

Ethnomedicinal, phytochemical, therapeutic and pharmacological review of the genus *Erythrina*

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Abstract

Medicinal plants are nature gift to human society to live disease free healthy life and is considered as a rich resource of constituents which can be used in drug development. Genus *Erythrina* belongs to the family Fabaceae. A wide range of chemical compounds have been isolated from it, mainly alkaloids, flavonoids and terpenoids and these bioactive compounds are responsible for the medicinal value. Plants have been investigated for various pharmacological actions i.e. antipyretic, anticancer, antiviral and anthelmintic. Almost each parts of the plants of this genus have been used in traditional medicine and have wide range of uses for the treatment of various diseases and disorders. It has been reported that bark of the plant is used maximum (42%) and roots are used minimum (4%) showed in Fig.2. The trend of plant part used as per medicinal values is Bark (42%) > Leaves (28%) > Flowers (16%) > Other plant parts (10%) > Roots (4%). The present review is therefore an effort to explore a detailed survey of the literature and current knowledge on its ethnomedicinal, phytochemical, therapeutic and pharmacological properties.

Keywords: erythrina, pharmacology, phytochemistry, ethnomedicinal, therapeutic uses

Introduction

Nature has been a source of medicinal agent for thousands of years and an impressive number of modern drugs have been isolated from natural sources, many of these isolations were based on the uses of the agents in traditional medicine (Sharma *et al*, 2020; Thakur *et al*, 2020) [25-29]. Mother Nature bestowed the world with herbal and medicinal plants as a boon. The palliating and ameliorating properties of many plants have long been recognized by the traditional Indian medicinal system such as Siddha and Ayurveda. Herbal medicines involve the use of leaves, roots, stem, bark, seeds, flowers or fruits for medicinal purpose. The medicinal properties of plants are based on the presence of nutrients and phytochemicals in plants (Sharma *et al*, 2020; Thakur *et al*, 2020) [25-29]. Phytochemicals support the growth of plants and apart from that there are some phytochemicals secreted as secondary metabolites i.e. alkaloids, flavonoids, phenols, terpenoids etc. Secondary metabolites with antibacterial potency have been actively investigated as alternatives to and or combination agents with antibiotics for the therapy of bacterial infection (Muthukrishnan *et al*, 2014) [17]. The genus *Erythrina* is widely distributed in the tropical and subtropical regions of the world comprises of approximately 110 species. Some species of this genus are a rich source of alkaloids and flavonoids and certain species are used in traditional medicine for the treatment of several diseases (Amir *et al*, 2011) [1].

Synonyms

Erythrina orientalis Murr., *Erythrina indica* Lam.,
Erythrina variegata Linn., *Erythrina orientalis* L. Merrill.

Taxonomy

Kingdom: Plantae (Plants)
Division: Magnoliophyta (Flowering plants)
Class: Magnoliopsida (Dicotyledons)

Family: Fabaceae (Legume family)

Subfamily: Papilionoideae

Genus: *Erythrina* L. (Coral Tree)

The Genus *Erythrina*

The genus *Erythrina* is one among several genera from the Fabaceae family. The origin of the name *Erythrina* comes from the Greek word “erythros” which means red, alluding to the bright red flowers of the trees of the genus (Krukoff & Barneby, 1974). Over 130 species of “coral tree” belong to the genus *Erythrina*, which has been widely studied. The genus *Erythrina* is represented by about 290 species (Cronquist, 1981) [7].

Botanical Description

Genus *Erythrina* belongs to the family Fabaceae is also known as Indian coral tree or Tropical coral tree. *Erythrina species* are a medium-sized, spiny, deciduous tree normally growing to 6-9 m tall. Young stems and branches are thickly armed with stout conical spines up to 8 mm long, which fall off after 2-4 years; rarely, a few spines persist and are retained with the corky bark. Bark is smooth and green when young, exfoliating in papery flakes, becoming thick, corky and deeply fissured with age. Leaves trifoliate, alternate, bright green, petioles are long about 6-15 cm, rachis 5-30 cm long, prickly; leaflets smooth, shiny, broader than long, 8-20cm by 5-15 cm, ovate to acuminate with an obtusely pointed end. Leaf petiole and rachis are spiny. Flowers are bright pink to scarlet, erect terminal racemes 15-20 cm long. Stamens are slightly protruding from the flower. Fruit is a cylindrical torulose pod, green, turning black and wrinkly as they ripen and thin walled and constricted around the seeds (Vaidyaratana *et al*, 2003; Kapoor *et al*, 2006; Nadkarni, 2006) [14, 18].

Habitat

Erythrina is well adapted to semi-arid humid and sub-tropics, found mostly in zones with annual rainfall of 750 to

1500mm. The species is commonly found at an elevation of 1500m. The plant grows all over the India mainly in forests and hills (Kapoor *et al*, 2006) ^[14].

Phytochemistry

Traditional usage of medicinal plant indicates that the plant has bioactive phytochemicals. These phytochemicals are responsible for their pharmacological properties. *Erythrina* is a rich in source of phenolic metabolites, such as pterocarpans, isoflavones, flavanones and chalcones, some of which displayed, antimycobacterial activity and cytotoxic activity against various cancer cell lines. It contains alkaloids and also contains sterols like campesterol, β -sitosterol, β -amyrin. Isoflavones named as indicanines D and E together with 9 known compounds including 6 isoflavones like genistein, wightone, alpinum isoflavones, dimethyl alpinum isoflavone, 8-prenyl erythrinin 'C' and erysenegalensein E and one Erythrinassinate B. Flavonoids include apigenin, genkwanin, iso-vitexin, swertisin, saponin, 5-O-glucosylswertisin and 5-O-glucosylisowertisin. The alcohol insoluble portion of the unsaponifiable matter has yielded n-hexosamol, heptacosine, nonacosane. The non-saponifiable matter of the petroleum ether extract has yielded myristic, stearic and oleic acids and also it contains erythrinins A, B, C (Asolkar & Kakkar, 1992; James & Christopher, 1999) ^[4, 12].

Alkaloids

The species of genus *Erythrina* is a rich in source of alkaloids (2.5%) (3-Demethoxyerythratidinone, erythraline, erythramine, erythrinine, erythratidinone, erysonine, erysotine, erysodine, (erysovine, 11-hydroxy-*epi*-erythratidine, erythratidine, *epi*-erythratidine, erysodienone, (erysotrine, erysopitine, 11- β -hydroxyerysotrine, erythartine are the tetracyclic alkaloids isolated from the various parts of plants (Gupta, 2002) and scoulerine, coreximine, 1-reticuline, and erybidine isolated from leaves (Rastogi *et al*, 2006) The ethanolic extract yielded chloroform-soluble and water-soluble bases, identified as erysovine and stachydrine (Singh *et al*, 1972). Eight spiroamine alkaloids along with three carboxylated indole-3-alkylmamines – hypaphorine, its methyl ester and *N*, *N*-dimethyltryptophan isolated from various parts of plant (Ghosal *et al*, 1972) ^[9]. Presences of isoquinoline (erythritol) and isococcolinine alkaloids are also reported in the studies (Chawla & Sharma, 1993).

Flavonoids

Flavonoids are chemical phenyl benzopyrones, which, usually conjugated with sugars, are present in all vascular plants (Zanoli *et al*, 2000) Isoflavonoids are reported to be the major phytoconstituents of *Erythrina*. It contains mainly erythrinins A, B, and C, osajin and alpinum isoflavone, in addition to the styrene oxyresveratrol and dihydrostilbene dihydroxyresveratrol. Linear pyranoisoflavones, robustone and 4-*O*-methylalpinum isoflavone are also isolated from the plant (Chawla *et al*, 1988) The previous studies that reported erycricstagallin, orientanol B, erystagallin A, stigmaterol, campesterol, stigmoidins A, B, and C, phaseollin, 3- β -acetoxy-B-norcholest-5-ene, docosanoic

methyl ester, 29-norcycloartenol, β -sitosterol and its archidate, and capric acid as main components refuted by recent well-documented and reliable investigations. Presence of flavonoid abyssinone V, erycricstagallin and 4-hydroxy-6, 3, 5-triprenylisoflavone was confirmed in other studies (Hedge *et al*, 1997) In recent studies two new diphenylpropan-1,2-diols, eryvarinols A and B, three new isoflavonoids, eryvarins M-O, two new 2-arylbenzofurans, eryvarins P and Q and a 3-aryl-2,3-dihydrobenzofuran, eryvarin R were isolated from the roots of *E. variegata* and their structures were elucidated on the basis of spectroscopic and chemical evidence (Tanaka *et al*, 2004). Bioassay-directed fractionation of the stem bark extract of *E. variegata* has resulted in the isolation of three new isoflavones: 5,4'-dihydroxy-8-(3,3-dimethylallyl)-2''ethoxyisopropylfurano [4,5:6,7] isoflavone, 5,7,4'-trihydroxy-6-(3,3-dimethyl allyl oxiranyl methyl) isoflavone, 5,4'-dihydroxy-8-(3,3-dimethylallyl)-2''-hydroxymethyl-2''methylpyranol [5, 6:6, 7] isoflavone and a new isoflavanone, 5,4'-dihydroxy-2''methoxy-8-(3,3-dimethylallyl)-2''-2''-dimethylpyranol [5, 6:6, 7] isoflavanone, together with seven known compounds, euchrenone b₁₀, isoerysenegalensein E, wightone, laburnetin, lupiwightone, erythrodiol, and oleanolic acid (Xiaoli *et al*, 2006) ^[35]. Other newly reported isoflavonoids of *E. Variegata* are epilupeol, 6-hydroxygenistein, and 3 β , 28-dihydroxyolean-12-ene (Rahman *et al*, 2007) ^[19].

Other phytoconstituents

Various other constituents, which have been reported from Genus *Erythrina* include erythrabyscin II, dihydrofolinin, octacosyl ferulate, wax alcohol, wax acids, alkyl ferulates, and alkyl phenolates. Seeds content moisture (3.8%), crude protein (31.2%), pentosan (11.9%), and water-soluble gum (1.6%). The amino acid composition of seed protein is as follows: alanine (7.2), arginine (3.4), 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. The seeds also contain isolecitins (EVLI, EVLII and EVLIII), the Kuntz-type trypsin inhibitors (ETIa and ETIb) chymotrypsin inhibitor (ECI) (Samantha and Laskar, 2008). Some important alkaloids that are distributed within plants from the *Erythrina* genus are areerytharbine, erythartine, erysotramidine and erysotrine. It is noteworthy that a characteristic feature of these alkaloids is the Spiro structure in the rings bearing the Nitrogen atom. (Joao X. de Araujo-Junior *et al*, 2012) ^[13]. A new 3-phenylcoumarin, indicanine A has been isolated from the root bark of the African medicinal plant. *Erythrina* together with three known compounds, robustic acid, daidzein, and 8-prenyldaidzein (Zhang *et al*, 2007; Kumar *et al*, 2010) ^[15]. Some important alkaloids that are distributed within plants from the *Erythrina* genus are erytharbine, erythartine, erysotramidine and erysotrine, shown in figure 1. It is noteworthy that a characteristic feature of these alkaloids is the spiro structure in the rings bearing the nitrogen atom Fig.1

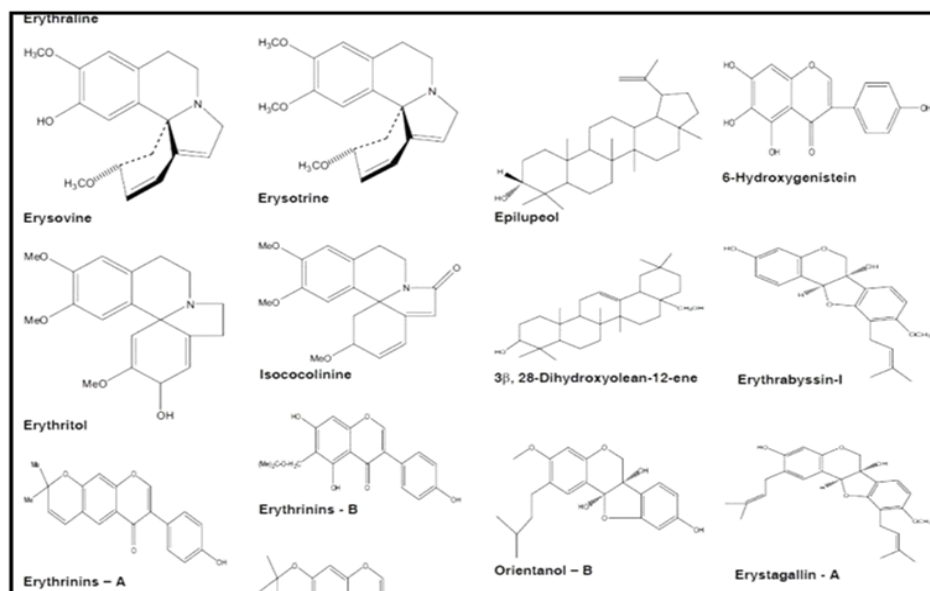


Fig 1: Few phytoconstituents of *Erythrina* species

Ethnomedicinal Uses

Genus *Erythrina* has been studied for its ethnomedicinal properties which are reported in Ayurveda, Siddha and Unani. Each plant part has significant uses like an Indian preparation is used to destroy pathogenic parasites and relieves joint pain. Juice from the leaves is mixed with honey and ingested to kill tapeworm, roundworm, and threadworm. Women take this juice to stimulate lactation and menstruation. A warm poultice of the leaves is applied externally to relieve rheumatic joint pains. The bark is used as laxative, diuretic, and expectorant. The leaf juice is used to heal wounds and sores. Leaf paste applied for muscular pain in cattle, the bark decoction is used in stomach disorders, anti-abortion treatment, malarial fever and liver problems. *E. indica* is used as a wind break and shade tree with in common plants. The coral plant is a multiuse plant for human as well as animals. It is used as food, the new leaves are eaten in curries, it is used as livestock fodder when lopped as it is rich in nitrogen (4% of dry weight), as fiber, the bark is stringy and provides a strong fiber that is used in rope making, as medicine: the bark and leaves Is used in stomach disorders, anti-abortion treatment, malarial

fever and liver problems, as Timber: The wood is light, soft, does not split and neither warps, making it suitable in applications where heavy wood is unsuitable such as in small curved articles. A red dye is extracted from its flowers and many more (Kumari and Kumari, 2017) [16]. The leaves are reportedly used to make a drink to cure curses, and the smoke from smoldering leaves, bark, or roots is inhaled for the same purpose. Also, the leaves and bark are reportedly used as a potion to treat stomach ache. The bark is mixed with others and used to treat stomach ache and occasionally used to treat eye ailments, and the bark is applied to swellings. In India, China, and Southeast Asia, the bark and leaves are used in many traditional medicines, including one said to destroy pathogenic parasites and relieve joint pain; the juice from the leaves is mixed with honey and ingested to treat tapeworm, roundworm, and threadworm in India; women take this juice to stimulate lactation and menstruation; it is commonly mixed with castor oil to treat dysentery; a warm poultice of the leaves is applied externally to relieve rheumatic joints; and the bark is used as a laxative, diuretic, and expectorant (Arthur *et al*, 2006) [3]. The various ethnomedicinal uses are tabulated in Table 1.

Table 1: Ethnomedicinal Uses of various species of Genus *Erythrina*

S.No.	Name of the Plant Species	Plant Parts Used	Ethnomedicinal Properties
1.	<i>Erythrina abyssinia</i>	Bark, roots	Trachoma, malaria, syphilis, elephantiasis
2.	<i>Erythrina americana</i>	Bark, flowers	Malaria, insomnia
3.	<i>Erythrina arborescens</i>	Bark, leaves	Anthelmintic, earache
4.	<i>Erythrina berteroaana</i>	Leaves	Snakebite, abscesses, boils, skin infections
5.	<i>Erythrina corallodendron</i>	Bark, leaves	Antiasthmatic, expel placenta
6.	<i>Erythrina coralloides</i>	Seeds	Measles
7.	<i>Erythrina cristagalli</i>	Bark, leaves	Urinary tract infections, respiratory tract infections, diarrhea, narcotic, antiseptic
8.	<i>Erythrina dominguezii</i>	Bark	Swelling and healing
9.	<i>Erythrina flabelliformis</i>	Seeds, leaves	Diarrhea, toothache, contraceptive
10.	<i>Erythrina folkersii</i>	Bark, seeds	Inflammation of uterus, appendicitis, diuretic
11.	<i>Erythrina fusca</i>	Bark, flowers	Migraine, infected wounds, fungal dermatosis
12.	<i>Erythrina glauca</i>	Bark and leaves	Headache, narcotic, kidney inflammation
13.	<i>Erythrina herbacea</i>	Seeds	Rats poison
14.	<i>Erythrina humeana</i>	Bark	Tuberculosis
15.	<i>Erythrina indica</i>	Bark, leaves, roots seeds	Antipyretic, eyedrop, menstrual regulator, laxative, diuretic, stimulation of milk production
16.	<i>Erythrina lanata</i>	Whole plant	Poison

17.	<i>Erythrina mildbraedii</i>	Bark	Aphrodisiac
18.	<i>Erythrina mulungu</i>	Bark	Antipyretic
19.	<i>Erythrina sacleuxii</i>	Leaves, roots	Antimalarial
20.	<i>Erythrina senagalenisis</i>	Bark, leaves, twig	Serious injury, yellow fever, bronchial diseases, eyes disorders and injuries
21.	<i>Erythrina species</i>	Bark, leaves	Broken bones, antipyretic
22.	<i>Erythrina standleyana</i>	Bark, leaves,	Parturition, toothache, nosebleed
23.	<i>Erythrina stricta</i>	Bark	Epilepsy, leprosy
24.	<i>Erythrina subumbrans</i>	Leaves	Menorrhagia
25.	<i>Erythrina ulei</i>	Bark	Antiseptic

Table Source: (Joao X. de Araujo-Junior *et al*, 2012)

Pharmacological Uses

The leaves of *Erythrina* (*E. indica*) are used to improve appetite and urinary discharge inflammation. Traditionally the leaves are known to possess analgesic, anti-helminthic, antiulcer and sedative properties. *E. indica* bark is used medicinally as febrifuge, anti-bilious, and anti-diarrheal antirheumatic. The bark has also been used in the treatment of asthma, burning sensation, itching, fever and leprosy (Amir *et al*, 2011) [1]. The various pharmacological properties of Genus *Erythrina* are showed in Table 2.

Anti-microbial activities

Genus *Erythrina* has been studied for its various anti-microbial activities. The antimicrobial activity has been screened because of its great medicinal relevance with the recent years, infections have increased to a great extent and resistance against antibiotics, become an ever-increasing therapeutic problem. Plant based antimicrobials have enormous therapeutic potential as they can serve the purpose without any side effects that are often associated with synthetic antimicrobial compounds. Many of the plants belonging to *Erythrina* genus possess secondary metabolites which are usually produced under stress conditions and often in response to infections. The root extracts of *Erythrina* possess antimicrobial activity against *Staphylococcus aureus* and *Mycobacterium smegmatis* (Doughari *et al*, 2008) [8].

Antibacterial/dental caries prevention

Isoflavonoids isolated from *Erythrina* (*E. variegata*) has been screened for antibacterial activity against methicillin-resistant *Staphylococcus aureus* and various other strains. Of the active compounds, erycristagallin and orientanol B showed the highest antibacterial activity. The antibacterial effect of erycristagallin to mutans streptococci was based on a bactericidal action. Erycristagallin has a potential as potent phytochemical agent for the prevention of dental caries by inhibiting the growth of cariogenic bacteria and by interfering with incorporation of glucose responsible for production of organic acids (Sato *et al*, 2003; Rahman *et al*,

2007) [24, 19].

Anti-helminthic activity

Various plant parts extract showed anthelmintic activity against *Pheritima posthumous* and other species (Sato *et al*, 2003) [24].

CNS effects

In the study total alkaloid fraction from the bark showed several characteristic pharmacological effects: neuromuscular blocking, CNS depressant, and anticonvulsant effects which are consistent with the reported uses of the plant extracts in the indigenous system of medicine. (Ghosal *et al*, 1972) [9].

Antioxidant activity

Saraswathy *et al*, 2008 [23] investigated the ethanolic extract of the stem bark of *E. indica* was screened for its invitro antioxidant activity and the ethanolic extract of the stem bark of *E. indica* possess significant antioxidant activity in Indian drugs. The generation of free radicals and other reactive oxygen species in the body is compensated by an elaborate endogenous antioxidant system. However, due to many environmental, lifestyle, and pathological situations, excess radicals can accumulate, resulting in oxidative stress. The potential value of antioxidants in eradicating oxidative stress has provoked researchers to investigate for natural compounds with potent antioxidative activity but low cytotoxicity. Crude extract obtained from the *E. variegata* evaluated for their radical scavenging properties and assessed that it could be rich source of natural oxidants for applications (Anwar, 2006) [2].

Analgesic and anti-inflammatory

The alkaloids extracted from the leaves of *E. variegata* are reported to have anti-inflammatory activity. The leaves and bark are also used in fever and rheumatism. It has been reported that the methanolic extracts of the leaf of *E. variegata* showing significant antinociceptive activity (Kumar *et al*, 2010) [15].

Table 2: Pharmacological activity of various species of Genus *Erythrina*

Name of the Species	Plant Part Utilized	Pharmacological activities	Location
1. <i>Erythrina abyssinia</i>	Bark, leaves, root	Mitogenic activity, anti-bacterial, anti-yeast, antimalarial, uterine relaxing and stimulant, toxic effect in rats, antiviral, peripheral muscle relaxing and stimulant, antidiarrheal	Kenya
2. <i>Erythrina Americana</i>	Bark	Plant germination, inhibition	unspecified
3. <i>Erythrina arborescens</i>	Leaves, stem, roots	Hypotensive, cytotoxic, antispasmodic,	India
4. <i>Erythrina berteriana</i>	Leaves, twigs, root, bark	Anti-yeast and anti- bacterial, cytotoxic, anti-fungal, pheromones etc.	Guatemala
5. <i>Erythrina bidwillii</i>	Root bark	Anti-fungal, anti-bacterial, and anticoagulant	Okinawa
6. <i>Erythrina breviflora</i>	Leaves, stem	Cancer induction	USA
7. <i>Erythrina caffra</i>	Bark, leaves	COX1 inhibitor, anti- bacterial	South Africa

8. <i>Erythrina corallodendron</i>	Seeds, dry fruits, seeds, leaves, stem	Antiphagocytic, trypsin inhibition	Greece, Israel
9. <i>Erythrina coromandelianum</i>	Whole plant	Molluscicidal activity	unspecified
10. <i>Erythrina crista-galli</i>	Bark, leaves, seed, flower, root, stem	Anti- inflammatory, analgesic, anti-bacteria, anti-phagocytic, anti-fungal, cytotoxic, antiviral, animal repellent	Argentina, Greece, Brazil, Germany, Egypt
11. <i>Erythrina eriotricha</i>	Root, bark	Anti-bacterial	Cameroon
12. <i>Erythrina excelsa</i>	Root, bark	Antibacterial, antifungal	East Africa
13. <i>Erythrina flabelliformis</i>	Seeds	Larvicidal	Unspecified
14. <i>Erythrina fusca</i>	Leaves	Hypotensive, uterine stimulant, diuretic, CNS depressor	Thailand, Indonesia
15. <i>Erythrina glauca</i>	Bark	Antiviral	Guatemala
16. <i>Erythrina humeana</i>	Bark, leaves	Antibacterial	South Africa
17. <i>Erythrina indica</i>	Bark, Leaves, Stem Flowers, root seeds	Antifungal, antibacterial, antimalarial, CNS depressor, cytotoxic	India, Sri Lanka, Egypt, and Nigeria
18. <i>Erythrina latissima</i>	Bark, leaves	Antibacterial	South Africa
19. <i>Erythrina lysistemon</i>	Bark, leaves, stem, roots	Antifungal, antibacterial, anti-yeast, estrogenic, bone formation stimulant, antidiabetic etc.	South Africa
20. <i>Erythrina mildbraedii</i>	Whole plant	Anti- tumoral, toxic effect, cytotoxic, anti-mycobacterial, and anti-bacterial	Unspecified
21. <i>Erythrina poeppigiana</i>	Root	Cytotoxic	Columbia
22. <i>Erythrina resupinata</i>	Roots	Fetal anti- implantation, anti- tumoral, uterine stimulant, abortive, toxicity evaluation	India
23. <i>Erythrina rubrinervia</i>	Twigs	“DNA linker”, cytotoxic	Unspecified
24. <i>Erythrina saculeuxii</i>	Leaves, root bark	Antimalarial, cytotoxic	Tanzania
25. <i>Erythrina senagalensis</i>	Bark, root, stem, flowers	Antimalarial, analgesic, anti- inflammatory, antibacterial etc.	Nigeria
26. <i>Erythrina sigmoidea</i>	Bark, roots stem	Anti-yeast, anti-fungal	Cameroon
27. <i>Erythrina variegata</i>	Bark, leaves, stem oil, fresh flower,	Anti-gastric ulcer, inhibition of plant germination and growing, anti- bacterial, anti-fungal, juvenile hormone activity, central nervous system effects, anti- yeast, anti- bacterial, anti-inflammatory, anti-tumoral, Skeletal muscle relaxer, spasmolytic	India, Thailand, Brazil
28. <i>Eythrina velutina</i>	Leaves, stem bark, tunk	Analgesic, anti-inflammatory, uterine stimulant, and molluscicidal	Brazil
29. <i>Erythrina variegata var. orientalis</i>	Leaves	Antispasmodic cytotoxic toxicity evaluation anti-yeast	India
30. <i>Erythrina variegata var. orientalis</i>	Root	Anti- bacterial anti-mycobacterial cytotoxic	Philippines
31. <i>Erythrina variegata var. orientalis</i>	Stem bark	Antiplasmodic	Brazil
32. <i>Erythrina vespertilio</i>	Bark	Inhibition of platelet aggregation Serotonin release inhibition	Australia
33. <i>Erythrina vogeli</i>	Root bark	Anti- fungal	Ivory Coast
34. <i>Erythrina zeyheri</i>	Leaves	Anti-bacterial COX1 inhibitor	South Africa

Table Source: (Joao X. de Araujo-Junior *et al*, 2012)

It is important to note that some of the activities shown in the biological tests were not cited in the ethnopharmacological studies, which indicates yet another importance for plants of the *Erythrina* genus, which have the potential to provide new compounds for the development of drugs for the treatment of diseases such as cancer, diabetes and hypertension.

Ethnomedicinal and Pharmacological Data

From the extensive literature survey and current knowledge of ethnopharmacological uses of various species of Genus *Erythrina*. As a result, the various parts of plants used in different traditional cultures are recorded. It has been reported that bark of the plant is used maximum (42%) and roots are used minimum (4%) showed in Fig.2. The trend of plant part used as per medicinal values is Bark (42%) > Leaves (28%) > Flowers (16%) > Other plant parts (10%) > Roots (4%).

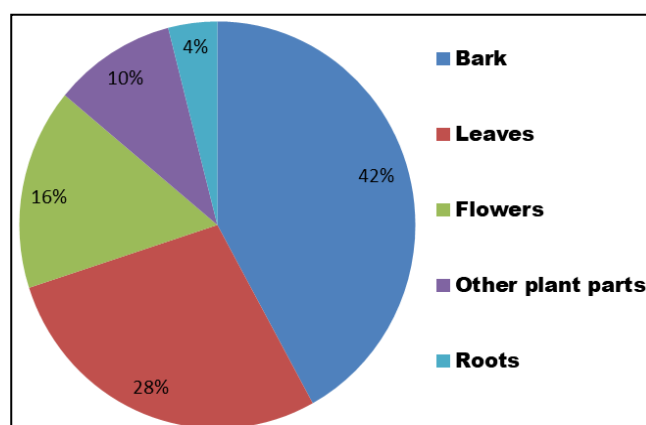


Fig 2: Various plant parts used in ethnomedicine and ethnopharmacology

Conclusion

This review concluded that *Erythrina* species are commonly utilized for numerous diseases and that many ethnomedicinal, phytochemical and pharmacological studies have been performed in order to confirm the activities attributed to these species. Due to its amazing chemical constituents it has several therapeutic as well as clinical applications such as antimicrobial, anthelmintic, wound healing, antioxidant, anticancer, diuretic, and cytotoxicity. In India, rural peoples are well aware of the usage of medicinal plants. Apart from the Botanists and Ayurvedic practitioners also possess good knowledge about the plants. In this study, there was a much attention on this genus *Erythrina* and their medicinal importance and pharmacological actions. There are thousands of tribal and other ethnic groups in India. Apart from that tribal group many other rural people also possess good knowledge about the plants. In the present article, we have reviewed the relevant literature to congregate the botanical, ethnomedicinal, phytochemical, and pharmacological information on various species of genus *Erythrina*.

References

1. Amir F, Wan SY, Yen CK. Phytochemical constituents and biological activities of *Erythrina indica*, European Journal of Chemistry. 2011; 2(4):561-565.
2. Anwar M. The pharmacognostic and pharmacological studies on medicinal valued herbal drugs, *Erythrina variegata* Var. *Orientalis*, *Matricaria chamomilla*, *Psoralea corylifolia* and *Chenopodium album*. Ph D. Thesis, Faculty of Pharmacy, University of Karachi, Karachi, Pakistan, 2006.
3. Arthur W, Whistle Craig R, Elevitch. *Erythrina variegata* (Coral tree). Species profiles for Pacific Island Agroforestry. 2006; 3:1-16.
4. Asolkar LV, Kakkar KK, Chakre OJ. Second supplement to Glossary of Indian Medicinal Plants with Active Principles, Part I (A-K), 1992 Edition, Published by CSIR, 1992, 300-301.
5. Chawla AS, Krishnan TR, Jackson AH, Scalabrinm DA. Alkaloidal constituents of *Erythrina variegata* bark. *Planta Med.* 1988; 54:526-8.
6. Chawla HM, Sharma SK, Erythritol, a new isoquinoline alkaloids from *Erythrina variegata* flower, *Fitoterapia*, 1993, 64-115.
7. Cronquist A. An integrated system of classification of flowering plants, Columbia University Press, ISBN 0231038801, 9780231038805, New York, United States of America, 1981.
8. Doughari JH, El-mahmood, AM Jyoyina I. Antimicrobial activity of leaf extracts of *Seena obtusifolia* (L). *African Journal of Pharmacy and Pharmacology.* 2008; 2:7-13.
9. Ghosal S, Dutta SK, Bhattacharya SK. Erythrina-chemical and pharmacological evaluation II: Alkaloids of *Erythrina variegata* L. *Journal of Pharmaceutical Sciences.* 1972; 61:1274-1277.
10. Gupta VK. editor. The Wealth of India (A dictionary of Indian raw materials and industrial product) 3rd Ed. New Delhi: National Institute of Science Communication and Council of Industrial and Scientific Research, 2002.
11. Hegde VR, Dai P, Patel MJ, Puar MS, Das P, Pai J. Phospholipase A2 Inhibitors from an *Erythrina* Species from Samoa. *Journal of Natural Products.* 1997; 60:537-539.
12. James HR, Christopher D, Mary JH. Synthetic studies on the *Erythrina* alkaloids. Preparation of 2-epi-erythritol, *Tetra Hedron Letters.* 1999; 40:6887-6890.
13. Joao Xde, Araujo-Junior, Mariana, De Oliveira SG, Pedro, Aquino GV *et al.* Phytochemical and Ethnopharmacological review of the Genus *Erythrina.* 2012; 3:228-256.
14. Kapoor LD. *Ayurvedic Medicinal plants*, CRC Press, Delhi, (2006-2005), 177-178.
15. Kumar BS, Prasad DN, Sandhya S, Rao KNV, Banji D. Cultivation, Phytochemistry, Pharmacological Actions and Therapeutic Applications of *Erythrina indica*. *Lam. International Journal of Applied Biology and Pharmaceutical Technology.* 2010; 1(3):858-968.
16. Kumari P, Kumari C. "*Erythrina variegata* L." The Coral Tree: A Review, *Journal of medical science and clinical research.* 2017; 5(08):26705-26715.
17. Muthukrishnan S, Palanisamy S, Santhanam I, Gandhi K. Phytochemical screening and antimicrobial activity of *Erythrina variegata*, *World Journal of Pharmacy and Pharmaceutical Sciences.* 2014; 3(6):680-690.
18. Nadkarni KM. *Indian Medicinal Plants and Drugs with Their Medicinal Properties and Uses*, published by Srishtih book distributors, Delhi, 2006, 153-154.
19. Rahman MZ, Sultana SZ, Faruquee CF, Ferdous F, Rahman MS, Islam MS. Phytochemical and Biological investigation of *Erythrina variegata*. *Saudi Pharma Journal.* 2007; 15:40-145.
20. Rastogi RP, Mehrotra BN, editors. *Compendium of Indian medicinal plants.* 2nd ed. Lucknow: Central Drug Research Institute and New Delhi, National Institute of Science Communication and Info Resources; Anonymous, 2006.
21. Sakat SS, Juvekar AR. Comparative study of *Erythrina indica* Lam. (Fabaceae) leaves extracts for antioxidant activity, *Journal of Young Pharma.* 2010; 2:63-67.
22. Samanta TD, Lskar S. Chemical investigation of *Erythrina variegata* Linn. Seed proteins. *Food Chemistry,* 2008, 114:212.
23. Saraswathy A, Ramaswamy D, Nandini DS. Invitro antioxidant activity and heavy metal analysis of stem bark of *Erythrina indica*. *Lam. Indian drugs.* 2008; 45(8):631-634.
24. Sato M, Tanaka H, Fujiwara S, Hirata M, Yamaguchi R, Etho H. Antibacterial property of isoflavonoids isolated from *Erythrina variegata* against cariogenic oral bacteria. *Phytomedicine.* 2003; 10:427-433.
25. Sharma M, Sharma AK, Thakur R, Sharma M. Dynamics of Traditional Information of Medicinal Plants from Hilly Terrains of Ramban (J&K) India. *Indian Journal of Ecology.* 2020; 47(4):1009-1013.
26. Sharma M, Thakur R, Sharma M, Sharma A.K, Sharma AK. Changing Scenario of Medicinal Plants Diversity in Relation to Climate Changes: A Review. *Plant Archives.* 2020; 20(2):4389-4400.
27. Sharma M, Sharma AK, Sharma M. Ethno-Botanical Study of Medicinal Plants from Unexplored Area of District Ramban (J&K) India. *Indian Journal of Agricultural Research.* 2020; 54:1-7. doi:10.18805/IJArE.A-5561.
28. Sharma M, Thakur R, Sharma M. Ethno-Botanical Survey of Medicinal Plants of Unexplored Hilly Areas

- of District Ramban (J&K), International Journal of Botany Studies. 2020; 5(3):55-63.
29. Sharma M, Thakur R, Sharma M. Ethnomedicinal, Phytochemical and Pharmacological Properties of *Crocus sativus* (Saffron). The Journal of Indian Botanical Society. 2020; 99(3-4):115-126.
 30. Singh H, Chawla AS, Jindal AK, Conner AH, Rowe JW. Investigation of *Erythrina* spp. VII: Chemical constituents of *Erythrina variegata* Var. *orientalis* bark. Lloydia. 1972; 38:97-100.
 31. Tanaka H, Hirata M, Etoh H, Sako M, Sato M, Murata J. Six new constituents from the Roots of *Erythrina variegata*. Chem Biodiversity. 2004; 1:1101-1108.
 32. Tanaka H, Hirata M, Etoh H, Watanabe N, Shimizu H, Ahmad M. Two Diphenylpropan-1, 2-diol Syringates from the Roots of *Erythrina variegata*, Journal of Natural Productio. 2002; 65:1933.
 33. Thakur R, Sharma M, Sharma M, Sharma AK. Biodiversity Status of Major Medicinal and Aromatic Plants (MAPs) in J&K, India. In: Traditional Medicinal Plants AkiNik Publications, 2020, 81-112. <https://doi.org/10.22271/ed.book.911>.
 34. Vaidyaratnam, Varies PS. Indian Medicinal Plants. A compendium of 500 species, vol II, 2006 edition, Published by Orient Longman pvt. ltd, Kotakkal, 2003, 378-381.
 35. Xiaoli L, Naili W, Sau WM, Chen AS, Xinsheng Y. Four Isoflavonoids from the stem bark of *Erythrina variegata*. Journal of chemistry and pharmaceutical research. Bull (Tokyo), 2006, 554:570.
 36. Yadava RN, Reddy KIS. A novel prenylated flavone glycoside from the seeds of *Erythrina indica*. Fitoterapia. 1999; 70(4):357-360.
 37. Zanolli P, Avallone R, Baraldi M. Behavioral characterization of the flavonoids apigenin and chrysin. Fitoterapia. 2000; 71:117-123.