

Phytopharmacological activities of *Euphorbia thymifolia* Linn.

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ABSTRACT

The use of plant extracts to cure many diseased conditions has been the traditional method in many parts of the world. The plant extracts are found to be effective in their mode of action and do not cause any side effects to the patient treated. Many plants and trees are found to have various medicinal values and among all the plants found all over the world many plants are found in India. *Euphorbia thymifolia* is one of the many medicinal plants which have various actions like laxative, aromatic, sedative, blood purification, anti-viral, anti-helminthic, anti-inflammatory, anti-spasmodic, anti-fungal, anti-bacterial, anti-microbial, diuretic properties and many more. Many of the properties of this *E. thymifolia* are discussed in this review.

Keyword: *Euphorbia thymifolia*; anti-microbial; anti-hyperglycemic; hepato-protective; anti-oxidant

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DOI : 10.5530/srp.2016.7.4

INTRODUCTION

The traditional medicine involves the use of extracts of various plants, which are found to have various medicinal properties. Not only the traditional medicine like Ayurveda and Siddha use these plant extracts, but in recent times the allopathic medicine is focusing on using plant extracts to develop medicine which shows more improvement and cures the disease without any side effects. *Euphorbia thymifolia* Linn. is usually referred to as laghududhika or choti-dudhi. *E. thymifolia* belongs to the family Euphorbiaceae, which has around 7500 species in about 300 genera. The plants under Euphorbia genus are used to treat cancer, migraine, warts, intestinal parasites, tumors, etc. The use of *E. thymifolia* in curing many ailments are increasing as more and more properties of this plant is being found due to advanced research. The *E. thymifolia* is found in tropical regions, but it is absent in North Australia.¹

This plant is present in the wastelands, along roadsides and wall sides in humid conditions, abandoned fields, etc.² In India, the plant is found in the hills and plains. *E. thymifolia* is found usually two ecotypes as green and red forms. These two forms interbreed among themselves and results in forming three intermediates. These are categorized into two major ecological groups like obligate calcifuges and facultative calcicoles. The traditional use of this *E. thymifolia* is mainly due to its actions involving laxative, aromatic, sedative, blood purification, anti-viral, anti-helminthic, anti-inflammatory, anti-spasmodic, anti-fungal, anti-bacterial, anti-microbial, diuretic properties³ etc.

BOTANICAL DESCRIPTION

E. thymifolia is a soft prostrate herb with puberulous stem usually slender and cylindrical in shape. It is often found pink in color when fresh and gradually becomes grayish green or dark purple in dry form. Stems have white latex and the stem is 10-20 cm long having a diameter of 1-3 mm. The branches are found to be slender, reddish in color and pubescent. Leaves are simple in structure with an oblong shape, having 6-8 mm length and 2-5 mm breadth with round apex.⁴ The petiole is 3-6 mm in length, 2-4 mm in breadth usually appearing green in color.⁵ The lamina is oval or obliquely oblong in shape. Apex is found to be obtuse or round shaped. Margin is rough towards apex and smooth at base with reticulate venation. Petiole is long, thin, slender and pinkish in color.

PHYTOCHEMISTRY

The various phytoconstituents present in *E. thymifolia* includes, carotene, vitamin C, chlorophyll a and b, phenols, tannins, carbohydrates, minerals, cinnamic acid derivatives, glycosides, sterols, isomallotinic acid and anti-oxidants.⁶ Various phytoconstituents present in *E. thymifolia* are grouped into nine categories as sterols, minerals, anti-oxidants, nutrients, cinnamic acid derivatives, glycoside, miscellaneous constituents, essential oil and hydrolysable tannin. All these compounds are extracted from various parts of the plant like roots, aerial parts, stem and leaves. Constituents like amino acids, proteins and alkaloids were completely absent.⁷

Triterpenoids are organic compounds which are very diverse in their structure. 4,14-dimethylergosta-8, 24(28)-dien-3 β -ol present in the ethanolic extract of the *E. thymifolia*. Its structure was completely studied using ¹H, ¹³C-NMR and IR and also by using mass spectroscopy.⁸ Table 1 shows the various phytoconstituents present in the *E. thymifolia*.

NUTRITIVE MINERALS PRESENT

The entire chemical composition of *E. thymifolia* was analyzed using GC-MS. The study showed the presence of various nutritive minerals. The minerals present in the plant *E. thymifolia* are sodium (Na), potassium (K), phosphorous (P), calcium (Ca), iron (Fe), sulfur (S), copper (Cu), zinc (Zn) and manganese (Mn).⁹ All these minerals are essential for proper functioning of various organs of our body.

ANTI-MICROBIAL ACTIVITY

E. thymifolia is considered to possess anti-microbial activity due to the presence of alkaloids.⁵ The microbes like *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Salmonella typhi*, *Staphylococcus aureus*, and *Klebsiella pneumonia* were tested to show the anti-microbial activity of *E. thymifolia*. These experiments show a great result by blocking the growth of the microbes. The extracts of *E. thymifolia* were used in drugs like fluconazole and ciprofloxacin to control the microbes.¹⁰

The recent research showed the effect of diluted latex, fresh extract of *E. thymifolia* against various microbes like *K. pneumonia*, *Bacillus pumi-*

lus, *Streptococcus pneumoniae*, *S. aureus*, *E. coli*, and *Citrobacter freundii*. These effects were studied using disc diffusion method.¹¹ Microbes like *E. coli*, *K. pneumoniae*, *S. typhi*, *Proteus mirabilis*, *Shigella dysenteriae* found to show decreased growth when treated with the extract of *E. thymifolia*.¹²

Anti-bacterial activity was demonstrated using an ethanolic extract of *E. thymifolia* against *Bacillus pumilis*, *S. aureus*, and *B. subtilis*.¹³ The extracts were obtained using chloroform and ethyl acetate. The growth of *E. coli* is inhibited by *in vitro* but *Shigella flexneri* is inhibited only by *in vivo* method.¹⁴

Fungi are saprophytes and they are harmful as well as useful to humans. The harmful effects are mainly like destroying crops; causing diseases etc. These activities of fungi should be brought down to have benefit for humans. Thus the plant extracts are checked for their activity as anti-fungal. *E. thymifolia* is found to have anti-fungal activity. Ethanolic extract of *E. thymifolia* was used against fungal strain *Candida albicans* to study the anti-fungal activity.¹³ The latex of *E. thymifolia* is also found to show anti-fungal activity. The fungi namely *Aspergillus niger*, *Trichoderma viride*, *Alternaria alternata*, *Fusarium moniliforme* and *Curvularia lunata* were found to show reduced activity when treated with the latex extract of *E. thymifolia* thus proving it to be an effective anti-fungal agent.¹⁵

The ethyl acetate extract and 3-O-galloyl-4,6-(S)-hexahydroxydiphenoyl-d-glucose (3OG46HG) of *E. thymifolia* were used in the *in vitro* study of anti-HSV-2 activity. According to the results the virus infectivity was proved with the 3OG46HG and ethyl acetate extract. Virus infectivity was significantly reduced in a concentration of 4.0 µ/ml of ethyl acetate extract, whereas, 3OG46HG diminished virus infectivity at a concentration of 0.5 µ/ml.¹⁶ The 3-O-galloyl-4,6-(S)-hexahydroxydiphenoyl-d-glucose (3OG46HG) and ethyl acetate (EtOAc) extract of *E. thymifolia* reduces the multiplication of HSV-2. Both extract showed diminished virus infectivity at different concentration.¹⁷

ANTI-SPASMODIC ACTIVITY

Spasm is a condition where the involuntary muscles contract, thereby leading to poor coordination of the muscles. This condition occurs mainly due to overuse of the muscle so that the muscle loses all the energy. The extract of *E. thymifolia* is found to have anti-spasmodic activity which relieves the spasm and prevents further spasm occurrence. The extract of *E. thymifolia* which was obtained using the ethanol was used to study anti-spasmodic activity and it was observed that the extract could inhibit the growth of *Plasmodium falciparum*.¹³

IMPROVE REPRODUCTIVE DYSFUNCTION

The root of *E. thymifolia* is found to improve the reproductive dysfunction in females. Stress is the main reason for reproductive dysfunction. During stress the levels hormones luteinizing hormone, follicle-stimulating hormone, estradiol, progesterone and prolactin were found to change causing reproductive dysfunction. But the use of ethanolic root extract of *E. thymifolia* during stress condition improves the levels of these hormones thereby preventing the reproductive dysfunction.¹⁸

ANTI-HYPERGLYCEMIC ACTIVITY

The oral test method for glucose tolerance was used to determine the anti-hyperglycemic activity. Mice were taken as the study subjects and were injected with different doses of the extract, followed by glucose. After 1 hour of administration serum glucose levels were examined. Different doses were administered in 50, 100, 200 and 400 mg/kg of body weight in mice to determine the glucose level reduction in the serum. The dose level of 400mg/kg showed the maximum glucose reduction level (60.5%) in the serum when compared with the anti-hyperglycemic drug called

glibenclamide which has a dose level of 10mg/kg body weight which showed glucose reduction of 48.6%.¹⁹

HEPATOPROTECTIVE ACTIVITY

The hepatoprotective activity along with anti-oxidant activity of ethanolic extract of *E. thymifolia* was determined. Carbon tetrachloride (CCl₄) is a hepatotoxin which damages the hepatocytes. When the extract of *E. thymifolia* is given to rats before treating them with CCl₄, showed to have hepatoprotective activity when CCl₄ is administered.²⁰

ANTI-BRONCHIAL ASTHMATIC ACTIVITY

It is observed that *E. thymifolia* is useful in the treatment of bronchial asthma. The plant species have two ecotypes- red and green. Water-soluble fraction of the total alcoholic extract of the plants was used for the efficacy estimation and the treatment. The intake of the drug helps in the relaxation of smooth muscles during a bronchial asthma.²¹ This helps the asthma patient to relieve from the symptoms of asthma as it relaxes the muscles.

ANTI-ARTHRITIC ACTIVITY

Rheumatoid arthritis, which is an auto-immune disease, occurs mainly due to the leukotrienes, pro-inflammatory markers and cytokines. Many medicinal plants were found to have property to cure and reduce the effect of arthritis.²² Albino rats were used to screen the anti-arthritis activity of *E. thymifolia* where the aqueous extracts were used. Number of phyto-constituents was screened and their effects in treating arthritis were measured using Freund's adjuvant. White blood cells, hemoglobin content, red blood cells, erythrocyte sedimentation rate, total protein, alkaline phosphate, serum glutamic pyruvate transaminase, serum glutamic oxaloacetate transaminase, lipid peroxidation were estimated. This result proved the anti-arthritis activity of *E. thymifolia*.²³

ANTI-DIARRHEAL AND ANTI-DYSENTERIC ACTIVITY

The plant *E. thymifolia* and many other plants were used among the Bhoja community people in the Dehradun district in Uttarakhand state of India to test its activity in people suffering with dysentery and diarrhea. The calculation of the use value and the fidelity level were observed in each plant species. The result concluded the effect of the plant in reducing the dysentery and diarrhea in people suffering with it. Hence, all plants tested showed improvement in patients suffering with diarrhea and dysentery.²⁴

ANTI-INFLAMMATORY ACTIVITY

Anti-inflammatory activity was studied using ethanolic plant extract of carrageenan-induced rat paw edema method. The reduction in the edema was observed with the dose of 100 mg/kg body weight when compared to Indomethacin which is a standard drug (10 mg/kg) and thus the extract produced sufficient anti-inflammatory response.²⁵

DIURETIC ACTIVITY

Diuretic is the action by which the body excretes large amounts of urine. Drugs that enhance this process are known as diuretics. These drugs are used to treat high blood pressure condition as it removes excess salt and water from the body thereby lowers the blood pressure. Diuretic activity of ethanolic extract and fractions of *E. thymifolia* is examined for its diuretic activity by its ethanolic extract and fractions. The dose dependent method is used to determine the diuretic activity.²⁶

Table 1: Various phytoconstituents present in the *E. thymifolia*, which are discovered and mentioned by various researchers.

Phytoconstituents	Study author/ year
Iso-mallotinic acid	Lee <i>et al.</i> ²⁹
Tetradecanoic acid	Prasad and Bisht ³⁰
Cymol	
2-(4-methyl-3-cyclohexene-1-yl)-2-proanol	
Isopinocampheol	
Limonene	
2,4-decadienal	
A-caryophyllene	
2,6,6- trimethyl-1-cyclohexane-1-carboxaldehyde	
Safranal	
2,4-heptadienal	
Piperitone	
1-pentanol	
Benzaldehyde	
2,3-heptadione	
Phytol	
Pentadecanoic acid	
Caryophyllene oxide	
n-hexadecanoic acid	
2-n-Ppentylfuran	
Nonanal	
Macro-minerals (Ca, Na, K, Li)	Prasad and Bisht ³⁰
Micro-minerals (Cu, Co, Fe, Mn)	
24-methylene cycloartenol and quercetingalactoside	Khare ³¹ Khare ³² Rastogi and Mehrotra ³³
Cosmosiin	
Kaempferol	
Salisylic acid	
Carvacrol	
2-sesquiterpenes	
Pedunculagin	
Sterol	
n-alkanes	
Esters	
Cholesterol	
B-amyrine	
12-deoxy-4-b-hydroxyphorbol-13-phenyacetate-29-acetate	
1 and 5- desgalloylstachyruin	
Epitaraxerol	
Corilagin	
B-sitosterol	
Phorbol derivatives	
Geraniin	
Eugeniin	
Quercetin-3-rhamnoside	
Stigmasterol	

continued...

Phytoconstituents	Study author/ year
Bixanin	
12-deoxy-4-β-hydroxyphorbol-13-dodecanoate-20-acetate	
12-deoxyphorbol-13,20-diacetate	
Casuarinin	
n-hexacosanol	
Euphorbol	
Two derivatives of deoxyphorbol-OAC	
Campesterol	
B-carotene	Prasad and Bisht ³⁰
Chlorophyll a and b	
Vitamin-C	
Tannins	
Phenolics	
Thymofoloinoates A and B	Hussain <i>et al.</i> ³⁴
p-hydroxycinnamic acid	
5-hydroxy-6,7,8,4'-tetramethoxy flavone	
5-hydroxy-3',4',6,7,8-pentamethoxy flavone	
5,7,4-trihydroxy flavones-7-glycoside	Anonymous ³⁵
Taraxerol	
Tirucallol	
Crude fat	Prasad and Bisht ³⁰
Crude protein	
Starch	
Crude fiber	
Total carbohydrate	
Amylase	
Cellulose	
Amylopectin	
Ash	
Acid soluble and insoluble ash	
Moisture	

ANTI-OXIDANT ACTIVITY

The anti-oxidant activity of *E. thymifolia* was studied using nitric oxide scavenging activity. Many anti-oxidants like beta-carotene, vitamin C, chlorophyll (a and b), tannins and phenolics are found to be present in the plant extract. The anti-oxidant activity was found in the ethanolic extract of *E. thymifolia*.¹²

ANTI-STRESS ACTIVITY

Stress is one of the important factors in causing female reproductive dysfunction. The forced swimming stress and restraint stress are the major factors found to induce reproductive dysfunction. Various concentration of the root extract of *E. thymifolia* are found to reduce the stress which were observed by changes experienced during the estrous cycle and by the weight of the organs. This anti-stress activity of the root extract of *E. thymifolia* is mainly due to the presence of various phytochemical constituents.²⁷

ANTI-HELMINTIC ACTIVITY

The helminths are parasites that live inside the body of the host and utilize all the food and energy of the host for its own growth and reproduction. Roundworm, flukes and tapeworm are helminths that affect humans, which are common in the unhygienic environment. Anti-helmintic is the property by which a compound acts against the helminths and kill them. The extract of *E. thymifolia* is found to have anti-helmintic activity. Methanolic and aqueous extracts of *E. thymifolia* were used for the study of anti-helmintic activity against *Pheretimaposthyma* and *Ascaridiagalli*. Different dose concentrations of the extract exhibit anti-helmintic activity.²⁸ The ethanolic extract has anti-helmintic activity by paralyzing the worms. Different concentrations were tested.¹²

CONCLUSION

In this systematic review, the phytochemistry, anti-microbial activity, anti-spasmodic activity, role in improving reproductive dysfunction, anti-hyperglycemic activity, hepatoprotective activity, anti-bronchial asth-

matic activity, anti-arthritis activity, anti-diarrheal and anti-dysenteric activity, anti-inflammatory activity, diuretic activity, anti-oxidant activity, anti-stress activity, anti-helminthic activity were discussed. Presently few drugs that contain derivatives of *E. thymifolia* are available to cure diseases, but further research on the medicinal activity of this plant will further help in producing more useful drugs.

CONFLICTS OF INTEREST

No funding source and there is no conflict of interest.

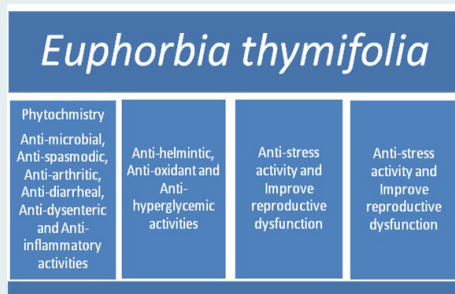
ABBREVIATION USED

C-NMR: Nuclear magnetic resonance; **IR:** Infra Red; **GC-MS:** Gas chromatography-mass spectrometry.

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PICTORIAL ABSTRACT



SUMMARY

- Euphorbia thymifolia* are widely used medicine for its broad medicinal properties.
- A detail furnished in this review is further helps in exploring more about other properties of this plant.

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