Euphorbia hirta: Its chemistry, traditional and medicinal uses, and pharmacological activities

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ABSTRACT

The oldest remedies known to mankind are herbal medicines. India is known worldwide for its Ayurvedic treatment. *Euphorbia hirta* is often used traditionally for female disorders, respiratory ailments (cough, coryza, bronchitis, and asthma), worm infestations in children, dysentery, jaundice, pimples, gonorrhea, digestive problems, and tumors. It is reported to contain alkanes, triterpenes, phytosterols, tannins, polyphenols, and flavanoids. This review describes the medicinal properties, chemical constituents, and other important aspects of *Euphorbia hirta*.

Key words: Antioxidant, antimalarial, antibacterial, *euphorbia hirta*

INTRODUCTION

In India use of the different parts of several medicinal plants to cure specific ailments has been in vogue from ancient times. The indigenous system of medicine, namely, Ayurvedic, Siddha, and Unani, has been in existence for several centuries. Some drugs from Ayurveda approaches modern diseases, have already reached the market place.[1] In modern medicines, plants occupy a very important place as the raw material for some important drugs. Synthetic drugs are effective in controlling different diseases but these synthetic drugs are out of reach of millions of people. It is estimated that around 70,000 plant species have been used for medicinal purposes. The herbs provide the starting material for the synthesis of conventional drugs. Medicinal plants have curative actions due to the presence of complex chemical constituents. India recognizes more than 2500 plant species having medicinal value, Sri Lanka around 1400, and Nepal around 700.[2] This review intends to provide an overview of the chemical constituents and pharmacological actions of *Euphorbia hirta*.

GENERAL INFORMATION

The largest genus of family Euphorbiaceae is Euphorbia with about 1600 species. It is characterized by the presence of white milky latex which is more or less toxic. Latices of *E. ingens*, *E. mey*, *E. tirucalli,* and *E. triangularis* are possible sources of rubber.[3] This group of plants has been a subject of intense phytochemical examination and isolated compounds which include:- flavanoids, triterpenoids, alkanes, amino acids, and alkaloids.[1] *E. ipecacuanha* is known as wild ipecac; *E. antiquorum* is known as *Tridhara*; *E. lathyrus* is known as caper spurge; and *E. thymifolia* is known as *Laghududhika*.[2]

There are many other species of Euphorbia which are used in traditional medicines. All species of Euphorbia exudes a milky juice when broken, which is more or less poisonous and used as an ingredient in arrow poisons. *E. hirta* possesses antibacterial, anthelmintic, antiasthmatic, sedative, antispasmodic, antifertility, antifungal, and antimalarial properties.[1]

Distribution

E. hirta is distributed throughout the hotter parts of India and Australia, often found in waste places along the roadsides.[6]

Plant Description

E. hirta Linn. Syn; *E. pilulifera* Linn. *Chamaesyce pilulifera* Linn.[5]
Family: *Euphorbiaceae*

Vernacular Names

Awuna	Akinkodze
Bengal	Barokhervi
English	Pill---bearing spurge, asthma herb, snakeweed
Gujarat	Dudeli
Hindi	Dudhi
Indonesia	Daun biji kacang, patikan kebo
Malayalam	Nelapalai
Malaysia	Ambin janyan, kelusan, keremak susu
Marathi	Dudnali, govardhan
Orissa	Jhotikhuntian

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Sanskrit	Amampatchairaisi, barokheruie, dugadhika
Tamil	Amumpatchaiyarissi
Telagu	Reddinanabrolu, bidarie, nanabala, nanabiyan
Visayan	Bovi, buyayava[1--4]

MORPHOLOGY

E. hirta belongs to the plant family *Euphorbiaceae* and genus Euphorbia. It is a slender- stemmed, annual hairy plant with many branches from the base to top, spreading upto 40 cm in height, reddish or purplish in color. Leaves are opposite, elliptic - oblong to oblong- lanceolate, acute or subacute, dark green above, pale beneath, 1- 2.5 cm long, blotched with purple in the middle, and toothed at the edge. The fruits are yellow, three- celled, hairy, keeled capsules, 1-2 mm in diameter, containing three brown, four-sided, angular, wrinkled seeds.[1-4]

ETHNOPHARMACOLOGY

E. hirta is used in the treatment of gastrointestinal disorders (diarrhea, dysentery, intestinal parasitosis, etc.), bronchial and respiratory diseases (asthma, bronchitis, hay fever, etc.), and in conjunctivitis. Hypotensive and tonic properties are also reported in *E. hirta*. The aqueous extract exhibits anxiolytic, analgesic, antipyretic, and anti-inflammatory activities. The stem sap is used in the treatment of eyelid styes and a leaf poultice is used on swelling and boils.[3]

Extracts of *E. hirta* have been found to show anticancer activity. The aqueous extract of the herb strongly reduced the release of prostaglandins I_2, E_2, and, D_2.[3] The aqueous extract also inhibits aflatoxin contamination in rice, wheat, maize, and mustard crops.[7] Methanolic extract of leaves have antifungal and antibacterial activities. The leaves pounded with turmeric and coconut oil are warmed and rubbed on itchy soles. The latex of *E. hirta* is applied on lower eyelids, like *surma* to cure eye sores. The root exudate exhibits nematicidal activity against juveniles of meloidogyne incognita.[3]

Decoction of dry herbs is used for skin diseases. Decoction of fresh herbs is used as gargle for the treatment of thrush. Root decoction is also beneficial for nursing mothers deficient in milk. Roots are also used for snake bites.[1] The polyphenolic extract of *E. hirta* has antiamoebic[8] and antispasmodic activity.[9] Quercitrin, a flavanoid glycoside, isolated from the herb showed an antidiarrheal activity.[10-11] It is reported to have a relaxation effect on respiration.[12] The alcoholic extract of whole plant shows hypoglycemic activity in rats.[6] It has a sedative effect on the genitor-urinary tract.[4]

CHEMICAL CONSTITUENTS

E. hirta has been studied by various workers and a number of active constituents have been isolated. Afzelin (I), quercitrin (II), and myricitrin (III) have been isolated from the methanolic extract of *E. hirta*.[13] The chemical investigation of *E. hirta* has led to the isolation of rutin (IV), quercitin (V), euphorbin-A (VI), euphorbin-B (VII), euphorbin-C (VIII), euphorbin-D (IX), 2,4,6-tri-*O*-galloyl-β-D-glucose, 1,3,4,6-tetra-*O*-galloyl-β-D-glucose, kaempferol, gallic acid, and protocatechuic acid.[14-15] *E. hirta* also contains β-amyrin, 24-methylenecycloartenol, β-sitosterol, heptacosane, *n*monacosane,[1] shikmic acid, tinyatoxin, choline, camphol, and quercitol derivatives containing rhamnose and chtolphenolic acid [Figure 1].[6]

PHARMACOLOGICAL ACTIVITIES

Antibacterial activity

The ethanolic extract of *E. hirta* inhibited the growth of the *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa,* and *Bacillus subtili*[16] and aqueous and chloroform leaf extracts of *E. hirta* possess an antibacterial activity against *Klebsiella pneumonia*. The extract is noncytotoxic and antibacterial.[17]

Antimalarial activity

The bioassay-guided fractionation of the methanolic extract of aerial parts of *E. hirta*, monitored against *P. falciparum parasites*, yielded a main active chromatographic fraction showing 90% growth inhibition of *P. falciparum* at a concentration of 5 μg/ml.[13]

Anti-inflammatory activity

The *n*-hexane extract of aerial parts of *E. hirta* showed anti-inflammatory effects in the model of phorbol acetate-induced ear inflammation in mice. It exhibited a dose-dependent effect.[18,19]

Galactogenic activity

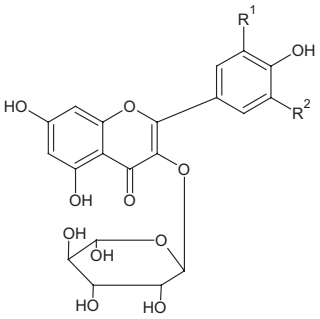
The powdered *E. hirta* showed a galactogenic activity in guinea pigs before puberty by increasing the development of the mammary glands and induction of secretion.[20]

Antiasthmatic activity

E. hirta is reported to have an antiasthmatic activity due to the relaxation effect on the bronchial tubes and a depressant action on respiration.[12]

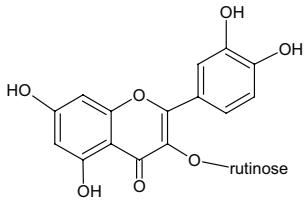
Effect on urine output and electrolytes

Ethanolic and aqueous leaf extracts of *E. hirta* significantly induced diuresis in rats. The diuretic effect of the ethanol extract was significant at 6 h (for 100 mg/kg) and at 24 h (for 50 mg/kg). The water extract induced a significant increase in urine Na^+, K^+ and HCO^{3-} loss. The ethanol extract (100 mg/ml) caused a significant decrease in the K^+ loss whereas the water extract increased its excretion. The HCO^{3-} urine output following the injection of both extracts was tremendously enhanced.[21]

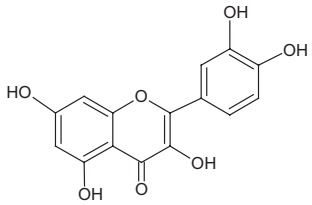


Basic structure

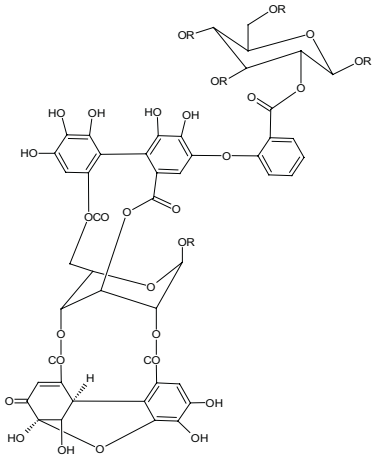
	R^1	R^2
I. Afzelin	H	H
II. Quercitrin	OH	H
III. Myricitrin	OH	OH



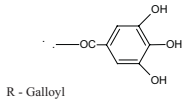
IV. Rutin



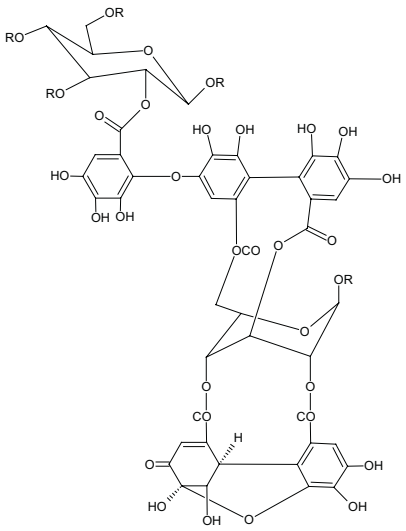
V. Quercitin



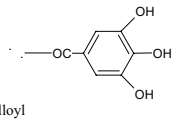
VI. Euphorbin-A (basic structure)



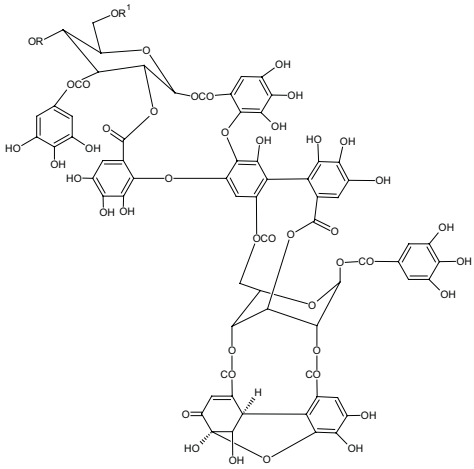
R - Galloyl



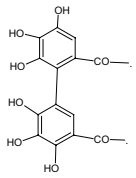
VII. Basic structure (euphorbin-B)



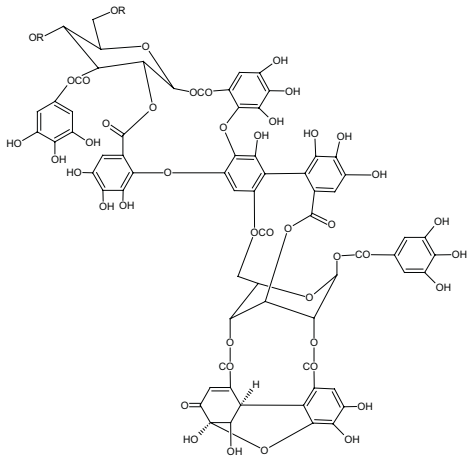
R - Galloyl



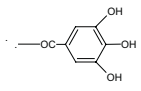
VIII. Basic structure (euphorbin-C)



RR ^{1} = (S) – HHDP (hexahydroxydiphenoyl symmetric)



IX. Basic structure (euphorbin-D)



R- Galloyl

Figure 1: Structures of some constituents present in *E. hirta*

Antidiarrheal activity

The antidiarrheal effect of the herb decoction was studied in mice. It demonstrated an activity in models of diarrhea induced by castor oil, arachidonic acid, and prostaglandin E_2.[10] Quercitrin, a flavanoid glycoside isolated from *E. hirta*, showed an antidiarrheal activity, at a dose of 50 mg/kg, against castor oil and prostaglandin E_2-induced diarrhea in mice.[11]

Antioxidant activity

The aqueous extract of *E. hirta L.* showed an antioxidant effect and a free radical scavenging activity in various *in vitro* models like total antioxidant and total ferric reducing power determination, assay for free radical-scavenging activity using ABTS, DPPH, and hydroxyl radical scavenging assays. It showed maximum antioxidants and free radical scavenging

activities, at 0.25 mg/ml. The free radical scavenging effect on DPPH and hydroxyl was found as 68.80 ± 5.21 and 73.36 ± 5.21%, respectively.[22]

Antifertility activity

E. hirta at a dose of 50 mg/kg reduced the sperm motility and density of cauda epididymal and testis sperm suspension significantly, leading to 100% infertility.[23]

Antiamoebic activity

The polyphenolic extract of *E. hirta* inhibited the growth of *Entamoeba histolytica* with a minimum active concentration of less than 10 μg/ml.[8]

Antifungal activity

An ethanolic extract of *E. hirta* showed an antifungal activity against plant pathogens *Colletotrichum capsici*, *Fusarium pallidoroseum*, *Botryodiplodia theobromae*, *Phomopsis caricae-papayae*, and *Aspergillus niger* using the paper disc diffusion technique.[24]

SUMMARY

In the present review, we have made an attempt to provide the mophological, phytochemical, ethnopharmacological, and pharmacological information on *E. hirta*, a herb used traditionally for medicinal purposes. The literature survey revealed that *E. hirta* contains afzelin, quercitrin, myricitrin, rutin, gallic acid, quercitin, euphorbin-A and ephorbin-B, euphorbin-C, euphorbin-D, β-amyrin, 24-methylenecycloartenol, β-sitosterol, heptacosane, n-nonacosane,[14,15] shikmic acid, tinyatoxin, choline, camphol, and quercitol derivatives containing rhamnose, and chtolphenolic acid.[6]

This herb shows antibacterial, anti-inflammatory, antimalarial, galactogenic, antiasthmatic, antidiarrheal, anticancer, antioxidant, antiferlity, antiamoebic, and antifungal activities. Further research is going on to find out more activities in constituents of *E. hirta*.

There are many other traditional uses of *E. hirta* in Ayurveda which serves as the basis for further studies. This review will definitely help the researchers to know its different properties.

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