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Potential use of Tawa Tawa: A Schematic review of literature

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Abstract

Euphorbia hirta is an annual herb belongs to Euphorbiaceae family. It has been found at warm and tropical regions mostly on roadsides and waste land throughout the world and used as traditional medicines. Tawa tawa contains lycosidal substance, terpenoids, tannin, phorbic acid, fatty acids and sterols, Flavonoids including quercitrol, quercetin, and its derivatives. The extent or amount of these chemical constituents varies in different parts of the tawa tawa plant and also depends on soil and climate condition. Recently published reports showed that tea of tawa tawa plant is helpful as anti-malaria and anti-dengue. *Euphorbia hirta* has been used for the remediation of respiratory disease, some female disease and also other such as dysentery, jaundice, gonorrhoea, pimples, tumors, digestive problems and children infections.

Key words: Euphorbiaceae, Flavonoids, derivatives, jaundice, Medicines

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1. Introduction

Tawa-Tawa (*Euphorbia hirta* L.) is an annual plant which belongs to Euphorbiaceae family. Euphorbiaceae is one of the large families of angiosperms that comprises of 300 genera and about 7500 species. Almost all members of this family comprise of herbs some are trees and shrubs. Certain species of these genera are xerophytes. Euphorbiaceae Family is widely dispersed in both hemispheres with variety of morphological arrangement, from trees to largest desert lush herbs. The most varied genera in plant kingdom are *Euphorbia*. Plants of *Euphorbia* may also be perennial herbs, possess trees or woody shrubs with corrosive and poisonous latex. The roots of tawa tawa are thick and some other plants have fine, tuberous or fleshy. Numerous species are relatively thorny, succulent or unarmed. In luscious species the leaves are frequently short-lived and small. *Euphorbia hirta* L. is a remedial, rhizomatous plant scattered in south west Ghats of Asian country India and north east Coastline of Tamil Nadu. *Euphorbia hirta* L. is a recognized as a therapeutic herb with numerous pharmacological outlines. Tawa-tawa is small, annual (yearly) plant have hairy stems and fruits of yellow colour [1]. *Euphorbia hirta* is known by various names which are given in different countries of the world, according to their language. In English is typically called snake weed. In India and Pakistan, it is called Dudhi or Dudhani. Other vernacular names of *Euphorbia hirta* are Sheer jiyah, Dhudi Kalan (Unani), Raktavinduchada (Sanskrit), asthma weed, milk weed, cat's hair (Australian), Brokeruee, Barakeru (Bengali), Tawa-Tawa (Kinaray), Nanbala, Bidarie (Telugu), Nayeti, Goverdhan, Dudhali (Mah) and Amumpatchaiyariss (Tami). In China, it is called Feiyangcao, Jiejiehua, Dafeiyang and Daruzhicao; in Malaysia: kelusan, Ambin jantan; in Indonesia: Daun biji kacang, in Papua New Guinea: kiki kana kuku, in Philippines: Botobotonis, (Tagalog), gatas-gatas; in Laos: ungl yang, Mouk may; in Thailand: Nam nomraatchasee (central), yaa nam muek; in French: euphorbepilulifere, Euphorbea fleusentete, in Liberia: tuagbono and in Norway: Demba sindji. Various floras of this are of great economic value. Mostly species are causing sickness, poisonous, or even death if swallowed. Dermatitis, the skin diseases is also produced by several species of Euphorbiaceae including tawa tawa, if liquid or juice of these plants gets contact to the skin. The rain water when even dripping from the certain herbs is sufficient to cause skin diseases like dermatitis.

2. History/origin

It is a native to India, subtropical and tropical regions of Africa, Asia and Central in addition to South America. This is broadly dispersed in the Philippines, from sea level to an altitude of 500 meters. This weed also arises in Indonesia, Borneo and New Guinea.

3. Location/demography

Euphorbia hirta mostly cultivates in the areas of lowland, gardens, paddy fields, waste places and road sides. Dry environmental condition is favourable for the better

growth of tawa tawa [2]. Warm climate is the key parameter for the growth of the Tawa tawa [3].

4. Botany, Morphology, Ecology

Several species of *Euphorbia* are succulent. The central stem of tawa tawa and other side branches of this species are fleshy and thick, 6- 36 inches (15-91 cm) tall. It is branched frequently four angled, covered with long yellowish hairs. The short leaves are elliptical, opposite, oblong or oblong-lenceolate, alternate or in whorls with a slightly toothed or rough margin, pale beneath and dark green on upper side. Base of the leaves of this plant is commonly unequal, rounded or acute. The main veins are 3-4 and distinct. The petioles are short in length about 2-3mm with long stipules pectinate. Leaves are mostly short-lived and small in succulent species. The stipules are generally small, somewhat changed into glands or spines. Flowers are numerous, small and crowed together in thick cymes having one cm diameter [4]. Just like all members of Euphorbiaceae, flowers of *Euphorbia hirta* are unisexual. Male flowers of these plants are sessile, absent perianth along with fringed or linear bracteoles and own one stamen. The female flowers of the *Euphorbia hirta* have superior ovary, short pedicel, rimmed perianth, covered with tiny hairs, holds three styles, three-celled, and the apex is two-fid. The fruit of this plant is intensely three-lobed, covered in short hairs, base truncate and three-seeded. The seeds of *E. hirta* are oblong, slightly wrinkled, pinkish brown, four-sided prismatic, and caruncle absent. Duration of flowering of individual herb is generally throughout year [2].

5. Chemistry

5.1. Chemical composition

Euphorbia hirta contains tannin, lycosidal substance, fatty acids, Jambulol melissic acid, phorbic acid, eciphosterol, sterols, and small amount of alkaloids and sugars. Chemical composition varies with different season [5]. Aerial parts of *Euphorbia hirta* contain terpenoids. Study of leaves of this plant shows the presence of phytochemicals such as flavonoids, alkaloids, tannins, steroids, carbohydrates and glycosides. But fats, saponins and protein are absent [6].

5.2. Phytochemistry

Phytochemicals (secondary metabolites) are found in one or several parts of therapeutic plants. GC-MS analysis is generally used in order to find chemical profile [7-9]. Polyphenols including Gallic acid, 3,4-di-O-galloylquinic acid, 2,4,6-tri-O-galloyl-Dglucose, 1,2,3,4,6-penta-O-galloyl-β-D-glucose and myricitrin are present in this plant. Flavonoids that present in the tawa tawa plant are euphorbianin, quercitrin, leucocyanidol and quercitol. Phytosterols and triterpenes including β-Amyrin, 24-methylenecycloartenol and β-Sitosterol while tannin including tuphorbins. Furthermore, n-nonacosane and heptacosane are the Alkanes present in tawa tawa. The arial part comprising of triterpenes including taxaxerol, α-amyrin, friedlin, β- amyrin, and esters of it are 11α-oxidotaraxerol, 12α-oxidotaraxerol, cycloartenol, euphorbol hexacosoate and 24-methylene-cycloartenol. Roots of tawa tawa plant possess components such as 12-deoxyphorbol-13-phenylacetate-20-acetate-ingenol triacetate, 12-deoxyphorbol-13-dodecanoate-20-acetate as well as highly toxic resiniferonol derivative. Besides these, other isolated terpenoids are sterols including cholesterol, β-sistosterol, stigmasterol and campesterol.

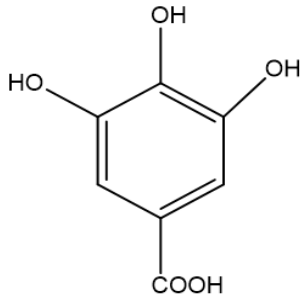

Fig.1. Structure of Galic acid

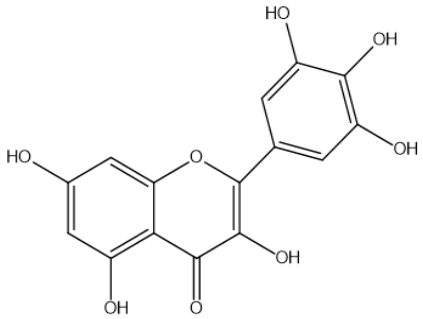

Fig.2. Structure of Myriceten

6. Uses

Several plants and herbal species contribute remarkably to the pharmaceutical industries [10-11]. A number of constituents isolated from medicinal plants showed antimicrobial activities against numerous pathogens [7-12-13]. Some secondary metabolites and the phenolic compounds are the bioactive components and act as membrane permeables. *Euphorbia hirta* play noteworthy role in remedial field including and act as anti-inflammatory, anti-oxidant, diastolic, diuretic, anthelminthic and antibacterial agents [14].

6.1. General uses

Euphorbia hirta also known *as E. pilulifera* L. have positive effect on diverse female disorders and in the cure of respiratory illnesses including bronchitis and asthma moreover it has character for cumulative milk flow because of having its milky latex. In India this plant is used for the treatment of worm infections in kids and also for gonorrhea, dysentery, jaundice, pimples, tumors and digestive problems. On the warts and wounds, the fresh milky latex obtained from tawa tawa plant is used. Roots are used in inflammation, sprains, miscarriage, epilepsy and irregular growth of teeth.

6.2. Pharmacological uses

Tawa tawa whole plant extracts is known to possess strong antioxidant potential. It has been reported that tawa tawa extracts possess anticancer, anti-tyrosinase and antimicrobial properties. Despite these reported properties and action mechanism it is necessary to be aware that tawa tawa contain milky latex which may be skin irritant. There is great diversity in the constituents of the tawa tawa that are responsible for their properties. The pharmacological properties of the whole plant including stem, leaves, roots and flowers, results from the combination of several different bioactive phytochemicals [15]. It was demonstrated by some researcher that dichloromethane extracts of tawa tawa have inhibitory effect of cancer cell line at 50% concentration. Taraxerone isolated compound from the tawa tawa exhibited the antimicrobial activities against several pathogens [15].

6.2.1 Prophylactic agent

Tawa tawa is broadly used as infusion or decoction to treat numerous disorders including intestinal diarrhoea, parasites, peptic ulcers, vomiting, heartburn, amoebic, bronchitis, dysentery, asthma, laryngeal spasms, hay fever, coughs, emphysema, colds, menstrual problems, kidney stones, venereal and sterility diseases. Furthermore, this plant can also be applied to treat skin affections and mucous membranes, like warts, tinea, scabies thrush, fungal afflictions, aphthae, measles, Guinea-worm and as an antiseptic to treat wounds, conjunctivitis and sores. Tawa tawa plant has a character to treat severe toothache, headache, colic, rheumatism and pains during pregnancy. It is used as pain relief and antidote of snakebites and scorpion stings [2].

6.2.2. Anti-dengue

Dengue fever is initiated by the arbovirus known as dengue virus, transferred by the mosquito named as *Aedes aegypti*. It is a big approach to treat this fetal fever using traditional or herbal medicines. *Euphorbia hirta* in the Philippines, natively known as “tawa tawa” has applications in herbal medicine to treat dengue fever in rural areas. The exact mechanism is yet unknown but it has considerable significance for the treatment of the dengue fever.

6.2.3. Antioxidant activity

Commercial antioxidants may show unwanted side effects so customer interested in herbal antioxidant during the current years [16]. Antixidant properties of plant are due to the presence of phenolic or flavonoid components [16]. The extract of *Euphorbia hirta* L. plant prepared in hot water was used for the determination of antioxidant potential. The crude extract exhibited noteworthy free radical scavenging action [17]. Flavonoids, components existing in tawa tawa extract have ability to scavenge the free radicals. Phenols and flavonoid components present in *Euphorbia hirta* extract are responsible for the antioxidant properties [4].

6.2.4. Anti-malarial activity or anti-plasmodium activity

Various extracts from different parts of nine medicinal plants were used in traditional medication for the cure of malaria. Out of these plant species, *Euphorbia hirta* whole plant including stem, leave, roots and flower cause more than 60% inhibition of the plasmodium growth [18]. The antiplasmodial action of tawa tawa may be correlated to the presence of some components including steroids, terpenes, coumarins, lignans, flavonoids, phenolic acids, anthraquinones and xanthones.

6.2.5. Anti-inflammatory activity

Main components of the isolated from aerial parts of *E. hirta* such as β-amyrin, triterpenes, β-sitosterol and 24-methylenecycloartenol showed anti-inflammatory effects. Both the triterpenes and the extract exerted major and dose-dependent anti-inflammatory action in ear inflammation induced by phorbol acetate as a model in mice. The aqueous extracts also showed anti-inflammatory activities [19].

6.2.6. Sedative and Anxiolytic activity

Lyophilized extract of *E. hirta* L. showed sedative and anxiolytic activity. Sedative characteristics can be established and verified with high doses by a decrease of interactive considerations measured in unfamiliar or unknown environment, whereas anticonflict response seemed at lower doses, by an improvement of behavioral parameters dignified in the light/dark choice condition test. These lead the traditional use of tawa tawa as a sedative and expose original anxiolytic characters [20].

6.2.7. Anti-diarrhoeal activity

Tawa tawa plant extract by decoction was used to understand the antidiarrhoeal activity in mice. A flavonoid glycoside component, quercitrin isolated from *E. hirta*, showed anti diarrhoeal activity against castor oil induced diarrhoea in mice. It also seems to delayed small intestinal transit. But, aglycone of quercitrin, in the occurrence of secretagogue composites, improved colonic liquid absorption signifying that the antidiarrhoeal action of quercitrin component is only because of its aglycone, released by the glycoside present in intestine [18].

6.2.8. Anticancer activity

Extracts of tawa tawa have been seemed to demonstrate selective cytotoxicity action against numerous cancer cells. This plant is beneficial in effective cure of cancer, especially squamous cell carcinomas and malignant melanomas.

6.2.9. Diuretic activity

The diuretic activity of *E. hirta* leaf was evaluated in rats using furosemide and acetazolamide as standard diuretic medications. Electrolyte excretion and urine output are considerably affected by ethanol and water extract of the plants. Study of tawa tawa plant reveals that active constituents in the water extract has analogous diuretic spectrum as of acetazolamide [20].

6.2.10. Antiamoebic activity and Antispasmodic activity

Tawa tawa whole plant show inhibition in the growth of unicellular organism including *Entamoeba histolytica* with a lowest active concentration of almost 10 pg/ ml or less. The alike extract also displayed more than 70% inhibition of induced KCI solution contractions and acetylcholine on isolated pig ileum at a concentration of about 80 μg/ ml [21].

6.2.11. Molluscicidal activity

The aqueous extracts of leaf, stem and bark of herb *Euphorbia hirta* have strong molluscicidal action. Sub-lethal doses of these extracts considerably change the levels of free amino acid, total protein and nucleic acids. Also change the action mechanism of alkaline phosphatase, acid phosphatase and enzyme protease in different tissues of the *Lymnaea acuminata* a vector snail by changing dose and time of tawa tawa extracts.

6.2.12. Anti-fertility activity

Tawa tawa has exhibited significant anti-fertility activity. Tawa tawa (50 mg/kg of body weight) reduces the density and sperm mobility or motility of cauda epididymal and lead to testis sperm interruption considerably, ultimately cause 100% infertility.

6.2.13. Anti-platelet aggregation and anti-inflammatory

Aqueous extracts of *Euphorbia hirta* strongly reduced the release or freedom of prostaglandins I2, D2 and E2. Moreover tawa tawa extracts also exhibits an inhibitory activity on platelet accumulation and lower the development of carrageenin in rats.

6.2.14. Repellent and antifeedant effect

The alcoholic extracts of *Euphorbia hirta* exhibit considerable the antifeedant and mosquito repellent effect. The extracts of tawa tawa contain quercitrin and polyphenols which might be responsible for the antifeedant effect and repellent activity.

6.2.15. Immunomodulatory activity

Aqueous-alcoholic and aqueous extracts, possesses polyphenols, flavonoids, terpenes and sterols, shown immunostimulant effect. The aqueous extract affects lymphoblast transformation which is lectin-induced and showed 45% Immunomodulatory action [22]**.**

6.2.16. Antifungal activity

The alcoholic extract revealed significant antifungal activity when verified against various plant pathogens including *Fusarium pallidoroseum, Colletotrichum capsici, Botryodiplodia theobromae, Penicillium* citrinum, *Alternaria alternata, Aspergillus niger* and *Phomopsis caricae-papayae* through paper disc diffusion method [23]. It is reported that antifungal activity of *E. hirta* may be due to the cell membrane leakage of cellular protiens.

6.2.17. Larvicidal activity

Tawa tawa have exhibited significant larvicidal activity. *Euphorbia hirta* (tawa tawa), was tested against the larvae of *Culex quinquefasciatus* (Say) and *Aedes aegypti* L. The larval mobility and mortality was detected after 24 h of tawa tawa extract exposure. *E. hirta* extract showed larvicidal activity against *C. quinquefasciatus and A. aegypti*. Petroleum extract of *E. hirta* showed maximum larvicidal activity such as 272.36ppm.

6.2.18. Antibacterial activity

E. hirta demonstrate noteworthy action against the bacteria such as *K. pneumonia*. This plant seems to have great antibacterial potential against various medically significant bacterial strains including *Staphylococcus epidermidis* [24], *Bacillus subtilis, Pseudomonas pseudoalcaligenes, Salmonella typhimurium, E.coli* [24], and *Proteus vulgaris.* The antibacterial potential of methanol and aqueous extracts was examined by well diffusion and disk diffusion methods [20]. The capability of tawa tawa plant in methanol extracts towards antibacterial activity is more than other solvents. The methanol extract of tawa tawa plant showed more activity against Gram-positive stain. The bacteria which exhibit most resistant are *P. vulgaris*. The presence of Citronellal in *Euphorbia hirta* might be responsible for having potential of antibacterial activity [24]. Ag nanoparticles manufactured using the leaves of tawa tawa are also used for Antibacterial activity [25].

6.2.19. Anti-diabetic activity

Anti-diabetic activity is the one of the important activities of the tawa tawa plant. Diabetes mellitus is such a metabolic ailment in which hyperglycemia caused imperfections in insulin action, insulin secretion or both. Chronic hyperglycemia is related with long-term impairment. Various studies have exposed that diabetes mellitus is concomitant with the decrease in antioxidant activity and increased creation of free radicals. So, free radicals have to be scavenged for its antidiabetic action. The anti-diabetic action of *E. hirta* flower extracts may consider due to the presence of tannins, flavanoids, and other phenolic constituents but exact mechanism is still unknown. It has lowered the side effects related with synthetic medicines.

7. Summary

Euphorbia hirta is an annual herb belongs to Euphorbiaceae family. It has been found at warm and tropical regions mostly on roadsides and waste land throughout the world and used as traditional medicines. Tawa tawa contains lycosidal substance, terpenoids, tannin, phorbic acid, fatty acids and sterols, Flavonoids including quercitrol, quercetin, and its derivatives. The extent or amount of these chemical constituents varies in different parts of the tawa tawa plant and also depends on soil and climate condition. Recently published reports showed that tea of tawa tawa plant is helpful as anti-malaria and anti-dengue. *Euphorbia hirta* has been used for the remediation of respiratory disease, some female disease and also other

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