotiorum*, *Botrytis cinerea*, *Pythium aphanidermatum*, *Trichoderma aggressivum f.sp. europaeum*, *Fusarium oxysporum*, *Alternaria brassicae* and *Cladobotryum mycophilum* [13]. Similarly to the anti-bacterial effect, the anti-fungal effect is maximum when administrated as oil in liquid or in vapor phase; meanwhile, certain studies came to demonstrate that

these extracts have similar effects with fluconazole, voriconazole or itraconazole [14].

THE ANTI-CANCEROUS ACTIVITY OF THYMUS VULGARIS

When it comes to the effect of *Thymus vulgaris* against tumoral development, these effects have been widely studied and demonstrated when it comes to breast, colorectal, hepatocellular, pulmonary and cervical cancer [6]. The effect in regard to breast cancer has been studied on rats; therefore, administration of dry *Thymus vulgaris* extract on breast tumors leaded to a reduction in volume of the tumors by 85%; this effect was explained by the upregulation of caspases, enzymes with apoptotic effect on the tumoral cells [15]. Although the maximum effect in animal models was obtained by administration of oil extracts, these data are not yet clearly demonstrated in humans [6].

THE ANTI-VIRAL EFFECT OF THYMUS VULGARIS

The anti-viral effect of *Thymus vulgaris* has been initially demonstrated when administrating vapours of thyme oil against Influenza virus; furthermore, this extract proved to be efficient against sexually transmitted diseases such as human immunodeficiency virus or herpes simplex virus; this aspect is particularly important when it comes to human deficiency virus due to the fact that until now there is no efficient vaccine against this virus [16,17].

CONCLUSIONS

Thymus vulgaris contains a significant amount of active substances with anti-inflammatory, anti-cancerous and anti-infectious properties which proved to be efficient in various situations. Although initial studies were performed in animal models, there is hope that in time these results will be also encountered in humans.

Conflict of interest: none declared
Financial support: none declared

REFERENCES

1. DebMandal SM. Thyme (*Thymus vulgaris L.*) oils, in: V. Preedy (Ed.), Essential Oils in Food Preservation, Flavor and Safety, Academic Press, London, UK. 2016;825–834.
2. Hosseinzadeh S, Kukhdan AJ, Hosseini A et al. The application of *Thymus vulgaris* in traditional and modern medicine: a review. *Global J Pharmacol.* 2015;9: 260–266.
3. Mogosanu GD, Grumezescu AM, Bejenaru C et al. Natural products used for food preservation, in: Food Preservation, Academic Press, London, UK. 2017;65–411.
4. Meeran MFN, Javed H, Al Taee H, Azimullah S, Ojha SK. Pharmacological properties and molecular mechanisms of thymol: prospects for its therapeutic potential and pharmaceutical development. *Front Pharmacol.* 2017;8:380–389.
5. Baser KH. Biological and pharmacological activities of carvacrol and carvacrol bearing essential oils. *Curr Pharm Des.* 2008;14:3106–3119
6. Patil SM, Ramu R, Shirahatti PS, Shivamallu C, Amachawadi RG. A systematic review on ethnopharmacology, phytochemistry and pharmacological aspects of *Thymus vulgaris* Linn. *Heliyon.* 2021 ; 7(5): 07054.
7. Manou I, Bouillard L, Devleeschouwer MJ, Barel AO. Evaluation of the preservative properties of *Thymus vulgaris* essential oil in topically applied formulation under a challenge test. *J Appl Microbiol.* 1998 ;84(3): 368-376, 1998.

8. Silva F, Ferreira S, Queiroz JA and Domingues FC. Coriander (*Coriandrum sativum L.*) essential oil: its antibacterial activity and mode of action evaluated by flow cytometry. *J Med Microbiol.* 2011;60: 1479–1486.
9. Silva F, Ferreira S, Duarte A, Mendonca ID, Domingues CF. Antifungal activity of *Coriandrum sativum EO*, its mode of action against Candida species and potential synergisms with amphotericin B. *Phytomedicine.* 2011;19: 42–47.
10. Abdel-Gabbar M, Ahmed RR, Kandeil MA, Mohamed AEH, Ali SM. Administration of ginger and/or thyme has ameliorative effects on liver and kidney functions of V-line rabbits: histological and biochemical studies. *J Anim Physiol Anim Nutr.* 2019;103:1758–1767.
11. El-Guendouz S, Aazza S, Dandlen SA, Majdoub N, Lyoussi B, Raposo S et al. Antioxidant activity of thyme waste extract in O/W emulsions. *Antioxidants.* 2019;8:1–14.
12. Vigo E, Cepeda A, Perez-Fernandez R. In-vitro anti-inflammatory effect of *Eucalyptus globulus* and *Thymus vulgaris*: nitric oxide inhibition in J774A.1 murine macrophages. *J Pharm Pharmacol.* 2004;56:257–263.
13. Dianez F, Santos M, Parra C, Navarro MJ, Blanco R, Gea FJ. Screening of antifungal activity of 12 essential oils against eight pathogenic fungi of vegetables and mushroom. *Lett Appl Microbiol.* 2018;67:400–410.
14. Shu C, Sun L, Zhang W, Thymol has antifungal activity against *Candida albicans* during infection and maintains the innate immune response required for function of the p38 MAPK signaling pathway in *Caenorhabditis elegans*. *Immun Res.* 2016; 64:1013–1024.
15. Kubatka P, Uramova S, Kello M, Kajo K, Samec M, Jasek K et al. Anticancer activities of *Thymus vulgaris L.* in experimental breast carcinoma *in vivo* and *in vitro*. *Int J Mol Sci.* 2019;20(7):1749
16. Astani J, Reichling P, Schnitzler. Comparative study on the antiviral activity of selected monoterpenes derived from essential oils. *Phytother Res.* 2010;24:673–679.
17. Feriotto G, Marchetti N, Costa V, Beninati S, Tagliati F, Mischiati C. Chemical composition of essential oils from *Thymus vulgaris*, *Cymbopogon citratus*, and *Rosmarinus officinalis*, and their effects on the HIV-1 Tat protein function. *Chem Biodivers.* 2018;15(2): 1002.