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Erythrina Subumbrans (Hassk) Merr*: An* Overview

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ABSTRACT

This overview gives a broader knowledge on the morphology, phytochemistry, and pharmacological aspects of *Erythrina subumbrans* (Fabaceae). *Erythrina subumbrans* (Fabaceae) is one of the gifted medicinal plants from Western Ghats of India. Traditionally, various parts of *Erythrina subumbrans* like stem, leaf, root and bark were used to treat various medical conditions like coughs, worms, dysentery, fever, insomnia and to treat spleen afflictions. Several compounds (22) have been isolated from bark, root and stem which were rich in Tannins, flavanone, isoflavone, alkaloids, pterocarpans, steroids, saponins, Triterpenoid and alkyl trans-ferulates. The primary reported constituents includes nine pterocarpans (orientanol B, phaseollin, erythrabyssin II, phaseollidin, erycristagallin, erystagallin A, eryvarin D, erythrabyssin A and erythrabissin I) three isoflavones (scandenone, bidwillon C and wighteone); two 2-arylbenzofurans (bidwillol B and eryvarin L); two steroids (a mixture of β-sitosterol and stigmasterol); two triterpenes (sophoradiol and soyasapogenol B); one coumestan (sigmoidin K); one chromen-4-one (eryvarin X); one chalcone (isobavachalcone) and coniferaldehyde. The crude extract helps to treat various sessional diseases and several other characteristic pharmacological effects like antiplasmodial activity, antimycobacterial activity and cytotoxicity activity. Hence the present article includes the detailed exploration of morphology, phytochemistry, and pharmacological aspects of *E. subumbran* an attempt to provide a direction for further research.

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INTRODUCTION

Erythrina subumbrans is one of the flowering plant species found in India out of 110 species of the genus Erythrina family. It is indigenous to Sahyadri (i.e., Western Ghats) & Eastern Ghats, Mostly Cultivated in the Native of Malaysian Region Asia, China, Mauritius, Myanmar, Niue, New Guinea, Philippines, Singapore, Sri Lanka, Thailand, Vietnam as well as in India. Commonly called as a Coral tree and Typically called as Seemai mullmurukku (Nath *et al.*, 2016), Seemai Kalyana murungai in southern states of India (Vanlalremkimi, 2016). Erythrina subumbrans is a deciduous Tree, and it will grow by 20

m (65ft) height at a rigorous rate. The flowers are pollinated by Birds and the capacity to fix the nitrogen by its own. It is suitable to grow in the light sandy soils, medium loamy soils and heavy clay soils, preferably in the well-drained soil and also suitable to grow in all type of pH conditions soils like acidic, neutral and basic (alkaline) soils. It cannot grow in the shade. It prefers dry or moist soil and can tolerate drought (Kongmanila *et al.*, 2013).

Figure 1: Erythrina subumbrans tree.

Taxonomy

Kingdom: Plantae

Order: Fabales

Family: Fabaceae

Subfamily: Faboideae

Tribe: Phaseoleae

Genus: Erythrina

Species: E. subumbrans (Hanum, 1997)

Figure 2: Erythrina subumbrans leaves.

Morphology

Size

An average deciduous nutritive tree can grow up to 16-82 feet and the central wooden axis of the tree reaching 60 cm in diameter. The horizontal width of the bark crown spread is whitish, and branches are not armed with stout spines. (Hanum, 1997). The typical whole tree is shown in Figure 1.

Leaves

Leaves are arranged in an alternate, orbicular shaped stipules, small, caduceus; 4-8 inches long rachis, including petiole of 3-6 inches with thickening base; leaflet up to 7 mm long; leaflets are ovate with three-sided base rhomboid, one large leaf terminal ranges from 2-5 inches × 3-6 inches, base rounded or heart-shaped, apex acuminate, smooth. Typical leaves of Erythrina subumbrans is shown in Figure 2. (Hanum, 1997)

Figure 3: Erythrina subumbrans flower.

Flowers

The racemose inflorescence is located in the upper axil and is the raceme which is 2-9 inches long and are brown. Flowers are arranged in cluster look like a group of three. Papilionaceous Corolla with short-clawed standard, sub-elliptic to ovoid shape, 3–4cm (1.2–1.6 in) long, longitudinal white lines; Pale red to the green color wing which is half compared to that of standard. Flowering is reported from July to December every year. Typical flower of Erythrina subumbrans is shown in Figure 3 (Hanum, 1997).

Figure 4: Erythrina subumbrans Seeds.

Seeds

Seeds are ellipsoid in shape, 7-18mm × 5-11mm in length, smooth, dull black. The fallen seeds on the soil were simply eroded by rain or by respective native range. Typical seeds of Erythrina subumbrans is shown in Figure 4 (Kongmanila *et al.*, 2013).

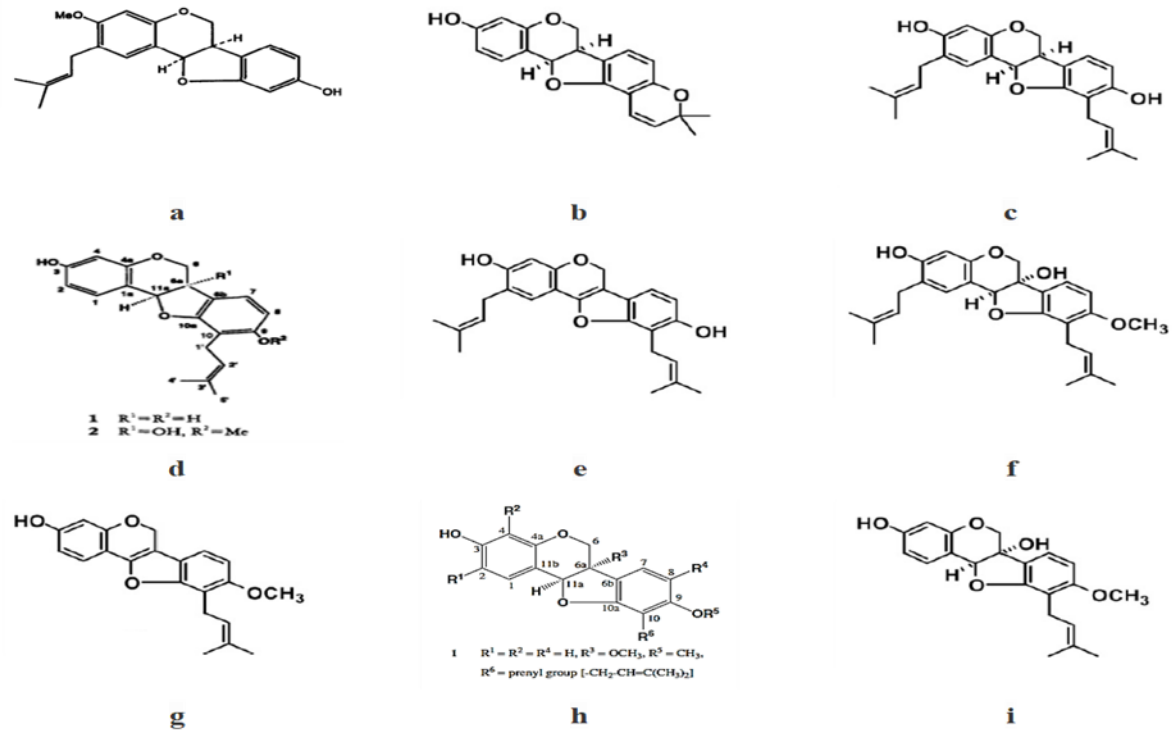

Figure 5: Erythrina subumbrans related compounds- pterocarpans (a-i).

Cultivation Details

A plant of low to medium elevations was observed in tropics, usually found at a height below 1,500 meters. It is found in locations where the mean annual rainfall is in the range of 500-2,000 mm and can grow under 100 mm rain for four months. The mean kinetic growing temperature is above 22°C. During wind session, trees are relatively tolerant, and borers damaged branches. Often grown as an ornamental or to provide shade in plantations, the tree has occasionally escaped from cultivation and become naturalized. It is classified as invasive in some Pacific islands. Thornless forms produced few flowers, and from wild forms, fruits have spines on it.

Thornless forms often than not die earlier due to pest and diseases; however, the cultivated from can grow up to 45-50 years. Pruning and pollarding are very well tolerated, Where the tree is trimmed by cutting away dead or overgrown branches and used as an average level shade tree; cross planted with other shade trees like Paraserianthes falcataria or Grevillea robusta which grow taller. Elsewhere, it is not trimmed, allow to grow as high shade tree and cross planted with Leucaena leucocephala to provide the soft shade. In the western region of Samoa, the canopy of the tree was used to cover the Yam vines which are planted in a circle around the tree to suppress the growth.

Nectar which is present in larger quantities, serve as a birdfeed during the dry season. The fertilization of the flowers is by birds, through various insects, which act as a carrier for pollen transmission and are believed to be self-compatible in all species of *Erythrina*, to produce a fertile hybrid, various Erythrina species were cross cross-fertilized (i.e., cross-pollination). The involved species were closely related to each other, and these species can crossbreed even they are distinct. A strong symbiotic connection could see between this species and naturally occurring soil bacteria, and these bacteria form nodes on the roots and help in fixing the nitrogen present in the atmosphere. Some part of the nitrogen was used for its growth and nearby plants also utilizing for their growth (Kongmanila *et al.*, 2013).

Propagation

Germination is at a higher rate and is often 100 %. Seed coat usually become harder and tougher over the period, and a six months old seed usually takes about 12-18 months for germination. A matured plant sows its seeds within 3-6 months' time period without any special handling. The germination rate of the aged seed can be considerably increased by soaking the seed in hot water by removing the seed coat. The seeds were added to water which is previously heated to boiling below its boiling point and allow to leave in the water for an hour to cool.

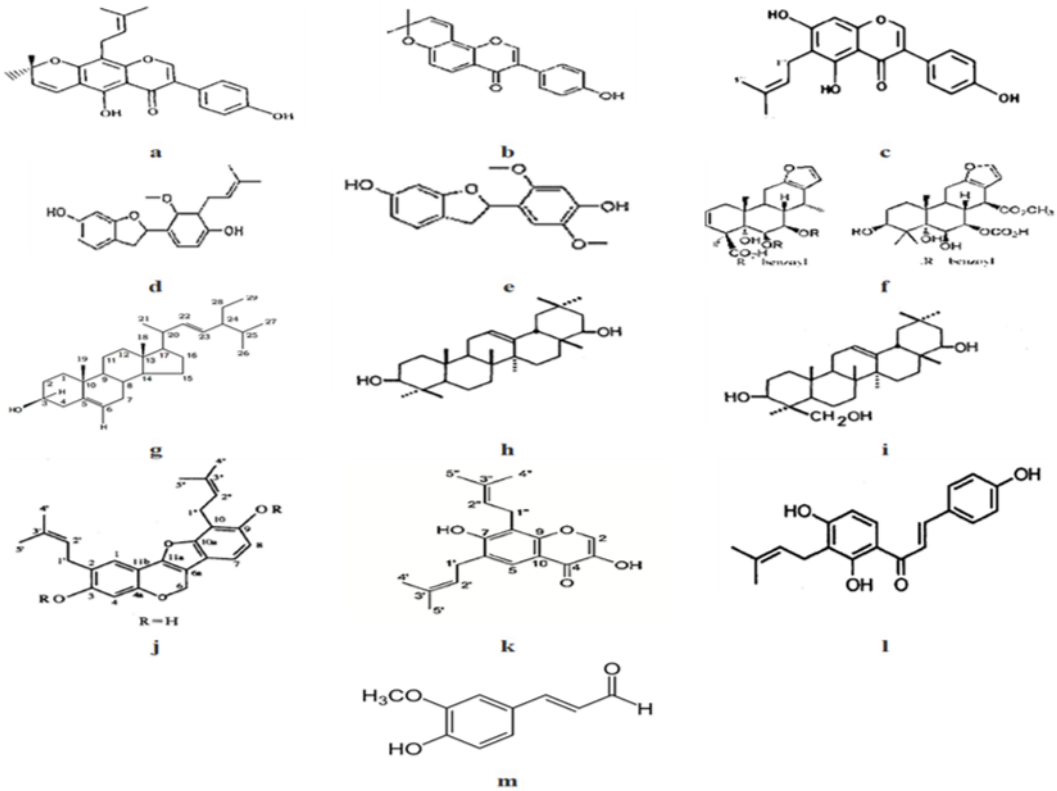

Figure 6: Erythrina subumbrans - Other related compounds (a-m).

The time varies for the aged seeds, i.e., about 2 hours for three years or more aged seed and sows in the usual way. An alternate way to prevent the death of the seed is by filing the seeds with a slender triangular file, and a groove can be made at sides of seed coat with care to avoid damage to the embryo and from fungal growth—health seeds from well-drained soil harvest solid seedlings which can survive from hampering off disease. The propagation of the plant is by seed, and the trees with thorns were produced from seeds that are generally thornless (Kongmanila *et al.*, 2013).

Phytoconstituents

Erythrina species are known for rich in alkaloid; Bark and root extract of Erythrina subumbrans showed the presence of tannins, volatile oils, proteins, glycosides and carbohydrates. The flavonoids which are present in vascular plants are chemically a benzopyrones phenyl derivative which is conjugated with sugars moiety. The significant phytoconstituents in stem and bark are isoflavonoids a class of flavonoid phenolic compound. The extract from seeds usually yields alkaloid, fatty oily and glucoside derivative. These alkaloids were identical to Hypaphorine an indole alkaloid.

The bark and root of Erythrina subumbrans showed the presence of carbohydrates, glycosides, proteins, volatile oils and tannins. The whole plant is a rich source of alkaloids (2.5%) in that most are flavonoids which are chemical phenyl benzopyrones, usually conjugated with sugars. Isoflavanoids are reported to be significant phytoconstituents in stem and bark (Rukachaisirikul *et al.*, 2007b). Seeds contain an alkaloid, fatty oil, and a saponaceous glucoside. Constituents of *Erythrina subumbrans Merr*. (Leguminosae) (Rukachaisirikul *et al.*, 2008) were also isolated from the roots for phytochemical investigation.

The isolation of the root extracts contains 22 compounds, among which are nine pterocarpans were shown in Figure 5**(a to i)**: orientanol B (**a**) (Tanaka and Tanaka, 1998), phaseollin (**b**) (Perrin, 1964), erythrabyssin II (**c**) (Tanaka and Tanaka, 1998), phaseollidin (**d**) (Dagne *et al.*, 1993), erycristagallin (**e**) (Mitscher and Drake, 1984), erystagallin A (**f**) (Tanaka *et al.*, 1997), eryvarin D (**g**) (Tanaka *et al.*, 2001), erythrabyssin A (**h**) (Nguyen *et al.*, 2009), and erythrabissin I (**i**) (Dagne *et al.*, 1993).

Other reported compounds were shown in Figure 6**(a to m)** includes three isoflavones: scandenone (**a**) (Nkengfack *et al.*, 1989), bidwillon C (**b**) (Iinuma *et al.*, 1994), and wighteone (**c**) (Monache *et al.*, 1995). Two 2-arylbenzofurans: bidwillol B (**d**) (Iinuma *et al.*, 1994) and eryvarin L (**e**) (Tanaka *et al.*, 2004); two steroids: a mixture of β-sitosterol (**f**) and stigmasterol (**g**) (Pouchert

and Behnke, 1993); two triterpenes: sophoradiol (**h**) (Kinjo *et al.*, 1985) and soyasapogenol B (**i**) (Mahato and Kundu, 1994); one coumestan: sigmoidin K (**j**) (Nkengfack *et al.*, 1994); one chromen-4-one: eryvarin X (**k**) (Tanaka *et al.*, 2011); one chalcone: isobavachalcone (**l**) (Pistelli *et al.*, 1996) and coniferaldehyde (**m**) (Shi *et al.*, 2009). Further identification of sophoradiol (**h**) has been reported (Kitagawa *et al.*, 1976). Based on the reported data in comparison with their physical and spectroscopic behaviour, these compounds have been identified.

Pharmacological Activity

Antiplasmodial activity

The antimalarial activity was evaluated against the Plasmodium falciparum (K1, multidrug-resistant strain) which was cultured continuously by inoculating a suspension of human AB erythrocytes with a small amount of falciparum-infected Aotus blood in a Petridis. Incubation of cell medium with tissue culture was performed using candle jars by maintaining 7 % Carbon dioxide, 5 % oxygen and a balance by Nitrogen (Trager and Jensen, 1976). Microtitration based morphological assessment was performed by measuring the suppression of parasite growth of a radiolabeled nucleic acid precursor due to the incorporation of [6-^{14}C] orotic acid and [G-^{3}H] hypoxanthine into deoxyribonucleic acid of Plasmodium falciparum (Desjardins, 1979). A significant reduction (50 %) in parasite growth was observed in tissue culture after inclusion of [G-^{3}H] hypoxanthine which was considered as inhibitory concentration (IC_{50} is 1ng/mL) (Rukachaisirikul *et al.*, 2007b). Few isolated compounds exhibit moderate antiplasmodial activity (Trager and Jensen, 1976).

Antimycobacterial activity

A sensible, fast, high throughput Microplate Alamar Blue Assay (MABA) was used to determine the antimycobacterial against Mycobacterium tuberculosis H_{37}Ra strain a basic biocontainment level 2 Anti-tuberculosis screen. The activity was carried out in a black, clear-bottom 96 well microplates. Serial dilution was made using Dimethyl sulfoxide and subsequently, doubled the dilution using 0.1ml of 7H9GC in microplates, to detect auto fluorescence, wells containing the drug were used, and color change from blue to pink was observed with the reading of $\geq$50000 fluorescence units (FU) at emission at 590 nm and excitation at 530nm. Background subtraction was made from the sample reading, and the per cent inhibition was calculated. The lowest concentration affecting an inhibitory action (>90%) was considered as minimum inhibitory action (MIC) (Rukachaisirikul *et al.*, 2007b). Rifampicin, isoniazid and kanamycin sulfate a known standard drug emit MIC of 0.004, 0.06 and 2.5 μg/mL (Collins and Franzblau, 1997). The higher antimycobacterial activity was exhibited by a few of the alkaloid of the isolated compounds (Rukachaisirikul *et al.*, 2006).

Cytotoxicity activity

A sensitive, rapid and inexpensive colourimetric method for determining the cytotoxic activity by measuring the optical density in a cellular protein of adherent culture, (i.e. culture fixed with trichloroacetic acid) was strained for 30 minutes with 0.4% sulforhodamine B (SRB) and a 10mM Tris hydroxymethyl aminomethane dye. Signal to noise ratio was approx—1.5, with 1000 cells per wall at 564 nm (Desjardins, 1979). Human small cell lung cancer (NCI-H187), oral human epidermal carcinoma (KB) and Human breast cancer (BC) cells were used in culture (Skehan *et al.*, 1990). Ellipticine, a known standard drug exhibit IC_{50} of 0.39, 1.33 and 1.46 μg/mL respectively (Tanaka *et al.*, 1997; Tanaka and Tanaka, 1998; Tanaka *et al.*, 2001, 2004). Erybraedin A (2) appeared to be the most potent compound against the NCI-H187 and BC cells with the IC_{50} values of 2.1 and 2.9 ~g/mL (Rukachaisirikul *et al.*, 2007a).

CONCLUSIONS

The plant Erythrina subumbrans (Hassk) Merr is a herbaceous tree grown in Western Ghats of Kerala, and Karnataka, Mizoram of India which is used as a traditional folk medicine for various ailments had been evaluated for in vitro antiplasmodial activity, antimycobacterial and cytotoxic activity. The phytochemical constituent of the aerial parts of the plant was evaluated and reported. More than 22 compounds have been isolated using Erythrina subumbrans includes orientanol B, phaseollin, erythrabyssin II, phaseollidin, erycristagallin, erystagallin A, eryvarin D, erythrabyssin A, and erythrabissin I; three isoflavones: scandenone, bidwillon C, and wighteone; two 2-arylbenzofurans: bidwillol B and eryvarin L; two steroids: a mixture of β-sitosterol and stigmasterol 29; two triterpenes: sophoradiol and soyasapogenol B; one coumestan: sigmoidin K (one chromen-4-one: eryvarin X; one chalcone: isobavachalcone and coniferaldehyde. Further, a detailed study on leaves and bark of Erythrina subumbrans is considered essential for the novel drug development in producing the positive results on healing the inflammation, cancer, androgenic, coronary and arthritic. To find the unexploited significance of the plant, substantial activities in the area of pharmacognosy and pharmacolog-

ical to be conducted.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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