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Unveiling The Medicinal Secrets Of Euphorbia Hirta: A Multifaceted Therapeutic Potential

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ABSTRACT : Euphorbia hirta Linn., commonly known as milkweed or the asthma plant, is a member of the Euphorbiaceae family widely used in traditional medicine. The plant contains various bioactive compounds**,** including flavonoids, triterpenoids, alkanes, amino acids, and alkaloids, responsible for its pharmacological properties. Traditionally, it has been employed to treat gastrointestinal disorders**,** respiratory ailments**,** and eye infections**.** Scientific studies have confirmed its antispasmodic, antidiabetic, anti-inflammatory, and anticancer activities. In Africa and Madagascar, decoctions of E. hirta are used to manage lung and respiratory diseases**.** Overall, the plant shows significant therapeutic potential**,** supporting its use in modern herbal medicine and future drug development.

Index Form : Euphorbia hirta, phytochemicals, traditional medicine, respiratory disorders, anti-asthmatic activity.

INTRODUCTION :

Euphorbia hirta Linn, commonly known as milkweed (Dudhi) or the asthma plant**,** is recognized by various names across different regions of the world. Members of the Euphorbiaceae family have been extensively studied for their phytochemical constituents, including flavonoids, triterpenoids, alkanes, amino acids, and alkaloids. Traditionally, E. hirta has been used in folk medicine for the treatment of various ailments such as gastrointestinal disorders (including diarrhea, amoebic dysentery, intestinal parasitosis, and peptic ulcers), respiratory conditions (such as asthma, bronchitis, hay fever, laryngeal spasms, and coughs or colds), and eye infections like conjunctivitis.[1]

Euphorbia hirta possesses antispasmodic**,** antidiabetic**,** anti-inflammatory**,** and anticancer properties. In Africa, decoctions prepared from this plant are traditionally used to treat lung disorders**.** In Madagascar, it is commonly employed to manage colds, fevers, coughs, bronchitis**,** and other respiratory ailments.[2]

Fig. No. 1 Gachwala Euphorbia Hirta[3]

DESCRIPTION :

Synonym - Asthma Weed, Snake Weed, Hairy Spurge, Ara Tanath

Biological Source - It consists of fresh and dried whole plant of Euphorbia hirta Linn

Family – Euphorbiaceae

Geographical Source –

- India
- Australia
- Africa
- North America
- Central & South America
- Pacific Island

Table No.1 -Taxonomical Classification of Euphorbia Hirta [4]

Kingdom	**Plantae**
Subkingdom	Viridiplantae
Division	Tracheophyta
Subdivision	Spermatophyta
Class	Magnoliopsida
Order	Malpighiales
Family	Euphorbiaceae
Genus	Euphorbia
Species	Euphorbia Hirta

Table No.2 – Common Name of Euphorbia Hirta [5]

Language	Name
English	Asthma Weed
Sanskrit	Dugdhika,Kshirini,Ksheerani, Svaduparni
Hindi	Dudhi
Telugu	Reddinanabrolu
Tamil	Amampatcharishi
Gujarat	Dudeli
Malayalam	Chittirappula,Nalapalai
Bengali	Barokheruie
Marathi	Dudhi,Mothidudhi
Malaysia	Ambin Jantin
Indonesia	Daun Biji Kcang
Philippins	Botobotonis
Thialand	Nam Nom Raatchasee

BOTANICAL DESCRIPTION :

Euphorbia hirta is a small, branched annual herb that grows prostrately. Its branches can reach up to 60 cm in height and are reddish or purplish in color. The plant contains abundant milky latex and is covered with fine hairs. [6]

Leaves : The leaves are opposite, distichous, and simple, with linear stipules. The leaf blades are lanceolate-oblong, serrated, and may also be long-elliptic, obovate, or ovate-lanceolate in shape. The leaf base is distinctly unequal—one side being cuneate and the other obliquely rounded—while the apex is acute. The leaves measure about 3–4 cm in length and 1–1.4 cm in width. The margins are finely toothed, and sometimes a purple blotch appears near the midrib.[7]

Fig. No. 2 Leaves

Flowers : The inflorescence of Euphorbia hirta is monoecious and occurs in terminal or axillary clusters known as cyathia, which are finely arranged into a cyme. Both male and female flowers are enclosed within a single involucre and lack petals. The flowers are unisexual—male and female flowers are separate but occur together in the same inflorescence. The male flowers are sessile, with linear and fringed bracteoles, lack a perianth, and contain a single stamen. The female flowers have a short pedicel, a rimmed perianth, and a superior ovary covered with fine hairs. The ovary is three-celled, bearing three small styles with bifid (two-lobed) apices. Flowering generally occurs throughout the year.[8]

Fig. No. 3 Flowers

Stem : The stems are slender, hairy, and elongated, exhibiting a monopodial branching pattern. The internodes measure about 2.5 to 3 cm in length. Stipules are present and covered with fine pubescence. [9]

Fig. No. 4 Stem

Root: The plant possesses a well-developed primary root system, characterized by a distinct taproot. [10]

Fig. No. 5 Root

TRADITIONAL & MEDICINAL USES :

The plant Euphorbia hirta has been widely used in traditional medicine across various cultures. It was officially listed in the Chinese Pharmacopoeia in 1977. Among the Yao people of China, the whole plant is used for treating bronchitis. A decoction made from the dried plant is applied externally to burns and scalds, while freshly crushed leaves are used to treat skin diseases. The Zhuang community in China uses decoctions or tinctures of E. hirta to manage asthma, chronic bronchial conditions, and emphysema. The Dai people employ it to promote milk secretion and relieve cough.

Traditionally, E. hirta has been extensively used for the treatment of cough, kidney stones, abscesses, and bronchial asthma. It is also utilized to prevent and cure gastrointestinal ailments, disorders of the mucous membranes, and respiratory system infections. In Nigeria, cold leaf extracts are commonly used for bathing infants suffering from skin infections. Ethnomedicinal literature further reports its use to enhance lactation in women and to manage various ailments.[11]

PHYTOCHEMISTRY :

Phytochemical analyses of Euphorbia hirta have revealed the presence of flavonoids, sterols, tannins, and triterpenoids in its bark and leaves.

Flavonoids : Two major flavonoids—quercitrin and myricitrin—have been isolated from E. hirta. In general, flavonoids are known for their diverse medicinal properties, including anti-inflammatory, antioxidant, anti-allergic, antibacterial, and antiviral activities. The most abundant flavonoid in E. hirta is quercetin, which has been identified as the principal compound responsible for alleviating the inflammatory component of asthma.

Flavonoids are believed to provide beneficial effects in numerous diseases, including asthma. Their biological activities are largely attributed to their antioxidant capacity—either through direct reduction reactions or by modulating intracellular redox balance. Moreover, flavonoids can interact selectively with the mitogen-activated protein (MAP) kinase signaling pathway, influencing various cellular responses.

Posssible Anti-Asthmatic effect of Quercitrin - Quercitrin (3-rhamnosylquercetin), a bioflavonoid found in E. hirta, possesses strong antioxidant and anti-inflammatory properties. Within the digestive system, quercitrin is converted into quercetin (3-O-α-L-rhamnopyranoside), its aglycone form. This converted product, quercetin, exhibits potent anti-inflammatory activity and is considered the key active constituent in E. hirta responsible for its anti-asthmatic effects.[12]

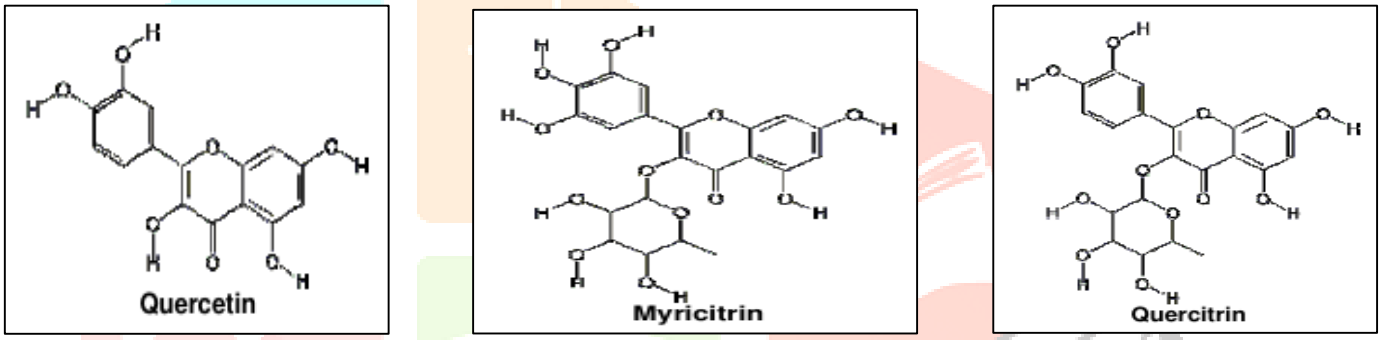

Fig. No. 6 Phytochemistry [13]

PHARMACOLOGICAL ACTIVITIES :

1. **Anti-Asthmatic Activity –**

The antihistaminic activity of Euphorbia hirta extract was further evaluated in rats sensitized by subcutaneous injection of 0.5 ml horse serum along with 0.5 ml of triple antigen containing 20,000 million Bordetella pertussis bacteria. In rats treated with E. hirta extract at a dose of 50 mg/kg body weight, mast cell disruption was 29.80 ± 2%, while 71.20 ± 2% of mast cells remained intact. At a higher dose of 100 mg/kg body weight, 24.70 ± 2% disrupted and 81.10 ± 2% intact mast cells were observed, which was comparable to the standard drug prednisolone.

To determine whether the antispasmodic effect of Euphorbia hirta is myotropic or neurotropic, its activity was tested against contractions induced by cholinergic and histaminic agents, allergic reactions, and direct muscular action on smooth muscle (trachea). The results indicated that the plant extract exhibited a direct and completely reversible muscular action, with minimal or no relaxing effect on normal muscle. [14]

2. Anti-Inflammatory Activity –

The anti-inflammatory activity of Euphorbia hirta extract may be attributed to the presence of several bioactive compounds, including phytol, fatty acids, and 5-HMF, among others. Additionally, E. hirta contains other constituents with known anti-inflammatory potential, such as glucosides, tannins, and flavones, which have been previously reported to inhibit nitric oxide (NO) production. In the present study, multiple anti-inflammatory compounds, including 5-HMF, MA, and others, were identified in the E. hirta extract, suggesting that these constituents may contribute to its overall anti-inflammatory activity.[15]

3. Anti-Oxidant Activity –

The phytochemical composition of the extract was analyzed using GC-MS, and molecular docking studies were conducted to evaluate the antioxidant potential of its major phytochemical constituents against human peroxiredoxin 5. The ethanolic extract was found to be rich in bioactive compounds, containing total flavonoids and phenolic acids at concentrations of 0.18 ± 0.009 mg/mg and 0.38 ± 0.04 mg/mg of extract, respectively. The antioxidant activity showed an IC_{50} value of 95.1 ± 10 µg/ml.These outcomes may be further extended through toxicity analysis and could contribute to the development of potential therapeutic agents.[16]

4. Anti-Anaphylactic Activity –

The ethanolic extract of Euphorbia hirta (EH-A001) exhibited significant anti-anaphylactic activity. Oral administration of EH-A001 at doses ranging from 100 to 1000 mg/kg showed a preventive effect against compound 48/80-induced systemic anaphylaxis. Within the same dose range, EH-A001 also inhibited passive cutaneous anaphylaxis (PCA) in rats and active paw anaphylaxis in mice. Furthermore, EH-A001 demonstrated a suppressive effect on the release of TNF-α and IL-6 from anti-DNP-HSA–activated rat peritoneal mast cells. [17]

5. Anti-Diabetic Activity –

The present study aimed to evaluate the antidiabetic and in vitro free radical scavenging activities of the flower extract of Euphorbia hirta. Ethanolic and petroleum ether extracts (at doses of 250 and 500 mg/kg) were administered orally for 21 days to alloxan-induced diabetic mice, and blood glucose levels were measured using a glucometer. Treatment with the extracts led to a significant reduction in serum cholesterol, triglycerides, creatinine, urea, and alkaline phosphatase levels, while high-density lipoprotein (HDL) and total protein levels were notably increased.[18]

6. Anti-Cancer Activity –

In the present study, the in vitro anticancer activity of Euphorbia hirta was investigated. The objectives were to identify the presence of secondary metabolites through preliminary phytochemical screening and FTIR analysis. The ethanolic leaf extract of Euphorbia hirta was evaluated for its cytotoxic potential against Dalton's Lymphoma Ascites (DLA) and Ehrlich Ascites Carcinoma (EAC) cell lines using the Trypan Blue exclusion method and the standard MTT colorimetric assay.

The E. hirta leaf extract exhibited higher cytotoxicity against EAC cell lines compared to DLA cell lines, showing 59.67% cytotoxicity against EAC cells. The extract demonstrated a dose-dependent inhibition of cell proliferation and induction of apoptosis in carcinoma cell lines. The IC_{50} values of the ethanolic leaf extract were found to be 560.83 µg/ml for DLA cells and 384.7 µg/ml for EAC cells, respectively. These in vitro findings indicate that Euphorbia hirta possesses strong anticancer potential against both DLA and EAC cell lines.[19]

7. Anti-Viral Activity-

The antiretroviral activity of Euphorbia hirta extracts was evaluated in vitro using the MT4 human T-lymphocyte cell line. The cytotoxicity of the extracts was assessed through the MTT cell proliferation assay, followed by testing the direct effects of the aqueous extract on the reverse transcriptase (RT) activity of HIV-1, HIV-2, and SIVmac251. A dose-dependent inhibition of RT activity was observed for all three viruses.

Further studies on the HIV-1 inhibitory potential of E. hirta compared the activities of aqueous and 50% methanolic extracts. The 50% methanolic extract demonstrated stronger antiretroviral activity than the aqueous extract. This methanolic extract was then fractionated using liquid-liquid partitioning with dichloromethane, ethyl acetate, and water. Among the fractions, only the residual aqueous phase exhibited significant antiviral activity, while the lipophilic fractions were inactive. Notably, after removing tannins from the aqueous extract, the inhibitory effect on viral replication was considerably reduced, suggesting that tannins are likely the main contributors to the strong antiretroviral activity of Euphorbia hirta.[20]

8. Anti-Bacterial Activity –

The antibacterial activity of both ethanol and aqueous extracts of Euphorbia hirta was evaluated against several pathogenic bacteria, including Escherichia coli, Haemophilus influenzae, Klebsiella pneumoniae, Proteus vulgaris, Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella typhi, and Shigella dysenteriae. The agar diffusion method was employed to assess the antibacterial effects of the extracts, while the minimum inhibitory concentration (MIC) was determined using a graphical approach.

The antibacterial sensitivity tests revealed that E. hirta extracts inhibited the growth of all tested microorganisms to varying extents. However, only a minimal or no zone of inhibition was observed against Haemophilus influenzae, indicating limited effectiveness of the extracts on this particular pathogen.[21]

9. Anti-Diarrhoeal Activity –

The antidiarrhoeal activity of the whole plant of Euphorbia hirta was evaluated. The lyophilized decoction exhibited significant antidiarrhoeal effects in experimental models of diarrhoea induced by castor oil, arachidonic acid, and prostaglandin E_2. However, it showed no activity against diarrhoea induced by magnesium sulphate. The decoction also delayed small intestinal transit that was accelerated by castor oil but had no effect under normal conditions. From the crude extract, a flavonoid compound, quercitrin, was isolated and identified as the active component responsible for the antidiarrhoeal activity.[22]

CONCLUSION :

Euphorbia hirta as a medicinally significant plant possessing diverse pharmacological activities supported by traditional and scientific evidence. Phytochemical investigations reveal the presence of flavonoids, tannins, sterols, and triterpenoids, which contribute to its wide range of therapeutic properties. Various studies confirm its anti-asthmatic, anti-inflammatory, antioxidant, anti-anaphylactic, antidiabetic, anticancer, antiviral, antibacterial, and antidiarrhoeal activities. Among its bioactive constituents, flavonoids such as quercitrin and quercetin play a major role in modulating inflammation and oxidative stress.Overall, Euphorbia hirta demonstrates strong potential as a natural source for developing novel herbal formulations and nutraceuticals. Further studies on its toxicity, dosage standardization, and clinical evaluation are recommended to validate its safety and efficacy for therapeutic use.

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