



# CHARACTERISTICS OF *Euphorbia hirta*: A REVIEW

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**Abstract:** The oldest treatment known to humans are from medicinal plants. India is known for its heritage in traditional medicine and Ayurvedic treatments. Curing diseases and infections using traditional methods has been as old as human civilization. Different parts of the plant parts proved to be valuable since it contributed towards some applications. The whole plant is found to have many medicinal properties, particularly leaves and seeds. Based on their curative ability, medicinal plants are categorized according to their biologically active compounds obtained from different plant parts like stem, roots, shoots, leaves, flowers or buds. Medicinal plants are considered as a rich source of ingredients which can be used in drug development. Some plants are considered as important source of nutrition and as a result of that they are recommended for their therapeutic values. Among thousands of species present, *Euphorbia hirta* is a valuable plant with traditional values, of family Euphorbiaceae. It is used to cure pimples, female disorders, respiratory ailments (cough, asthma, coryza and bronchitis), dysentery and tumors. *E. hirta* contains compounds like phytosterols, flavonoids and tannins. The current review article portrays the medicinal properties, chemical constituents, methods of extraction of phytochemicals highlighting *E. hirta*.

**Key Words:** *Euphorbia hirta*, Phytochemicals, Ayurvedic, Anti Wound Healing activity, Anti Venom Activity.

## I. INTRODUCTION

Medicinal plants are considered as the backbone of traditional medicine (Swathisri, S and Palaniswamy, R, 2019). They are used to maintain human health and enhance the quality of human life since decades. During the recent times, the humans explored the plants rich in bioactive compounds. It is understood that different plants possess different kinds of chemical compounds which has immense therapeutic value to cure human ailments (Hussain, A, 2011). Plants are the source of global food and medicinal supply based on the selection of phenotype and genotype (Ebert, A W and Engels, J M, 2020). Medicinal plants having one or more of its parts contains substances that can be used for therapeutic uses (Sofowora, A et al 2013). It is noted that around 60-85% of the human population in every country of the developing world depends on traditional medicine. Use of traditional medicine to cure diseases is widespread in China, India,

Japan, Pakistan, Sri Lanka, Thailand, and Korea (Jima, TT and Megersa, M, 2018). In addition, some plants are considered as important sources of nutrition and as a result of that these medicinal plants are also consumed for dietary purposes (Mani and Shankar, 2016).

### 1.1 *Euphorbia hirta* :

It is used to treat wounds for over 5000 years by Egyptians, Romans, indigenous people of Africa Asia and America (Garcia-Orue, I, 2017). The roots of *Astragalus propinquus* and *Rehmannia glutinosa* are encouraged for diabetic wound healing and postischemic neovascularization (Yudharaj, P, 2016). *E. hirta* has gained popularity for its medicinal importance among the tribal population. It is commonly used to heal the wounds; However, *E. hirta* is often used traditionally for female disorders, worm infestations in children, dysentery, jaundice, pimples, gonorrhea, digestive problems and tumors (Kausa, J et al 2016). The largest genus of family Euphorbiaceae is Euphorbia with about 1600 species. Latices of *E. ingens*, *E. mey*, *E. tirucalli*, and *E. triangularis* are possible sources of rubber. This plant has been subjected to intense phytochemical examination and many compounds have been isolated that has paved way to understand the therapeutic value of this plant (Kumar, S et al 2010).

### 1.2 Taxonomic classification



Figure 1: Leaves of *E. hirta*

**Kingdom** – Plantae **Subkingdom** – Viridiplantae **Infrakingdom** – Straptophyta **Division** – Tracheophyta **Subdivision** – Spermatophytina **Infradivision** – Angiosperms **Class** – Magnoliopsida **Superorder** – Rosanae **Order** – Malpighiales **Family** – Euphorbiaceae **Genus** – *Euphorbia* **Species** – *hirta*.

**Local names of the plant:** Since it is grown in various parts of the country, each state has recognized this plant and the local names are as follows: In **English**, it is commonly called as Asthma Weed, Dove milk, Common spurge, Cats hair **Hindi:** Bara dudhi **Tamil:** Ammam Paccharisi **Malayalam:** Nelapalai **Telugu:** Nanabalu **Kannada:** Hachchedida, Kempuneneak kisoppu, Accheche **Bengali:** Barokarni **Nepali:** AnkhleJhaar, Dudhe, DudheJhaar, Dudhiyaa, Raato Maase Laharaa, RaatoLahare Ghaans, Chimphar Jhaar, JotaneJhaar **Assamese:** Gakheerotee bon **Mizo:** Zawhte-hlo.

**Description:** *E. hirta* is a small annual herb. Usually it grows on roadsides, grasslands, pathways, rice field and as a weed of cultivation and is also found in areas rich in water. It is widely distributed in pan-tropic, partly subtropic areas and worldwide like different parts of Australia, Central America, Africa, Indomalaysia, Philippines, China and India. It is native to Central America (Burkill, HM, 1985). Grows upto 80 cm in height and it has slender and erect stem. *E. hirta* has broad, oblong leaf arranged opposite to one another on a hairy. The fruits are yellow in colour with 1-2 mm in diameter that has wrinkled seeds along the four sides with hairy capsules (Tuhin, RH et al 2017).

**Traditional Uses:** Commonly *E. hirta* plant is used to treat many ailments like gastro intestinal disorders, respiratory diseases like cough, cold, asthma, bronchitis, hay fever, emphysema, various ocular ailments, skin and mucous membrane problems (guinea worm, scabies, tinea, trush, aphtha) and tumour. In south India, it is used as ear drops and as a treatment for wounds. The latex of the plant is often used for warts and cuts to prevent pathogen infection. A decoction of leaves induces milk flow and the leaf chewed with palm kernel is used for restoration of virility. It is also used to treat ulcers and is also eaten as a vegetable (Asha, S et al, 2016).

**Phytochemical Constituents:** Phytochemicals are bioactive compounds present in the plants, formed during the normal metabolic process. Various bioactive compounds like alkaloid, tannin, quinone, flavonoid, cardiac glycosides, coumarins, phlobatannin, steroid and phytosteroid, terpenoids and phenols are reported

to be present (Kalpana Devi, R et al, 2014). These phytochemicals are natural and non-nutritive bioactive compounds produced by plants that act as protective agents against environmental stress and pathogenic attack. The medicinal values of all plants are embedded in their phytochemical components (Biradar, YS et al, 2007). In the recent times, the need for growing medicinal plants and products has escalated across the globe indicating its demand worldwide. Many secondary metabolites and its unidentified components are investigated as a source of medicinal agents (Krishnaraju, AV et al, 2005).

*E. hirta* plants produce bioactive compounds like polyphenols, flavonoids, steroids, tannins and alkaloids (Asha, S et al, 2016). In a phytochemical characterization study on the aerial part of *E. hirta*, after extracting and purification by chromatographic techniques, it was found to contain 9 different compounds that were isolated (Wu, Yi et al, 2012).

## II. METHODS FOR PLANT EXTRACT PREPARATION:

Extraction of medicinal plants is an initial process of separating the biologically active compounds or secondary metabolites from the mixture of compounds. For this purpose, different types of steps are followed (Caruthers, SD et al, 2007). Medicinal plants are extracted and analysed for direct consumption as herbal or traditional medicine or prepared for research purposes (Ingle, KP et al, 2017). Preparation of plant extracts for experimental purposes demands the proper and timely collection of the plant samples, adequate drying and grinding and finally authentication by an expert (Azwanida, NN, 2015). Secondary metabolites such as alkaloids, flavonoids, terpenes, saponins, steroids and glycosides from inert or inactive material using different types of solvent and standard extraction procedure was also carried out successfully when the leaves of *E. hirta* were used (Pandey, A and Tripathi, S, 2014).

Different methods are applied for the extraction of medicinal plants like maceration, infusion, decoction, percolation, digestion and Soxhlet extraction, superficial extraction, ultrasound-assisted and microwave-assisted extraction. In addition, Thin-Layer Chromatography (TLC), High-Performance Liquid Chromatography (HPLC), Paper Chromatography (PC), and Gas Chromatography (GC) are used for the separation and purification of secondary metabolites (Sasidharan, S et al, 2011).

### 2.1 Solvent Extraction:

**Water:** It is a polar solvent which is universally used all over the world. Water dissolves numerous compounds and is non-toxic in nature (Das, K et al, 2010). **Chloroform:** It is a non-polar solvent and is used to extract the phytochemicals like terpenoids, flavonoids, fats, and oils (Tiwari, P et al, 2011). It is soluble in alcohol and is colorless and sweet smelling (Cowan, MM, 1999). **Ether:** This is non-polar in nature and used to extract bioactive compounds like alkaloids, terpenoids, coumarins, and fatty acids (Cowan, MM, 1999). It has a low boiling point, miscible in nature, colorless and stable by nature (Majekodunmi, SO, 2015). **Methanol:** It is a polar solvent, found to be highly efficient in extraction of lower molecular weight polyphenols (Dai, J, Mumper, RJ, 2010). **Ethanol:** It is a polar solvent. Generally used to extract polyphenol and is safe for human consumption (Do, QD et al, 2014).

### 2.2 Methods used for phytochemical extraction:

Some of the common methods used are described in the following paragraphs.

**Soxhlet extraction:** This technique is also known as continuous hot extraction made of glass (Hossain, MA et al, 2014). Superior quantity of compound is extracted by using less amount of solvent and no filtration is needed and also high amount of heat is used for this process (Harborne, JB, 1998). **Infusion:** It is an extraction process where the plant material is ground into powder form and addition of solvent assists in the extraction of bioactive compounds (Sasidharan, S et al, 2011). It is an efficient method for extraction of highly soluble bioactive compounds from freshly prepared plant materials (Abubakar, AR, Haque, M, 2020). **Maceration:** It is a technique used for the production of wine and is also commonly used in medicinal plant research. It involves soaking of the plant material (crude or powder) in the solvent for 3 days with continuous agitation (Handa, SS, 2008). **Percolation:** Special apparatus or a percolator is used in this technique where the sample is dried and powdered. It is processed in moderate temperature to avoid evaporation of extracts (Azwanida, NN, 2015). **Decoction:** It is similar to maceration, uses the same principle. It is an effective method for heat-stable compounds, oil and for soluble compounds (Rathi, BS et al, 2006). **Reflux extraction:**

This method requires less amount of solvent and compared to others, it is an efficient method to extract compounds except thermolabile natural products (Zhang,QW et al,2018).

**2.3 Physical Methods:** Several physical methods are used for the separation process from the mixtures of compounds. Some of the methods are separation funnel method, fractional distillation, fractional crystallization and sublimation method (Doughari,JH.2012).

A. **Separation funnel method:** When different solvents are selected fractionation begins by dissolution of crude extract with water. Then it is transferred to the separating funnel, shaken and allowed to settle. Least polar solvent like n-hexane can be added and shaken. The content then settles and then the bottom of the separating funnel is opened to remove the liquid layer. Addition of n-hexane is continued until reasonable quantity of extract appears to be separated (Ingle,KP et al,2017).

B. **Fractional distillation:** This technique is used for separation or for purifying compounds from a given mixture. Generally it is used to separate hydrocarbons like crude oil, citral and eucalyptol. The purification varies based on their boiling process. When heat is applied, the compounds will evaporate and separate at their boiling point (Doughari,JH.2012).

C. **Sublimation:** This is a direct phase transition of a solid into a gas without first becoming a liquid, which takes place at temperature and pressure lower than that of the compound's triple point. The process of sublimation can be utilized to purify both organic and inorganic solids. During the purification technique, a solid is heated directly into the gas-phase(Kaplan,L et al, 1952).

D. **Fractional crystallization:** Generally most of the compounds present in the plant extract exist as crystals in nature. Separation process is performed via formation of crystals during concentration of an extract using heat or refrigeration (Ferraris,Q.Qian,MC.2021).

### III. MEDICINAL PROPERTIES OF *E. hirta*:

Adequate work has been done on the identification of the medicinal properties of *E.hirta* by many researchers. Due to the presence of rich source of phytochemicals in the plant, it has found a high place in the traditional medicine and can be used to cure many ailments<sup>[38]</sup>. In modern medicine, the plants plays very important role for the production of natural drugs which are effective medicines to treat various types of diseases<sup>[39]</sup>. Other than *E.hirta* different species or Euphorbia are used in traditional medicines. All species of Euphorbia release milky juice when it is broken, which is more or less poisonous and used as an ingredient in arrow poisons. *E.hirta* is known to possess antibacterial, anthelmintic, anti-asthmatic, sedative, antispasmodic, antifertility, antifungal and antimalarial properties (Williamson, EM. 2002).

The polyphenolic extract of *E. hirta* plant has antiamebic and antispasmodic activity (Tona,L et al,2000). Antidiarrheal activity was exhibited due to the presence of bioactive compounds like Quercitrin, a flavonoid glycoside present in the plant (Galvez,J,1993). The ethanolic extract of the whole plant was shown to possess hypoglycemic activity in rats(Sood,SK et al 2005).

- i. **Anti-Bacterial Activity:** Several plants were found to possess rich antibacterial activity due to the different phytochemicals that are present in them (Palaniswamy and R.Dhanyasri,S.2019). The antibacterial activity of *E. hirta* was identified and proven scientifically. The non-cytotoxic concentration of the plant extract was analysed and anti-bacterial activity was tested against the various types of the pathogen (Kumar,S et al,2010). The antibacterial activity of *E. hirta* was found by using cup plate method, one of the easiest and economic methods for identifying antibacterial activity of *E.hirta* (Saravanan,R et al,2012).
- ii. **Anti-Diabetic Activity:** *E. hirta* leaves made into an ethanolic and ethyl acetate extract were used to identify the anti-diabetic activity. It was performed under *in vitro* conditions using alpha glucosidase inhibitor method. Blood glucose level was identified in diabetic mice on treatment with ethanolic extract of *E.hirta* plant(Widharna,RM et al,2010). The effects of the treatment in the mice with all extracts and glibenclamide on blood glucose concentration in normal and diabetic mice was studied. It was analysed using the leaf, stem and flower extracts and identified the presence of antidiabetic activity compounds in *E.hirta* extract (Kumar,S.Kumar,D.2010).

- iii. **Anti-venom activity:** Snakebite is still a general medical concern in many of the tropical and sub-tropical Asian countries. World Health Organization has recently categorized snakebite as a neglected tropical disease which requires more attention from national and international health authorities (Gopi,K et al,2016). It was found that the methanolic extract of *E.hirta* can inhibit the venom enzymes in mice under *in vitro* conditions. Details were collected by the analysis of histopathology of the vital organs. It was concluded that due to the presence of compounds of ellagic acid, gallic acid and quinic acid, the extract has the ability to inhibit the venom proteases (Gopi,K et al,2016).
- iv. **Wound Healing activity:** Wound healing is a process of restoration of tissues and the re- growing of the damaged skin and tissues. It comprises a systematic movement of actions like inflammation, angiogenesis, proliferation and synthesis of collagen for the final process of healing (Ahmed,S et al,2016). Recent studies proved that the methanolic extract of *E.hirta* has the ability of wound healing and has high anti-microbial activity against *E.coli* (Upadhyay,A et al,2014). From the root and stem of the *E.hirta* extract, compounds like triterpenes showed to possess anti-microbial activity for common wound healing(Ragasa,CY and Cornelio,KB.2013).
- v. **Anti - malarial activity:** Malaria is a highly dangerous parasitic disease that affects people all over the world (Ashok,P et al,2013). It is treated with drugs like quinine, chloroquine, amodiaquine, mefloquine, and artemisinin among others(Uzor,PF.2020). Mosquito larvicidal bioactive compound (saponin) was extracted from *E.hirta* and tested against *Culex quiquefasciatus*. II instar and IV instar mosquito larvae which was exposed to four different concentration of bioactive saponin. After 24 hours values were determined using probit analysis method. Obtained result confirms bioactive compound derived from *E.hirta* susceptible to II instar larvae compare to IV instar larvae (Neetu Arya et al,2011).
- vi. **Immunostimulatory activity:** The immune system including organs, cells and molecules plays important roles in preventing infections, maintaining homeostasis and monitoring abnormal cells (Aipire,A et al 2020). Polysaccharides derived from plants grabbed much attention due to their immunomodulatory activities and safety(Kikete,S et al,2018). It was analysed that the effect of bronchodilator using alcoholic extract of *E. hirta* with different doses induced bronchodilation (KarpagamKumaraSundari,S et al, 2004).
- vii. **Anti-thrombocytopenic activity:** Thrombocytopenia is a condition associated with a lower production of platelets than the normal numbers in the bone marrow (Anjum,V et al, 2017). The death occurs due to its adverse effects on liver and excessive bleeding (Ahmad,N et al,2011). The antithrombocytopenic effect of *E. hirta* leaf extract (lyophilized extract) in Sprague - Dawley rats and the bleeding time, clotting time and platelet count were analysed in four different groups of rats. The platelets count was increased and bleeding decreased which was a clear indication that the *E. hirta* plant extract (leaf decoction) acts as a potential antithrombocytopenic agent (Joveneio,G et al,2012).
- viii. **Antioxidant activity:** Plant related natural antioxidants are present in the form of leafy vegetables, fruits, seeds and algae that are used as a good source to produce a wide range of natural antioxidants (Radha Palaniswamy and Palghat Raghunathan Padma.2017). The potential scavenging abilities of the plants could be determined by methods like DPPH assay, ABTS, reducing power etc (Tran,N et al,2020). The methanolic extract of *E. hirta* (leaves, flowers, root and stem) antioxidant activity was tested in different aerial parts. It was shown to exhibit maximum amount of DPPH scavenging activity (72.96±0.78)% at 1mg/mL like flowers (52.45±0.66)% , roots (48.59±0.97)% , stem (44.42±0.94)% respectively. Antioxidant activity of the sample was measured spectrophotometrically using the DPPH at 517 nm (Basma,AA et al,2011).
- ix. **Anti-Cancer Activity:** Most of the traditional plants are rich in secondary metabolites and show diverse medical properties. Especially the plant sources rich in phenolics are promised to provide good antioxidant and anticancer activities. The phytochemicals inhibit the cytotoxic effect of the cells *in vitro* which has been proved in several studies and extended to *in vivo* experiments also. Extracts of *E.hirta* contain tannin, saponin, alkaloids and flavonoids. Experiments have proved that the chloroform and ethanol extract enhance the survival time and reduced hard tumor mass in mice (Aleksandrov,M et al,2019) indicative of the fact that the antitumor activity found in *E.hirta* is due to the presence of flavonoids(atil,SB and Magdum,CS.2011). The dried leaves in methanolic extract of *E. hirta* effectively inhibit the growth of human hepatocellular carcinoma lines SMMC-7721, BEL-7402, HepG2 and gastric

carcinoma cell line SGC-7901 and colorectal cancer cell line SW-480(Cheng,J et al,2015). These experiments are a clear indication that the activities possessed by the *E. hirta* leaf extract can be used as a potential anti cancer agent ( (Tran,N et al,2020).

- x. Anti-allergic activity:** Allergy is a common disease which spreads all over the world and its great prevalence makes allergic disorder a growing global concern(Kawai,M et al ,2007). Allergic reaction can be a life-threatening condition particularly in anaphylaxis and severe asthma (Thabet,AA. et al,2018)Anti-allergic studies were determined with 95% of ethanolic extract of aerial parts of the *E.hirta* which significantly inhibited rat mast cell degranulation. *E. hirta* extract suppressed the allergic compound and results of this finding proved *E.hirta* has significant activity for prevention of early and late allergic reactions (Singh,GD et al,2006).
- xi. Anti-Inflammatory Activity:** Many plants are having the anti-inflammatory property. Inflammation is a defence mechanism of our body against hazards like allergens or damage to the tissues (Bagad,AS et al 2013). Recent studies and research have reported that the extracts of *E. hirta* perform various pharmacological functions, acting as an anxiolytic, sedative and anti-inflammatory agent (Xia,M et al,2013). Anti-inflammatory activity of methanolic extract of *E. hirta* leaves were analysed by using xylene-induced ear edema and cotton pellet-induced granuloma formation method in mice which showed promising results for anti inflammatory action (Rahman,MS et al,2019).
- xii. Diuretic activity:** Many diuretics are identified and purified from medicinal plants as mentioned in ayurvedic system of medicine (Agrawal,SS et al,2009). *E. hirta* leaves proved to possess diuretic activity which was extracted with three different solvents (water petroleum ether, ethanol) (Johnson,PB et al,1999). Whole plant ethanolic extract proved to possess potential diuretic activity. It was also noted by the significant changes in pH and color of the urine output. *E. hirta* plant extract particularly increases the index of diuresis including urine volume, urination frequency, diuretic action, natriuretic and saluretic indices (Kanedi,M.2017).

#### IV. CONCLUSION:

Medicinal plants play an important role in the improvement of human life style. *E. hirta* is a traditionally valuable plant with high amount of potential for phytochemical and antioxidant properties. *E. hirta* has a large spectrum of therapeutic properties because of the presence of active compounds like polyphenols, flavonoids, steroids, tannins and alkaloids. These compounds are proved to treat diseases like female disorders, respiratory ailment (cough, coryza, bronchitis and asthma), worm infestations pimple, jaundice and tumors. Hence, from this review, it can be concluded that extract of *E.hirta* is useful for the development of commercial products in future instead of using synthetic drugs. The greatest advantage of using herbal medicine is that it does not possess any ill effects of side effects.

**V. CONFLICT OF INTEREST :** The authors do not express any conflict of interest with regard to this review paper.

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