*Original Article*

*Bulletin of Pure and Applied Sciences.*
*Vol.37 B (Botany), No.2. Jan-Jun 2018: P.20-26*
*Print version ISSN 0970 4612*
*Online version ISSN 2320 3196*
*DOI : 10.5958/2320-3196.2018.00002.2*

# *EUPHORBIA HELIOSCOPIA* L: PAST, PRESENT AND FUTURE PROSPECTS

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**Received on** 13.03.2018,
**Accepted on**. 20.03.2018

**Abstract**

Sun spurge (*Euphorbia helioscopia* L., Euphorbiaceae family) is an annual plant, native to most of northern Africa, Europe and eastward through most of Asia. It emerges from November to December and invades winter crops and vegetables, such as wheat, lentil, chickpea, potato, and pea. The flowers are hermaphrodite (have both male and female organs) and are pollinated by flies. Seedlings of *E. helioscopia* L exhibit epigeal germination. This plant showed various types of biological activities such as an antitumor, antiviral, antibacterial, nematicidal, an antifungal and molluscicidal effects. The presence of secondary metabolites revealed that the plant *Euphorbia helioscopia* L can be used in future for finding various biological potential for prevention of various human diseases.

**Keywords**: *Euphorbia helioscopia* L, Phytoconstituents, Biological activity, Secondary metabolites

## INTRODUCTION

The *Euphorbia* is the largest genus in the plant family Euphorbiaceae, comprising about 2,000 known species (Jassbi, 2006). *Euphorbia* are widely distributed throughout both hemispheres and range in morphology from large desert succulents to trees and even some small herbaceous plant types. Researched parts in various *Euphorbia* species include the roots, seeds, latex, lactiferous tubes, stem wood, stem barks, leaves, and whole plants. Many studies have suggested that these plants have not only therapeutic relevance but that they also display toxicity (Hohmann, 2004). Some constituents of *Euphorbia* species may be promising lead compounds for drug development. Certain *Euphorbia* species have been reported to possess antitumor activity and have been recommended for use as anticancer remedies (Ahmad *et al*., 1988; Duarte *et al.* 2006). Their antitumor activity was mainly attributed to the

presence of abietane diterpene derivatives, most of which contain lactone structures reported to possess potent antineoplastic activity towards various cancer cell lines (Duarte and Gyémánt, 2008; Liu, 2002; Luo and Wang, 2006; Duarte and Loge, 2008; Kigoshi, 2001).Moreover, some *Euphorbia* species have been also used as medicinal plants for the treatment of skin diseases, gonorrhoea, migraines, intestinal parasites, warts and for mediating pain perception (Shi, 2008). Singla (1990, 2009), Appendino(1997) and many researchers have shown that *Euphorbia* species also possess antiproliferative activity (Xu *et al.;* 1998), cytotoxicity (Fatope, 1996), antimicrobial activity (Murugan *et al*.,2007),antipyretic-analgesic activity, inhibition of HIV-1 viral infection (Hezareh, 2005), inhibitory activity on the mammalian mitochondrial respiratory chain etc (Betancur-Galvis *et al*., 2003). Besides having beneficial importance, there are also some reports of toxicity in *Euphorbia* species. Their toxic substances originate from the milky sap, which is a deterrent to insects and herbivores. They may possess extreme proinflammatory and tumor promoting toxicities (Vogg *et al.,* 1999; Baloch *et al.,* 2005). Severe pain and inflammation can result from contact with the eyes, nose, mouth and even skin, which may be due to the activation of protein kinase C enzyme (The toxic constituents of *Euphorbia* species were considered to be a kind of specific diterpenes, globally called phorboids, which comprise tigliane, ingenane and daphnane diterpene derivative (Cateni *et al*., 2003, Kedei *et al.,* 2004; Zayed *et al*., 2001). Steroids, cerebrosides, glycerols, phenolics and flavonoids were also isolated from plants of *Euphorbia* ( Shi *et al*., 2009 ) but the compounds most relevant to the toxicity and considerable biological activities in *Euphorbia* are diterpenes, especially those with abietane, tigliane, and ingenane skeletons (Shi *et al.,* 2009). 13C-NMR data of these three important diterpene skeleton types of *Euphorbia* species, covering 42 abietanes, 51 ingenanes and 30 tiglianes and their structure activity relationship on the chemical shifts were also discussed (Qi-Cheng Wu, 2009). The plant lattices have been used as fish poison, insecticide and as ordeal poison. *Euphorbia* is stated to possess inflammatory, antiarthritic, antiamoebic, spasmolytic, antiviral, Hepato protective and antitumor activity (Tona *et al*., 2000; Shimura *et al*., 1990). The major classes of secondary metabolites present in *Euphorbia* species are alkaloids, terpenes, cyanogenic glycosides, glucosinolates, lipids and tannins (Hegnauer, *et al*., 1989).

Sun spurge (*Euphorbia helioscopia* L*,* Euphorbiacae family) is an annual plant rising 10 to 50 cm high with erected reddish stem, oval alternate leaves and small yellow green flowers. It is an indigenous plant of North Africa and most of the Europe and Asia (Blamey & Grey-Wilson, 1989). It emerges from November to December and invades winter crops and vegetables, such as wheat, lentil, chickpea, potato, and pea. It is in flower from May to October. The flowers are hermaphrodite (have both male and female organs) and are pollinated by flies. Clusters of flowers arise on short stiff stalks from the axils of the rosette of leaves at the apex of the stem. Each flower cluster consists of five leaf-like bracts, from the axils of which arise five short stalks, which again divide into three and then into two. Seedlings of *E. helioscopia* L exhibit epigeal germination. The hypocotyl is erect, smooth and about 1 cm tall. The cotyledons are smooth, oval and spreading. The epicotyl is short and carries pairs of oval juvenile leaves, 5-10 mm long. The whole seedling exudes white latex when injured.

*Euphorbia helioscopia* L has been considered as medicinal plant and was used in folk medicine of various countries around the world (Barla *et al*., 2006; Qureshi *et al*., 2007). A large number of secondary metabolites have been reported from sun spurge plant including diterpenoid, triterpenoid, tannins and steroid (Barla *et al*., 2006, Wu *et al*., 2009) which offered to sun spurge herb a wide array of bioactive functions. In fact, *Euphorbia helioscopia* L plant was reported to have an antitumor, a vasodepressor (Barla *et al*., 2006), an antiviral, an antibacterial (Al Younes and Abdullah, 2009), a nematicidal, an antifungal (Uzair *et al*., 2009) and a molluscicidal effects, the leaves and stems are used as febrifuge and vermifuge (Wu *et al*., 1991).The oil from the seeds has purgative properties, the roots are used as anthelmintic and the seeds mixed with roasted pepper has been used in the treatment of cholera (Panda *et al*., 2004).

## COMMON NAMES

Cat's milk, madwoman's milk, sun euphorbia, sun spurge, umbrella milkweed, wart spurge, wart weed, wartgrass, wartweed.

## ORIGIN

Native to Northern Africa (i.e. Algeria, Egypt, Libya, Morocco and Tunisia), the Azores, the Madeira Islands, the Canary Islands, Europe (i.e. Denmark, Finland, Ireland, the UK, Sweden, Norway, Austria, Belgium, Czechoslovakia, Germany, Hungary, the Netherlands, Poland, Switzerland, Belarus, Estonia, Latvia, Lithuania, Moldova, Ukraine, western Russia, Albania, Bulgaria, Greece, Italy, Romania, Yugoslavia, France, Portugal and Spain), western Asia, the Indian Sub-continent (i.e. northern India and western Pakistan), China, Vietnam, Japan, Korea and Taiwan) (Singh and Ishfaq,2017).

## HABIT AND HABITAT

This family occurs mainly in the tropics, with the majority of the species in the Indo-Malayan region and tropical America. A large variety occurs in tropical Africa, but they are not as abundant or varied as in these two other tropical regions. Common in cultivated ground throughout Britain to an altitude of 450 meters. However, *Euphorbia* also has many species in non-tropical areas such as the Mediterranean Basin, the Middle East, South Africa, and southern USA found in waste land and sunny fields. It is also found in the India, Pakistan, Bangladesh. In India, it is found in northern states, in Uttrakhand, Jammu and Kashmir, Himachal Pradesh and Punjab. This species is widely naturalised in the southern parts of Australia (i.e. in some parts of southern Queensland, in southern and eastern New South Wales, in southern and western Victoria, in Tasmania, in south-eastern and southern South Australia, and in the coastal districts of south-western Western Australia).

## BOTANICAL DISCRIPTION

It is an annual plant growing in arable land and disturbed ground. It grows to 10–50 cm tall, with a single, erect, hairless stem, branching toward the top. The leaves are oval, broadest near the tip, 1.5–3 cm long, with a finely toothed margin. The flowers are small, yellow-green, with two to five basal bracts similar to the leaves but yellower, flowering lasts from mid spring to late summer (Blamey & Grey-Wilson, 1989). Height of the plant is 15–40 cm (6–16 in.). Stem often base branched, sparsely hairy which containing latex. The radially symmetrical flowers are unisexual, with the male and the female flowers usually occurring on the same plant. The small male and female 'flowers' lack a perianth and are borne in groups in the centre of a bowl-like involucres (formed by fused bracts), the whole resembling a single lime green flower. Nectariferous glands in cyathia elliptically round, green, with no points. Subtending bracts obovate, like stem leaves. Stamens numerous and pistil of 3 fused carpel. Inflorescence a 5-branched compound umbel, branches first 3-branched then 2-branched. They can be monoecious or dioecious. The stamens (the male organs) can number from one to 10 (or even more). The female flowers are hypogynous, that is, with superior ovaries. The leaves are alternate, seldom opposite, with stipules. They are mainly simple, but where compound, are always palmate, never pinnate. Stipules may be reduced to hairs, glands, or spines, or in succulent species are sometimes absent. Fruits are about 3 mm (0.12 in.) long, 3-valved, glossy, glabrous capsule.

## PHYTOCHEMICAL STUDIES

The phytochemical analysis i.e. total lipids, total proteins and carbohydrates of crude powder showed that lipids and proteins contents were high (2.4% and 0.91% respectively) in pulverized stem while carbohydrate contents were high (78.27%) in pulverized leaves. Qualitative analysis by FTIR fingerprints and UV-scanning showed that stem and leaves of the plant contained the same constituents because their spectra are super-imposable. Quantitative analysis was done by calculating the primary and secondary metabolites (total proteins, total glycosaponins, total alkaloids, total flavonoids, and total polyphenolics) in all the organic extracts using suitable markers. Chloroform

gave very less percentage yield and nil primary metabolites so it was eliminated from secondary metabolites estimation. The maximum value of total proteins, total glycosaponins, total alkaloids, total flavonoids and total polyphenolics were found in the leaves methanol (36.56%), stem methanol (34%), stem ethanol (41.84%), leaves methanol (108.96%), and leaves petroleum ether (7.22%) respectively. Different pharmacological activities of the plants are due to their flavonoid contents (Singh and Isfaq, 2017).

## CHEMICAL CONSTITUENTS

*E. helioscopia* L contains 4 esters, the jatrophone- type diterpenoids euphoheliosnoid A,B,C of 12-deoxyphorbol(12 Deoxyphorbol-13-phenylacetate -20 acetate, 12- deoxy phorbol-13-do dec-dienoate-20-acetate can be isolated from the fresh aerial parts. These substances are the major skin irritants found in the plant (Schmidt, 1980). m-hydroxy phenylglycine and 3,5 dihydroxy phenylglycine are two amino acids that can be isolated from the latex of *E. helioscopia* (Müller,1968).Hydrolysable tannins can be found in *E. helioscopia*. Helioscopinin A, helioscopinin B, helioscopin A and helioscopin B can be found together with the other tannins corilagin, punicafolin, geraniin, elaeocarpusin, furosin, terchebin, mallotusinin, carpinusin **(** Lee,1990, Zhang *et al*., (2005; 2006). Helioscopinin -A shows anti-allergic and anti asthmatic activities in guinea pigs. It is suggested that this compound exerts its activities through antagonism on leukotriene D4 induced responses (*Park,* 2001; Shi *et al*., 2005; Shi and Kiyota, 2008*).*

## BIOLOGICAL ACTIVITY

In traditional Tunisian medicine, sun spurge has been used as treatment of warts through local applications of the latex on the infected area. A large number of secondary metabolites have been reported from sun spurge plant including diterpenoid, triterpenoid, tannins and steroid (Yamamura *et al*., 1989; Lee *et al*., 1990; Barla *et al*., 2006, Wu *et al*., 2009) which offered to sun spurge herb a wide array of bioactive functions. In fact, *Euphorbia helioscopia* L plant was reported to have an antitumor, a vasodepressor (Barla *et al*., 2006), an antiviral, an antibacterial (Al Younes and Abdullah, 2009), a nematicidal, an antifungal (Uzair *et al.,* 2009) and a molluscidal effects. Moreover, *Euphorbia helioscopia* L was reported to have antioxidant proprieties. Some of the important biological activities are as follows:

***Antioxidant Properties****:*

Sun spurge plants (*Euphorbia helioscopia,* L) were collected from the north of Tunisia. Dried plant parts namely flowers, leaves and stem were individually extracted with methanol and ethanol. Extracts were screened for their antioxidant activity using the 1,1-Diphenyl-2-picrylhydrazyl (DPPH) free radical test. Total phenolics and total flavonoids amounts were also measured. The highest radical scavenging effect was observed in flowers methanolic extract with IC50 value of 26.66 ± 0.000µg/ml. While, relatively poorer antioxidant activity were observed in the same extracts of leaves and stem with respective IC50 values of 65.25 ± 0.004 and 80.17± 0.012 µg/ml. Polyphenols and total flavonoids amounts varied in significant way among tested aerial parts of *Euphorbia helioscopia* L and among two used solvents, the highest phenolics and flavonoids contents were found in methanolic flowers extracts (51.49 ± 0.012 mg GAE / g dry weights, 11.38 ± 0.004 mg QE / dry weight respectively). However, ethanol extract of stem gave the lowest amounts of total phenolics and flavonoids (4.80 ± 0.001 mg GAE / g dry weight and 1.69 ± 0.001 mg QE / dry weight respectively) (Uzair *et al*., 2009).

***Allelopathic potential:***

Studies investigating the allelopathic effect of root, stem, leaf, and fruit water extracts and infested soil of *Euphorbia helioscopia* L. on the seed germination and seedling growth of wheat, chickpea, and lentil were conducted in a completely randomized design with 4 replications. Water extracts of root, stem, leaf, and fruit were prepared by soaking dried plant parts of *E. helioscopia* L in water (1:20 w / v) for a period of 24 h. Seedling emergence, seedling vigor index, and total dry weight of wheat, chickpea, and lentil seedlings were significantly reduced when these crops were grown in soil taken from an *E. helioscopia* L infested field compared to soil collected from an area free of any vegetation. *E. helioscopia* L infested soil also significantly decreased the root length of wheat and lentil, and shoot

length of lentil compared to the control soil. Water extracts of various organs of *E. helioscopia* L significantly decreased the seedling vigor index and growth of test crops. Leaf extract had a greater inhibitory effect than the other extracts. Water extracts from the root, stem, leaf, and fruit of *E. helioscopia* L resulted in a reduction in the seed germination (chickpea and lentil only) and germination index but the leaf extract increased the mean germination time in all test crops.

***Anti-Leishmanial Activity:***

*E. helioscopia* L has anti leishmanial activity with LC 50 value ≤ 10 ug/ml. The standard error for the test plant extract and positive control was calculated with 95% confidence interval having significance value of 0( Naveeda *et al*., 2014).

***Vasodepressor Activity:***

From the aerial parts of *Euphorbia helioscopia* L. (Euphorbiaceae), a jatrophane diterpene ester, 5,11-jatrophadiene-3-benzoyloxy-7,9,14-tri-acetyloxy-15-ol and 2 lupane derivatives, lup-20(29)-ene-3-acetate and lup-20(29)-ene-3-palmitate, together with common triterpenoids of Euphorbiaceae, 24-methylenecycloartanol, 24-methylenecycloart-3-one, cycloartanol, and stigmast-4-ene-3-one were isolated. The last compounds, lup-20(29)-ene-3-acetate, 24-methylene cycloartanol, 24-methylenecycloart-3-one, cycloartanol, and stigmast-4-ene-3-one, were isolated for the first time from *E. helioscopia* L. The fractions and the isolates were tested for their vasodepressor activity using Wistar Albino rats, and 5,11-jatrophadiene- 3-benzoyloxy-7,9,14-tri-acetyloxy-15-ol, lup-20(29)-ene-3-acetate, and stigmast-4-ene-3-one were found to possess relevant activity. The structures of all of the compounds were identified with spectroscopic methods. The detailed spectroscopic data of compound **1** is given in the present study ash (Barla, 2006).

## FUTURE PROSPECTIVES

*Euphorbia helioscopia* L has been considered as medicinal plant and was used in folk medicine of various countries around the world (Barla *et al*., 2006; Qureshi *et al*., 2007). *Euphorbia helioscopia* L. whole plant has great medicinal importance, the leaves and stems are used as febrifuge and vermifuge (Wu *et al*., 1991).The oil from the seeds has purgative properties, the roots are used as anthelmintic and the seeds mixed with roasted pepper has been used in the treatment of cholera (Panda *et al*., 2004). A large number of secondary metabolites have been reported from sun spurge plant including alkaloids, flavonoids, cardiac glycosides, carbohydrates, saponins, tannins and triterpinoids. The presence of these secondary metabolites revealed that the studied plant *Euphorbia helioscopia* L can be used in future for finding various biological potential like antimicrobial activity as the synthetic antibiotics have several side effects along with its antioxidant ability.

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