OPEN ACCESS
Advances in Animal and Veterinary Sciences
Review Article

Subject Review: Pharmacological Application of Thyme

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Abstract | This paper reviews studies conducted to explore **the physiological** and therapeutic applications of thyme plant "Thyme vulgaris". The review started with biological active components of thyme such as flavonoids,luteolin, carvacrol, eugenol, thymol as well as aliphatic phenols, tetramethoxylated flavones and saponins that attribute to thyme pharmacological properties.Discussion extended to thyme forms and products such as powder, extracts or oil and how these products utilized toenhance immunity, finally reviewer tackled main thyme effects such as antioxidant, hypoglycemic (antidiabetic), antilipidemic, antitumor and antimicrobial action.

Keywords | Thyme, Antidiabetic, Antilipidemic, Antitumor, Antimicrobial.

Editor | Kuldeep Dhama, Indian Veterinary Research Institute, Uttar Pradesh, India.
Received | June 15, 2018; **Accepted** | July 08, 2018; **Published** | August 22, 2018
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Citation | Khafaji SSO (2018). Subject review: pharmacological application of thyme. Adv. Anim. Vet. Sci. 6(9): 366-371.
DOI | http://dx.doi.org/10.17582/journal.aavs/2018/6.9.366.371
ISSN (Online) | 2307-8316; **ISSN (Print)** | 2309-3331

INTRODUCTION

During last decades, the world tended to use the medical plants and herbs like celery, clove, coriander, thyme and *nigella sativa* to improve immune response, reproduction efficacy and general health (Nzeako et al., 2006; Al-Khafaji, 2013a,b; Khafaji, 2018). Thyme is important aromatic plant among Mediterranean flora, used as conventional medication and as spices. Richard et al. identified many types of *Thymus* across the world (Richard et al., 1985). Several studies reported that thyme possess active biological action such as antifungal (Soliman and Badeaa, 2002), antibacterial (Essawi and Srour, 2000; Dob et al., 2006), antioxidant activities (Tepe et al., 2005) antitabagism (Carlini et al., 2006), antispasmodic (Meister et al., 1999) and giardicidal (Amaral et al., 2006).

Also, the use of thyme oil as dietary addition sustained a higher total body status of antioxidant, glutathione peroxidase and superoxide dismutase activities (Youdim and Deans, 2000; Tsai et al., 2007). At non-toxic concentrations, thyme extracts were recognized as a natural antimutagen with the ability to improve the error repairing of free DNA (Vukovic-Gacic and Simic, 1993).

The flowered stem contains phenolic acids e.g: rosmarinic and cafeic, flavonoids derived from luteolol and apigenol, resin, tannins and especially essential oil rich in chemical compounds that is responsible for the majority of its pharmacological effects (Hmamouchi, 2001). Thyme used to treat fever, diarrhoea, infected wounds and cough. As well as, it used as a stimulant and tonic (Sijelmassi, 1993; Bellakhdar, 1996). Thyme extracts, such as essential or volatile oils, utilized in animal feeding and considered as growth and immune enhancers due to their antioxidant, antimicrobial and digestion properties (Abdulkarimi et al., 2011; Assiri et al., 2016).

According the common uses of this plant to reduce some healthy problems, I focused in this paper to investigate thyme's chemical composition actions that intervene with disorders which cause death according to Center of Disease Control and Prevention.

LITERATURE REVIEW

Chemical Composition

Thyme (*Thymus Vulgaris L.*) is a main medicinal plant which belongs to the Lamiaceae family (Masada, 1976). Carvacrol (5-isopropyl-2-methyl phenol) and thymol (5-methyl-1-2-isopropyl phenol) are the main phenolic components in *Thymus vulgaris*,which form about 20–

55% of thyme oil extract (Masada, 1976). Many studies demonstrate that thyme volatile oil is among the main essential oils used in cosmetics as antioxidants and preservatives and in food manufacturing (Zarzuelo and Crespo, 2002). Essential oil of *thymus vulgaris* is a combination of monoterpenes, the main substances of this oil are phenol isomer carvacrol and its nature terpenoid thymol, which have antimicrobial, antioxidative, antibacterial, antitussive, antispasmodic and expectorant actions (HÖferl et al., 2009). Phenolic acid, terpenoids and flavonoids glycosides also present in *Thymus Vulgaris L* (Vila, 2002). In addition, other active biochemical compounds of Thyme species are flavonoids (e.g. thymonin, cirsilineol and 8-methoxycirsilineol), caffeic acid, triterpenoids, aliphatic aldehydes, long-chain saturated hydrocarbons and "Labiatae tannin" (rosmarinic acid) (Horváth, 2005).

Antidiabetic Action

Recently, researchers' interest increased in medicinal plants to treat hyperglycemic status (Mansi and Lahham, 2008). Several researchers suggested to utilize these plants for their different biological effects in special disease like diabetes (Jung et al., 2006). Maqsood et al. recommended thyme amongst those plants that has antidiabetic action (Maqsood et al., 2009).

Thyme aqueous extract revealed antihyperglycemic effect in alloxan induced hyperglycemic rabbits without effect on body weights. Due to the plant's ability to boost elimination of glucose from circulation, reduce liberating of glucagon or rise of insulin, decrease absorption of glucose from the GIT or stimulate the peripheral tissues for glycolysis process, directly (Marrif et al., 1995 and Alamgeer et al., 2012).

Other research revealed that *T. serpyllum* and its extracts have inhibitory action on α-glucosidase *in vitro* (Gholamhoseinian et al., 2008). The α-glucosidase is among the enzymes present in the intestine at the brush border, it converts polysaccharides into simple sugars. Diminishing the action of this enzyme delays increment of glucose in blood after ingestion of carbohydrate rich diet and it is one of the important methods to reduce the postprandial glucose in circulation that may prevent the triggering of complications of late diabetes (Lebovitz, 1997; Ortiz-Andrade et al., 2007). The antioxidant potential of thyme aqueous extract is responsible for the antidiabetic effect of this plant, it provides a defense against the cytotoxic activity of free radicals produced by the diabetes or alloxan itself (Gallo et al., 2005; Wadood et al., 2007; Alamgeer et al., 2012).

Besides, thyme aqueous extract could cause hypoglycemic effects in diabetic rabbits, without a change in body weight, and improve hematological traits in diabetic rabbits (Alamgeer et al., 2012).

Other studies found that thyme oil is rich in active substances like phenolic and flavonoids compounds, especially carvacrole and thymol (Fachini-Queiroz et al., 2012). This may be caused hypoglycemic effect due to action of thymol or carvacrole that mimics insulin, beside, the ability of its oil to counteract the inhibitory effects of alloxan on glucokinase which is the glucose sensor of the β cells (Rahimi et al., 2011; Hanna et al., 2014).

Antilipidemic Effects

The antilipidemic potential of thyme might be due to its constituent of active biological agents, many researchers suggested that carvacol and thymol could reduce plasma cholesterol concentration, it elevate the action of microsomal geranyl pyrophosphate pyrophosphatase (Taku et al., 2007). The constitutional variety of the isopropanoids could inhibit the synthesis of cholesterol due its ability to rise the effect of pyrophosphatase Thymoquinone is considered important derivative of thymol due to its antilipidemic activity (Ali and Blunden, 2003; Badary et al., 2000). Benkhayal et al., 2010, explain the role of biological constituents of thyme on the typical biochemical traits and histological studies of the kidney and liver in rats treated by thyme because it regenerates alteration normal roles secondary to antihyperglycemic action.

Several researcher revealed the antihyperglycemic and antilipidemic effects of volatile oil of Thyme. The decrement in LDL concentration may be attributed to the compounds of oil thyme that possess antioxidant potential that inhibit peroxidation of lipid, subsequent LDL declines, and inhibit fat decomposition (Tuama, 2016), furthermore, the flavone is one constituents of thyme oil owning the antioxidant properties that decrease triglycerides and cholesterol concentration, causing lipid depression (Nadia and Rachid, 2013).

Antitumoral Activity

Antitumoral effects of thyme, specially the two pure compounds carvacrol and thymol, attributed to their cytotoxic action on tumor cells, several researchers showed thyme carvacrol is the most important cytotoxic product against P815mastocytoma cell line, Indeed, essential oils with high amount of carvacrol have more cytotoxic activity (Jaafari et al., 2007).

AitM'barek et al. (2007), concluded that the essential oil of thyme has an important *in vitro* cytotoxic effects against human ovarian adenocarcinoma cells that are resistant to chemotherapeutic agents as well as a significant antitumor effect in mice, due to the biological active components of thyme like carvacrol and thymol.This multicomponent of natural products are effective in preventing growth of tumor in mice and subsequently delaying animal mortality. The mechanism of thyme cytotoxic actions may be due to

its lipophilic nature, causing accumulation of volatile compounds of plant in the cell membrane leading to increase in its permeability; subsequently causing leakage of metabolites and enzymes (Bard et al., 1988; Sikkema et al., 1995).

Antibacterial Activity

The antimicrobial activity of thyme depends on their chemical constituents especially thyme essential oil. Borugă*et al.*, 2014, demonstrated the effectiveness of thyme essential oil against the food-related bacteria and fungus. The antimicrobial potential of thyme essential oil is related to its contents of phenolic compounds (thymol) and terpene hydrocarbons (γ-terpinene), respectively (Dorman and Deans, 2000; Skočibušić et al., 2006; Rota et al., 2008). A third main agent in thyme according to its fraction is p-Cymene displays synergistic antibacterial action in combination with γ-terpinene and thymol (Dorman and Deans, 2000; Delgado et al., 2004; Gallucci et al., 2009).

Thymol and carvacrol possess antimicrobial and antifungal effects (Twetman and Peterson, 1997; Basilico and Basilico, 1999). Furthermore, the antimicrobial mechanisms of carvacrol and thymol based on their ability to disintegrate the outer membrane of bacteria, which affects pH homeostasis and equilibrium of inorganic ions causing a release of lipopolysaccharides and an increase in permeability of the cytoplasmic membrane to ATP12 (Lambert et al., 2001).

Thyme essential oil possess the ability to prevent *E. coli* growth *in vitro* (Marino et al., 1999). Other researchers found that thymol prevents *S. typhimurium* and *E. coli* growth (Karapinar and Aktug, 1987). Dorman and Deans, (2000), reported that a thymol, is chief component of the essential oil from thyme, has antimicrobial potential. Varga et al. (2015) found the essential oils of *Thymus serpyllum* and *Thymus vulgaris* have the strongest action against the microorganisms, it proportionates directly with their content of thymol. Also, the essential oil of various types of thyme used in vaporizers against various yeasts, human pathogenic Gramnegative and Gram-positive bacteria.

Cosentino et al. (1999) found that the extracts of Thyme oilwas unsuccessful to kill off *Klebsiella pneumonia* or *Salmonella choleraesuis and Staphylococcus aureus*, but was successful to inhibit *Candida albicans* and *Pseudomonas aeruginosa* growth. While, Sienkiewicz et al. (2012) found the oil of thyme is efficient against standard and clinical strains belonging to: *Staphylococcus sp., Enterococcus sp., Escherichia sp., and Pseudomonas sp*. genus.

Antifungal Activity

Several researches revealed that the thyme possess effect against fungi. de Lira Mota et al. (2012), showed that the *T. vulgaris* essential oil regarded as efficient as antifungal and could be used for mucormycosis treatment due to its interference with ergosterolcausing membrane disturbance of fungi and loss of intracellular contents, as well as, it depresses sporangiospores germination and development of mycelial. Thyme essential oil, is rich in thymol and other antifungal substances, used to disinfect mouldy walls in the dwellings in low concentration (S˘egvic et al., 2007).

Rasooli and Owlia (2005), found that a chief targets of thyme oils were cell wall and membrane of *Aspergillus parasiticus* led to depress growth of *Aspergillus parasiticus* and its aflatoxin production, by causing irreversible damaging to cell wall, membrane and cellular organelles of the fungus subsequently inactivate critical enzymes, causing reaction with proteins of cell membrane or functionally interrupt the genetic substances (Davidson, 2001; Lo'pez-Malo et al., 2005).

CONCLUSION

Thyme is a medicinal plant use as flavoring substance in food, its products such as powder, extracts and oil, have antioxidant, antidiabetic, antilipidemic, antitumor and antimicrobial actions attributed to thyme's active components such as carvacrol and thymol in combination with other biological components.

ACKNOWLEDGEMENTS

I am deeply grateful to Dean of College of Agriculture, University of Kerbala and to the head and all members of-Department of Animal production for providing me with all facilities required for this study.

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