A Concise Review on *Erythrina variegata* and its Pharmacological Properties

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Abstract- **This study gives a brief account of current knowledge on the morphology, phytochemistry, and pharmacological aspects of *Erythrina variegata. E. variegata* also called as *Erythrina indica,* which is a thorny deciduous tree growing up to 60 feet tall, native to the Indian subcontinent, eastern Africa, northern Australia, and the islands of the Indian Ocean and the western Pacific Ocean. A wide range of phytoconstituents have been isolated from this plant mainly alkaloids, flavonoids, triterpenoids, and lectin and different parts of the tree have been used in traditional medicine as anti-inflammatory, antioxidant, antiepileptic, antiseptic, as nervine sedative, collyrium in opthalmia, antiasthmatic and as astringent. The alkaloids extracted from the leaves of *E. variegata* are found to have analgesic, anti-inflammatory and antioxidant activity. *E. variegata* has a reputation for its medicinal properties in most of the countries mainly in India, China and Southeast Asia. Hence this article gives a brief knowledge about the plant *E. variegata* and its pharmacological properties.**

Keywords: Erythrina variegata, **Pharmacology, Pharmacognosy, Phytoconstituents.**

I. INTRODUCTION:

The genus *Erythrina* consists of about 110 species of trees and shrubs and it is mainly originated from India to Malaysia, but is native to ancient westward to Zanzibar and eastward to eastern Polynesia. It is mostly found on sandy soil and sometimes in coastal forest up to 250m (800ft) in elevation. [1] *E. variegata* commonly called as "Indian coral tree" or "Tigers claw". In most of the hill stations in India, the coral tree is cultivated particularly as an ornamental tree and as a shade and soil improvement tree (it fixes nitrogen) for other tree crops such as tea plantations, coffee and cacao. [2,3] This is a fast-growing tree, which grows up to 60 feet tall with wide deciduous tree having 6-inch-long leaves creates a broad canopy but has spiny branches. In spring, before the leaves appear, coral tree is decorated with flowers of showy red blossoms which looks like tiger's claw, each flower 2.5 inches long and are arranged in dense, six-inch-long racemes and these blooms contain poisonous seeds. [4] Illustration of Phytochemical profiling of *E. variegata* have proved that alkaloids and flavonoids are major phytoconstituents and are responsible for majority of pharmacological actions. Different parts of the tree have been used in traditional medicine as nervine sedative, febrifuge, anti-asthmatic and antiepileptics. [5] It also has potential effects for treatment of various diseases like inflammation, cough, bacterial infection, convulsion, fever, insomnia, helminthiasis, cuts and wounds. [6,7] The leaves and bark of the tree are used in many traditional medicines such as paribhadra, an Indian medicinal preparation used to treat parasitic infections, PCODs and also to relieve joint pain. Juice from the leaves is mixed with honey and ingested to kill tapeworm, roundworm and threadworm and when mixed with castor oil it is used to cure dysentery. In rural parts of India women take this juice to stimulate lactation and menstruation. [8]

II. TAXONOMY: (9)

Kingdom:	Plantae – Plants
Division:	Magnoliophyta – Flowering plants
Class:	Magnoliopsida – Dicotyledons
Family:	Fabaceae (Legume family)

Subfamily:	Papilionoideae
Genus:	*Erythrina* L. – Coral Tree
Species:	*E. variegata* L.

Common names:
Indian coral tree, tiger's-claw (English)
Dadap aykam (Indonesia)
Gatae (Horne Islands, Cook Islands)

III. GEOGRAPHICAL DESCRIPTION:

E. variegata is native to the India, China and some of the islands of Pacific Ocean, tropical and subtropical regions of eastern Africa, northern Australia, and the islands of the Indian Ocean.

IV. MORPHOLOGY:

Size

The tree grows up to 50-60 Ft. tall with dense branches. The lower branches spread to form a rounded, oblong crown followed by many ascending branches.

Flowers

The tree has dense clusters of scarlet or crimson flowers and black seeds. In terminal or axillary racemes inflorescence of fascicles occurs up to 20cm (8 in) or more long. Calyx has a deep split along one side, 1–1.8cm (0.4–0.7 in) long, on a pedicel 2–5mm (0.1–0.2 in) long; corolla is papilionaceous, short-clawed, ovate to subelliptic, 3–4cm (1.2–1.6 in) long, red-orange with longitudinal white lines; wings are about half, greenish to pale red; keel is as long as the wings, greenish to pale red and ovary is superior, in which 10 stamens are diadelphous where 9 are fused together at the base part and enclosed within the keel. Flowering of the tree occurs from July to November in the southern hemisphere and 6 months later in the northern hemisphere.

Leaves

The leaves of the tree are pinnate with a 20 cm (7.9 in) petiole and three leaflets, each leaflet measures up to 20 cm (7.9 in) long. Rachis is almost 10–20 cm (4–8 in) long; blades of the leaf are ovate to rhomboid, 8–18 cm (3.2–7.2 in) long; petiolules 6–13 mm long, with vegetative parts finely pubescent. The *E. variegata* retains its leaves better than any other *Erythrina* species.

Fruit

Fruit is a compressed, oblong pod 10–14 cm (4–5.6 in) long, which is sterile in the basal portion, and not constricted between the 5–10 dark brown seeds. The fruits are ripe from the month of March to April in the Northern Hemisphere and October to November in the Southern Hemisphere.

Seeds

Seeds are shaped like kidney, dark purple to red, and 1–1.5 cm (0.4–0.6 in) in length and these may be washed away when they fall on the ground. The tree may have approximately 1450–5000 seeds/kg. [3,4]

V. PHYTOCONSTITUENTS:

Through literature survey a number of reports concluded the presence of various phytoconstituents such as Alkaloids, flavonoids, triterpenes, steroids, pterocarpans, alkyl trans-ferulates, proteins, and lecithin in the genus. Below are the lists of constituents present in *E.variegata.*(Fig 1.)

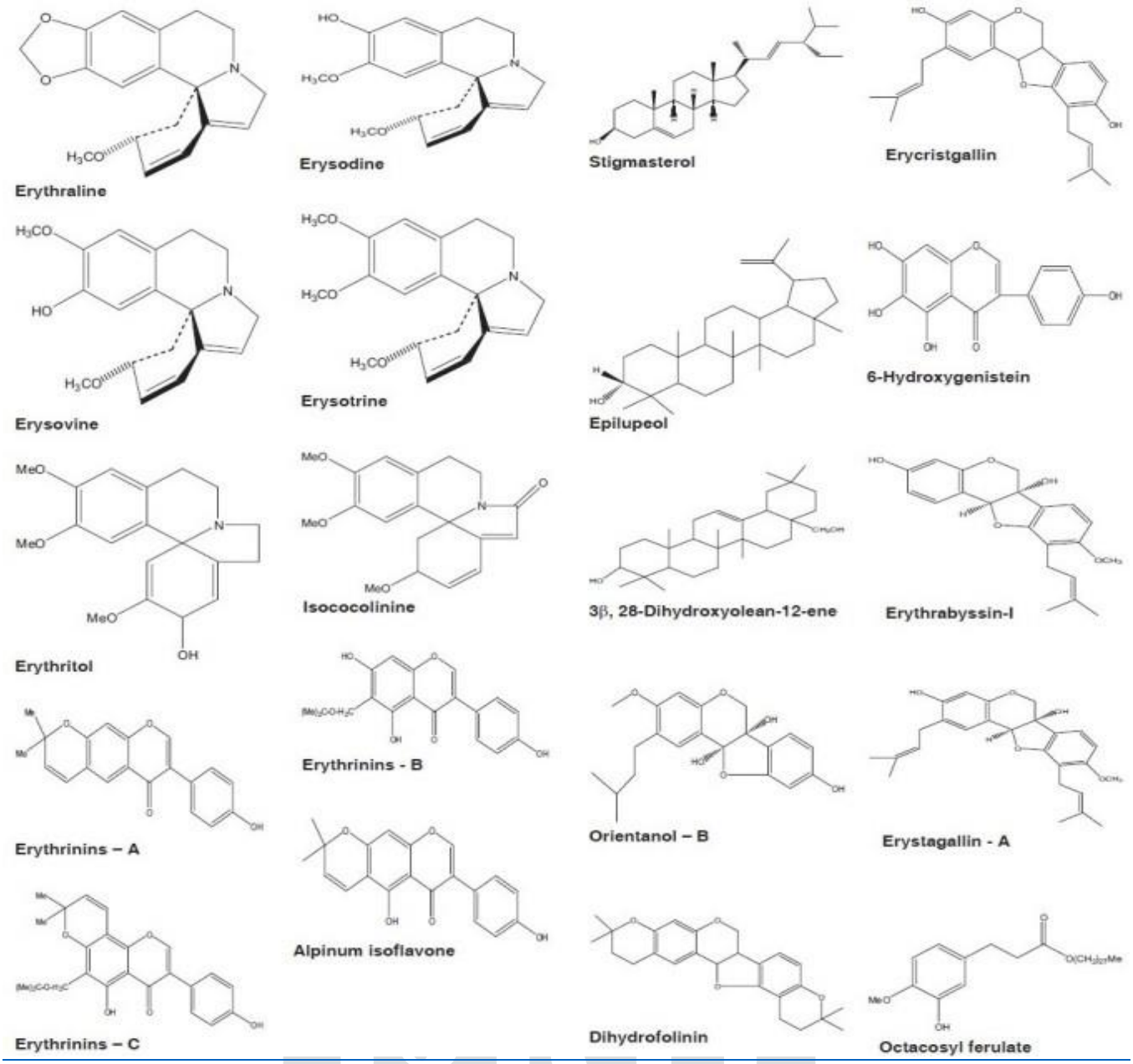

Fig. 1. Phytconstituents of *E. variegata*

Alkaloids

This genus is a rich source of alkaloids (2.5%) which contains; (+)-erythraline, (+)-erythramine, (+)-erythrinine, (+)-3-Demethoxyerythratidinone, (+)-erythratidinone, (+)-erysodienone, (+)-erysotrine, (+)-erysopitine (+)-erysonine, (+)-erysotine, (+)-erysodine, (+)-erysovine, (+)-11-hydroxy- *epi*- erythratidine, (+)-erythratidine, (+)-*epi*- erythratidine, and (+)-11-β-hydroxyerysotrine[(+)-erythrartine] are the tetracyclic alkaloids isolated from the various parts of the tree and scoulerine, (+)coreximine, l-reticuline, and erybidine are isolated from the leaves. [7] The ethanolic extract yielded erysovine and stachydrine which are chloroform bases and Eight spiroamine alkaloids along with three carboxylated indole-3-alkylmamines – hypaphorine, its methyl ester and *N, N*-dimethyltryptophan are isolated from various parts of the tree. [10,12] Presences of isoquinoline (erythritol) alkaloids are also reported in the studies. [11]

Flavonoids

Flavonoids are chemically of phenylbenzopyrones, which are present in all vascular plants and are usually conjugated with sugars. [13] Isoflavonoids are found to be the major phytoconstituents of *E. Variegata*. [14] It contains mainly erythrinins, alpinum isoflavone, styrene oxyresveratrol and dihydrostilbene dihydroxyresveratrol. [15,16] Robustone, pyranoisoflavones and 4-*O*-methylalpinum isoflavone are also isolated from the genus. Previous studies have reported the presence of erystagallin A, stigmasterol, campesterol, stigmoidins A, B, and C, phaseollin, 3-β-acetoxy-B-

norcholest-5-ene, docosanoic methyl ester, β-sitosterol and its archidate, and capric acid as the main components refuted by recent well-documented investigations. [17,18] Presence of flavonoid such as V, erycricstagallin and 4-hydroxy-6, 3, 5-triprenylisoflavonone was also reported in the literature. [19,20]

Miscellaneous phytoconstituents

Other components identified from E. variegata include alkyl phenolates, octacosyl ferulate, erythrabyssin II, dihydrofolinin, wax alcohol, and wax acids. Seeds have the following contents: 3.8% moisture, 31.2% crude protein, 11.9% pentosan, and 1.6% water-soluble gum. Aspartic acid (12.9), glutamic acid (13.4), glycine (7.6), histidine (3.9), isoleucine (3.6), leucine (7.1), lysine (5.1), methionine (0.5), phenylalanine (3.3), proline (4.7), serine (7.1), threonine (5.7), tyrosine (2.2), and valine (4.8) g/100g are the amino acid composition of seed protein. [21] The seeds also include kuntz-type trypsin inhibitors (ETIa and ETIb), chymotrypsin inhibitor (ECI), and isolecitins. [22]

IV. PHARMACOLOGICAL ASPECTS:

In ancient times, the leaves of the Indian coral tree are said to be used in Pohnpei, an island in South Pacific Ocean, to prepare a drink that can break curses, and the smoke from smouldering leaves, bark, or roots is also inhaled for the same effect. Similarly, the bark and leaves of coral tree are combined with other ingredients and used as a stomach-ache remedy. Samoan people occasionally apply the bark to swellings and use the leaves to treat eye conditions. The bark and leaves are used in numerous traditional treatments in India, China, and Southeast Asia; one such remedy is supposed to eliminate harmful parasites and ease joint pain; the leaf juice is combined with honey and used to treat roundworm, tapeworm, and other parasitic infections. [23,24]

Antioxidant

The body has a complex endogenous antioxidant system that balances out the production of free radicals and other reactive oxygen species. Oxidative stress, on the other hand, can arise from the accumulation of excess radicals brought on by various environmental, lifestyle, and disease circumstances. Researchers are searching for natural substances with strong anti-oxidative activity but low cytotoxicity because of the potential benefit of antioxidants in eliminating oxidative stress. [5]

SS Sakat et al., reported the Comparative Study of *Erythrina variegata Lam. (Febaceae)* Leaves Extracts for Antioxidant Activity. The results indicated that the aqueous and methanol extracts of *E. variegata* leaves possesses significant antioxidant activity that may be due to the presence of flavonoids and related polyphenolic compounds. Crude extract from *E. variegata* was tested for its ability to scavenge radicals and was shown to be a rich source of naturally occurring anti-oxidants for use in various applications. [33]

Analgesic and anti-inflammatory

It has been reported that the alkaloids that were extracted from the leaves of *E. variegata* had anti-inflammatory properties. The leaves and barks have also been used to treat fever and rheumatism. [7]

Haque R et al., reported that in acetic acid induced writhing model, the methanolic extract of the leaf of *E. variegata* at a dose of 500 mg/kg showed significant antinociceptive activity with 49.03% inhibition of writhing response. The results were statistically significant ($P < 0.01$) when compared to the control. At a dose of 500mg/kg, the extract showed significant increase in the tail flick latency of about 36.02% elongation of tail flick time in the radiant heat tail-flick model. [9]

Anti-tumor

Rahman MZ et al., reported the presence of potent bioactive principles in the extracts of *E. variegata* might be very useful as antiproliferative, antitumor, pesticidal, and other bioactive agents. In this study, *Artemia salina* was used to test the lethality of various fractions of methanolic extract of *E. variegata* including n-hexane, carbon tetrachloride, chloroform, and water in brine shrimp. The LC50 values for n-hexane, carbon tetrachloride, chloroform, and aqueous fractions were found to be 36.68, 4.67, 7.733, and 14.289 µg/mL, respectively. The carbon tetrachloride and chloroform-soluble fractions of the methanolic extract demonstrated a significant cytotoxicity when compared to the positive control, vincristine sulphate. This concluded that these extractives had potent bioactive principles that could be extremely useful as pesticidal, anticancer, anti-proliferative, and other bioactive compounds. [15]

Antibacterial/dental caries prevention: Mohammed Z. Rahman et al., reported the antibacterial property of 7 compounds (isoflavanoids), isolated from *E. variegata* by repeated silica gel column chromatography, against cariogenic oral bacteria. The results show that erycristagallin, one of the seven compounds, is a powerful phytochemical agent for preventing dental caries by inhibiting the growth of cariogenic bacteria and interfering the incorporation of glucose, which is necessary for the production of organic acids. [15,16]

CNS effects

S Ghosal et al., reported the total alkaloid fraction from the bark showed several characteristic pharmacological effects: neuromuscular blocking, CNS depressant, and anticonvulsant effects which are consistent with the reported use of plant extracts in various system of medicine. [8]

According to Bhattacharya SK et al., the use of contemporary antiepileptic medicines (AEDs) for the therapeutic treatment of epilepsy is linked to side effects and dose-related teratogenic consequences, and over 30% of patients still experience seizures while on AED therapy. The discovery of contemporary medications has benefited greatly from the use of natural materials from folk medicines, which may also serve as a substitute source for the development of AEDs with unique structures and improved safety and efficacy profiles. Tests on mice using the pentylenetetrazole model of clonic seizures have demonstrated the anticonvulsant efficacy of *E. variegata*. Given that *E. variegata* has protective effects against clonic seizures, treating absence seizures may benefit from its use. [27]

Cardiovascular effects

Cardiovascular disease continues to be a major global source of morbidity and mortality despite advancements in pharmacotherapies and mechanical treatments, and this burden is certain to rise. [25]

G.K. Chatterjee et al., reported that on intravenous administration of *E. variegata* seed extract at a dose ranging from 0.1 to 0.4 mg/kg resulted in a sudden and transient drop in blood pressure in both cats and rats. A 5 mg dose of the extract resulted in a complete but reversible block of the heart in isolated frog hearts, while a lesser dose had no effect. [26]

Smooth muscle relaxant

At concentrations of 0.5–2.0 mg/mL, the total alkaloidal fraction from bark caused relaxation of the smooth muscles of isolated rabbit ileum and prevented spontaneous rhythmic contraction of isolated rat uterus. Because of its relaxing effects, *E. variegata* functions like a spasmolytic drug and can be useful in treating disorders including diarrhoea, spasms, and colic pain. [8]

Anti-osteoporotic effect

Yan Zhang et al., The study showed that *E. indica* (syn: *E.variegata*) could suppress the high rate of bone turnover induced by estrogen deficiency and improve the biomechanical properties of bone in the lab rats. [29]

Calcium homeostasis

The effects of *E. variegata* extracts on the regulation of gene expression in the kidney and duodenum as well as calcium homeostasis in overiectomized rats were assessed. In OVX rats, it raises the serum calcium level and decreases the excretion of calcium in the urine. This may be because *E. variegata* upregulates the expression of VDR mRNA in the duodenum and CaBP-9k mRNA in the kidney. [28]

Zinc removal

The dumping of undesired and unwanted foreign stuff into the environment as a result of significant industrial expansion and modernization is known as pollution. The biggest threat to humanity is the release of untreated solid, liquid, and gaseous wastes that degrade the physical and ecological surroundings. The effluents from smelters, mining, processing facilities, paints & pigments, insecticides, and galvanizing units are some of the ways that heavy metals like zinc enters water bodies. Living things are negatively impacted by zinc when its concentration in wastewater exceeds allowable limits. A multitude of biological materials have shown successful metal biosorption and in recent studies it has been reported that the leaf powder of *E. variegata* has metal biosorption properties. It is observed that when pH rises from 2 to 3, the percentage elimination of Zn(II) was found to have significantly increased and reaches its maximum at pH 7 where the agitation time is 60 min. [32]

Cadmium removal

According to reports, cadmium, a priority contaminant, can be effectively removed from aqueous solutions using powdered *E. variegata* leaf. For the cadmium biosorption onto *E. variegata* leaf powder, an equilibrium agitation duration of 50 minutes is required. As the adsorbent's size decreases from 212 to 53 μm, the percentage removal rises. When the adsorbent dosage is increased from 10 to 50g/L, the percentage removal increases as well. The percentage elimination increases dramatically when pH rises from 2 to 4. As pH rises above 7, the percentage elimination falls. [31]

Trypsin/proteinase inhibitors

Despite having a significant degree of amino acid sequence similarity, research shows that *Erythrina kunitz* proteinase inhibitors have different potencies against serine proteinases in the fibrinolytic and blood coagulation systems. [30]

V. CONCLUSION

The use of plant extracts in traditional health system, provides necessary knowledge to treat a wide range of population, particularly in developing countries and in recent years, interest in formulating plant based medicine has grown rapidly among scientists and biologists. Since medicinal plants are a source of many noble drugs, the demand for herbal formulations in the global medicine markets are increasing day by day. [35] *Erythrina variegata L.*, often known as the "Coral plant," exhibits the presence of many phyto-constituents, including alkaloids, flavanoids, steroids, tannins, glycosides, phenols, saponins, triterpenoids and resins. Ethnomedicine has utilized *E. variegata* as a therapeutic agent for a wide range of disorders and also its wide applications in experimental animal procedure have been demonstrated by numerous studies. [34] The phytoconstituents such as alkaloids and flavonoids extracted from this plant are responsible for its pharmacological effects. Furthermore, several extracts of *E. variegata* demonstrated anti-convulsant, anti-bacterial, anti-diuretic, and other properties. The entire plant has been used to cure a variety of illnesses and further step is to establish the particular bioactive molecules that might be responsible for these effects. Thus, it is imperative to cultivate, collect, and conduct additional pharmacological research on *E. variegata*. Although this plant has numerous biological and medicinal uses but its therapeutic applications are assessed only in few cases.

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