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A Complete Profile on Phyto Pharmaceutical Studies of Mangrove *Excoecaria Agallocha* Linn

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A B S T R A C T

In traditional medicine, an extensive variety of plants that have distinct pharmacological and medicinal benefits are utilized. The essential mangrove plant Excoecariaagallocha L. (Euphorbiaceae) is extensively investigated in this article, along with its phytochemistry, ethnobotany, and medicinal benefits. In earlier times, it has been utilized for treating a wide range of illnesses, which include paralysis, rheumatism, leprosy, ulcers, and epilepsy. The plant has been frequently referred to as the "blind-your-eye mangrove plant" due to the toxic latex that can cause short-term blindness in individuals. Multiple phytoconstituents have been determined from the plant, includes sterols, flavonoids, triterpenoids, diterpenoids, and a few more substances. More than fifty volatile components, fifteen terpenoids, and twenty different polyphenols were detected in the extracts of the leaves, stem, latex, and roots.Antioxidant, antibacterial, anti-inflammatory, analgesic, antiulcer, anticancer, antireverse transcriptase, antihistamine-release, antifilarial, DNA damage protective, antidiabetic, and antitumor protecting characteristics are just a few of the plant's several pharmacological qualities. As a result, this study may be beneficial for experts who want to carry out more research in those domains.

Keywords: Mangroves, pharmacology, phytoconstituents, Euphorbiaceae, Excoecariaagallocha, rutin, terpenoids, diterpenoids, and ThillaiMangroves, pharmacology, phytoconstituents, Euphorbiaceae, Excoecariaagallocha, rutin, terpenoids, diterpenoids, and Thillai

1. Introduction

A kind of flora referred to as mangroves can be observed in tropical and subtropical coastal intertidal zones. The majority of the mangrove community's trees and shrubs have thick, leathery leaves which persist all year and are round and can withstand salt content. Sometimes tree roots spread upwards from the main stem and branches, creating an unstable and sticky a basis resemble stilts. At the Chidambaram shrine of "Tillai Lord Nataraja," an old species of mangrove known as "Talavirucham" in Tamil is called Excoecariaagallocha L. (Euphorbiaceae). The common names for Excoecariaagallocha are "Agallocha," "blinding tree," "Tillai," "Kampetti," "Tilla," "Tella," and "Chilla" in Telugu, and "Thelakiriya," "Thalia," in Singhalese and Tamil. It is found extensively through Australia, from Northern New South Wales to the Indian Coastal Regions and the Pichavaram Mangrove Forest.toAustralia's West. By Red List regulations, it is a least-concern social standing [1]. (arranged categorizing) (Figure 1). For the majority of their essential medical needs, nearly everyone in the world completely or partially rely on the traditional medical system. A 1993 global health organization survey finds that approximately 80 percent, 90%, and 85% of patients in India, Bangladesh, and Burma receive medical attention by traditional physicians [2]. Industrialized as well as developing nations have been utilising more plant-based food health cures in recent years, which has led to a significant rise in the global market for herbal products. An expanding ability have been found in the study of herbals [3].

1.1 Plant Introduction

The genus Excoecariaconsists roughly forty species that occur in mangrove circumstances in Asia, Africa, and northwest Australia [5]. The milky latex which the bark of Excoecariaagallocha develops has the potential to be hazardous and may trigger epidermal swelling and partial blurry vision [6]. In addition is the latex recognized for being capable of kill aquatic creatures and phytoplankton, but it also causes a metabolic a slump in Oziotelphusasenex, the rice field crab. It may also be utilized as auterotonic, fish poison, dart poison, and includes captivating materials titled chalcones and piperidine alkaloids [7]. The leaves of E. agallocha usually get shed once a year. They don't have the characteristic airborne roots known pneumatophores, which extend above the soil's surface while providing oxygen to the roots below it, like greater mangrove species do[(8)].

Fig 1: *Excoecariaagallocha*. Linn

1.2 Vernacular names [9]

Telugu	:	Thilla
Hindi	:	Gangiva, Tejbala
English	:	Milky mangrove, blind-your-eye-mangrove
Sanskrit	:	Agaru, Gangwa, Gaourai
Bengali	:	Gewa
Malayalam	:	Komatti, Kammetti, Kannampotti

1.3 Botanical description

Botanical name: *Excoecariaagallocha.* Linn

Synonyms [9, 10]

Excoecaria affinis Endl.

Excoecaria camettia Willd.

Stillingiaagallocha L.

Commiacochinchinensis, Lour.

Excoecariaagallocha var. lancifolia, Pax& K. Hoffm.

*Excoecariaagallocha var. orthostichalis*Mull.Arg

Excoecariaagallochavar.dallachyana, Baill.

Excoecariaagallocha var. muelleriana, Baill.

Excoecariaagallochavar.ovalis(Endl.), Mull. Arg.

Common name [9]

Blind-Your-Eyes,

Buta-Buta, Bebuta,

Milky Mangrove,

KayuButa-buta,

Kampetti,

Thilla, Tilai.

Taxonomical classification [9]

Kingdom : Plantae

Phylum	:	Charophyta
Class	:	Equisetopsida
Subclass	:	Magnoliidae
Order	:	Malpighiales
Family	:	Euphorbiaceae
Genus	:	*Excoecaria*
Species	:	*E. agallocha*Linn.

Biogeographical Distribution [11]:

Native Distribution: From India and Sri Lanka, to Taiwan, southern Japan, Southeast Asia, Papua New Guinea, Northern Australia, and the Pacific Islands.

Native Habitat: Shoreline (Mangrove Forest)

Preferred Climate Zone: Tropical, Sub-Tropical, and Monsoonal climate zones are preferred.

Morphology [9, 11]

The tree that was planted is 15 meters tall and contains multiple tendrils. Its grayish-brown, warty bark elements vertical fissures and lenticels. Any plant splinter than breaks generates a white latex solution. Because deciduous, it generally leaves its leaves well in ahead of flowering.
Stem: Bark seeps fast and a great deal, sometimes becoming brown.
Roots: Roots are elongated and frequently covered in lenticels lying parallel to the ground.
Leaves: Thick, oval, pointy, and alternating (5–10 cm long), leaves are grouped in a spiral manner. New leaves are pink, while older leaves first turn yellow, then fiery red and then wither away. Usually, dry weather causes leaves to drop.
Flowers: Less than 1mm in size, flowers are small. Trees only produce one type of develop, never two: male or female. Male flowers begin as thin erect cones.When adolescents, they increase into longer spikes (5–10 cm), they eventually turn into yellow tassels that suspend. It has been said that male flowers are "very scented".Shorter spikes can be observed in female flowering.
Fruits and Seeds: Fruits: surrounding 8 mm in diameter, 3 petals. The seeds are approximately 4 mm long. The radicle has a single millimeter long.

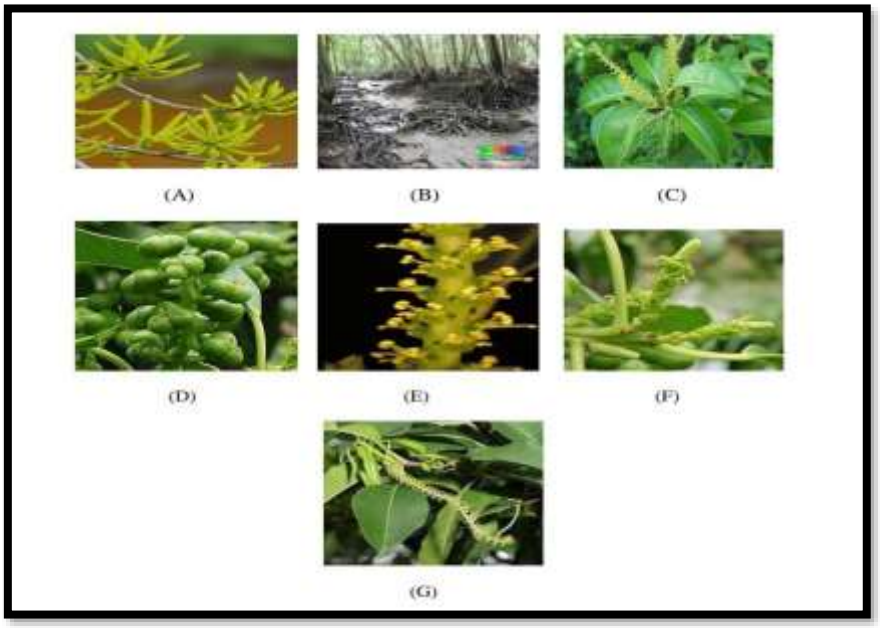


Fig: 2. Parts of *Excoecariaagallocha*Linn. (A) Flowering branches (B) Roots (C) Leaves (D) Fruits (E) Flowers (F) Female flowers (G) Male flowers.

2. Uses

2.1. Ayurvedic uses [12]

Studying the effects of E. agallocha extracts pharmacologically revealed

1. Antioxidant and antibacterial
2. Antiviral
3. Anticancer
4. Anti-inflammatory and analgesic
5. Treatment of Epilepsy
6. Reduce Ulcers
7. Leprosy
8. Rheumatism and paralysis

2.2 Traditional medicinal uses [9]

1. In addition, it has been historically used to treat dermatitis, haematuria, and conjunctivitis.
2. This plant secretes latex, which has been used as a purgative, abortifacient, and to cure rheumatism, paralysis, ulcers, and leprosy.
3. The indigenous populations of Malaysia, India, and New Caledonia use the leaves and latex of this plant as fish poison.
4. The wood and bark are used to alleviate flatulence in Thailand.
5. Leprosy is alleviated in Sri Lanka with the smoke from wood being burned, and swellings of the hands and feet are dealt with the root pounded with ginger.
6. The oil extracted from the woods is used by the Malays to treat skin infections and irritation.
7. The plant's roots are used to relieve swellings and toothaches.

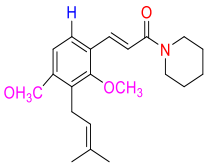
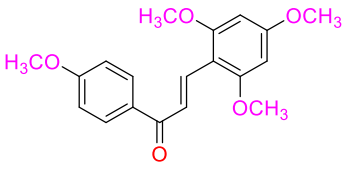
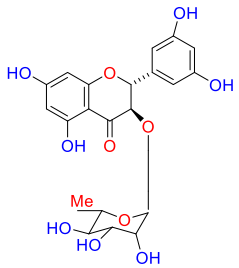
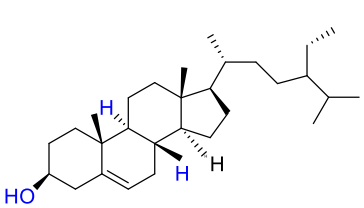
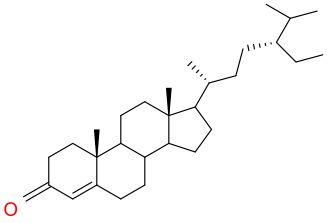
3. Phytochemical properties [14-20]

Table 1: Phytochemical review of *Excoecariaagallocha*Linn.

S.NO	Plant part with extract	Isolated compounds	Title of the work	Author	Journal (year)
1.	Petrol extract of Stem wood	Piperidine - alkaloid	A Piperidine Alkaloid from *Excoecariaagallocha*.	SatyaPrakash, et.al	Phytochemistry (Elsevier), Pergamon (1982)
2.	Ethyl acetate & Acetone extracts of Latex	3,5 – tetracadienoate& 3,5,7 – hexadecatrienoate (Daphnane&Tigliane types)	Cryptic & free skin irritants of Daphnane&Tigliane types in latex of *Excoecariaagallocha*.	C. Karalai, et.al	Planta Med (1993)
3.	Dichloromethane &Methanolic extracts of leaves and bark twigs	Phorbol ester	Novel Phorbol ester from *Excoecariaagallocha*.	Karen L. Erickson, et.al	Journal of Natural Products (1995)
4.	Ether extract of Wood	Excoecarins A, B & C	Chemical structures of Excoecarins A, B & C: three new Labdane type diterpenes from wood, *Excoecariaagallocha*.	TenjiKonishi, et.al	Chem. Pharm. Bull (1996)
5.	Ether extract of Resinous Wood	Excoecarin H	Stereostructure of Excoecarin H, a novel seco-Labdane-type diterpene from *Excoecariaagallocha*.	TenjiKonishi, et.al	Chem. Pharm. Bull (1997)

6.	Ether extract of Resinous Wood	Labdane-type Diterpenes	Five new Labdanediterpenes from *Excoecariaagallocha*.	TenjiKonishi, et.al	Chem. Pharm. Bull (1998)
7.	Ether extract of Wood	Excoecarins F, G1, G2 &Labdane type diterpenoids	Stereostructures of new Labdane-type diterpenes, Excoecarins F, G1, G2 from wood of *Excoecariaagallocha*	TenjiKonishi, et.al	Chem. Pharm. Bull (1999)
8.	Hexane extract of Roots	Agallochins A-E diterpenoids	Five diterpenoids (Agallochins A-E) from mangrove plant *Excoecariaagallocha*Linn.	A.S Anjaneyulu, V L Rao.	Elsevier.com/ locate / phytochem, 55 Pergamon. (2000)
9.	Ethyl acetate extract of resinous wood	Diterpenes and Excoecarins M & N	Novel diterpenes, excoecarins M and N from resinous wood of *Excoecariaagallocha*Linn.	TenjiKonishi et al.	Tetrahedron letters 41, Pergamon. (2000)
10.	Acetone extract of Stem	Excoecarins V1-V3 diterpenoids& Flavone glycoside	Three diterpenoids (Excoecarins V1-V3) & a flavone glucoside from fresh stem of *Excoecariaagallocha*.	TenjiKonishi, et.al	Chem. Pharm. Bull (2003)

Chemical structures of *Excoecariaagallocha*Linn.

COMPOUNDS	**STRUCTURES**
Alkaloids	 2,4-dimethoxy-3-ψ,ψ-dimethylallyl -trans-cinnamoylpiperidide
Flavonoids	 2′,4′,6′,4-tetramethoxychalcone  3,5,7,3',5'-pentahydroxy-2R,3R-flavanonol 3-O-α-L-rhamnopyranoside
Sterols	 β-sitosterol  β-sitostenone

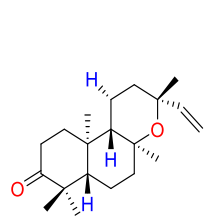
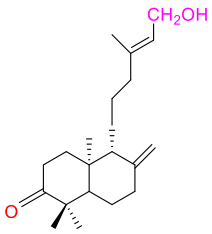
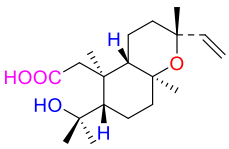
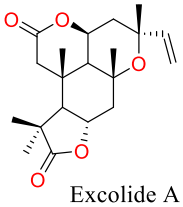
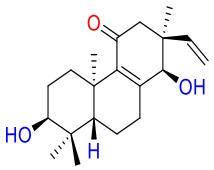
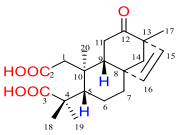
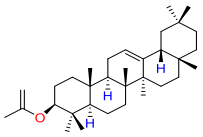
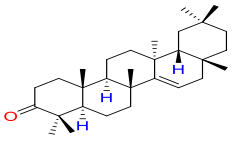
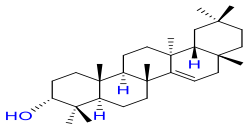
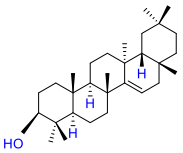
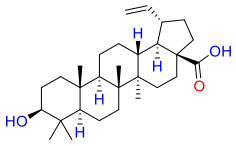
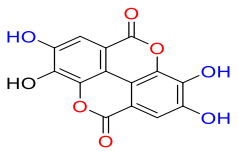
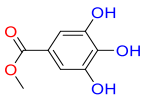
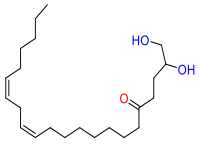
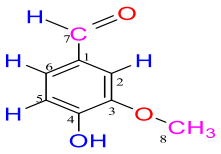
Diterpenes	 ent-3-oxo-13-epi-manoyl oxide(Ribenone)  ent-15-hydroxylabda-8(17),13E-dien-3-one  Excoecarin H  Excolide A  Agallochaol A  ent-12-oxo-2,3-secobeyer-15-ene-2,3-dioicacid
Triterpenoids	 β-amyrin acetate  Taraxerone  3-epitaraxerol  Taraxerol  Betulinic acid
Others	 Ellagic acid  Methyl 3,4,5-trihydroxybenzoate  (9Z,12Z)2,3dihydroxypropyl octadecadienoate  Vanillin

Table: 2. [Chemical structures of Alkaloids – 2, 4-dimethoxy-3-ψ, ψ-dimethylallyl-*trans*-cinnamoylpiperidide [21], Flavonoids - 2′, 4′, 6′,4-tetramethoxychalcone [21], 3,5,7,3′,5′-pentahydroxy-2 *R* ,3 *R* -flavanonol 3- *O* -α- L –rhamnopyranoside[22], Sterols – β-sitosterol& β-sitostenone[23], Diterpenes – *ent*-3-oxo-13-epi-manoyl oxide (Ribenone) [17], *ent*-15-hydroxylabda-8(17),13*E*-dien-3-one [24], excoecarin H [19], Excolide A [25], Agallochaol A [26], *ent*-12-oxo-2, 3-secobeyer-15-ene-2, 3-dioic acid [15], β-amyrin acetate [27], Taraxerone[27], 3-epitaraxerol [27], Taraxerol[27], Betulinic acid [28], Ellagic acid [29], Methyl 3,4,5- trihydroxybenzoate[15], (9Z, 12Z) 2,3 dihydroxypropyloctadecadienoate[28], Vanillin].

4. Pharmacological properties

4.1. Antitumor protecting activity [30]

Seven diterpenoids from the strong, resinous woods of E. agallocha have been reported. These compounds have shown a remarkable capacity to stop the Epstein-Barr virus (EBV) from evolving into active, which was initiated by the tumor promoter 12-O-tetradecanoylphorbol-13-acetate (TPA). Additionally, in a two-phase experiment for the carcinogenesis of mouse cancerous growths, ent-3 β-hydroxy-15-beyeren-2-one (82) shown exceptional antitumor promoting activity in vivo when used as an initiator and a promoter, using 7, 12-dimethylbenz[a] anthracene (DMBA).

4.2. Antidiabetic activity [31]

In mice given alloxan to induce diabetes, Thirumurugan et al. investigated the anti- diabetic effects of E. agallocha leaves. The findings showed that at 500 mg/kg, the ethanolic leaf extract greatly enhanced the hypoglycemic effect in both normal and alloxan-induced diabetic mice.

4.3. DNA damage protective activity [5]

According to Poorna et al. (2012), E. agallocha leaves have the ability to prevent DNA damage. This is especially so because of the water-containing parts of the leaf extract, which have been shown to be especially helpful in this regard.

4.4.Antifilarial activity [32]

Experimentally, the methanolic leaf extract of E. agallocha evidenced significant antifilarial efficacy in a dose-dependent response, as proven by the death of the metazoan filarial parasite Setariadigitate at multiple stages of development. After getting exposed to methanolic leaf extracts for 24 hours at 10, 50, and 100 µg/ml, it was determined that almost 30%, 75%, and 90% of the embryonic stages of S. digitata were dead.

4.5. Antihistamine-release activity [33]

Using an ionophore A23187-induced histamine-release assay paradigm, Hossain et al. investigated the antihistamine-release activity of E. agallocha bark. Comparable to hexane, chloroform, and ethyl acetate, other fractions exhibited less significant antihistamine-release activity than ethanol and distilled water, according to the results.

4.6. Antireverse transcriptase activity [34, 35]

The antireverse transcriptase efficacy of the ethanol extract of E. agallocha stems has been demonstrated by Patil et al. (2011). The results of the research showed that the activity-guided ethanol fraction of the stem ethanol extract has significant antireverse transcriptase activity [34]. A novel Phorbol ester with an IC50 of 6 nm has been found to be an effective in vitro inhibitor of HIV-1 replication by lowering the quantities of p24 and reverse transcriptase in the supernatant [35].

4.7. Anticancer activity [34]

The MTS in vitro assay has been used by Patil et al. (2011) to report anticancer activity through using the activity-guided fraction of the E. agallocha stem ethanol extract. With an IC50 of 4 µg/ml and 7 µg/ml, respectively, the results showed strong activity against the pancreatic cancer cell lines Capan-1 and Miapaca-2.

4.8. Antiulcer activity [37]

The study examined the antiulcer properties of E. agallocha leaves in rats that produced ulcers due to non-steroidal anti-inflammatory medication use. The results suggested that the leaf extract may improve the stomach region's mucosal defenses while additionally lowering acidity. In turn, the plant produces leaves that are antiulcerogenic.

4.9. Anti-inflammatory activity [38]

Babuselvam et al. examined the acute inflammatory characteristics of ethanol in water (3:1) extract of many distinct E. agallocha components, including latex, leaves, and seeds, in a carrageenan-induced rat paw edoema model. Compared to the control, the results demonstrated statistically significant activity at 500 mg/kg, resulting in an inhibition of 63.15%, 62.15%, and 69.69% in latex, leaves, and seeds, respectively. In contrast to expectations, the cotton pellet-induced granuloma test showed that the seed extract exhibited maximum activity at a dose of 500 mg/kg, which was 57.03% more than the control.

4.10. Analgesic activity [38]

The analgesic effect of ethanol has been investigated by Babuselvam et al. using a water (3:1) extract of E. agallocha leaves, seeds, and latex; the extract from the seeds drastically decreased the number of writhes in 20 minutes and increased the percentage of inhibition in the acetic acid writhing test of the test organisms. Aside from that, the 500 mg/kg concentration of the seed extract in the tail immersion model shows the highest activity (80.29%) as opposed to the control.

5. Conclusion

Various parts of E. agallocha L., especially the leaves, roots, woods, stems, bark, latex, and seeds, have been shown to have medicinal potential for the treatment of a variety of illnesses in traditional medicine. Among these are qualities that prevent tumors from growing, lower blood sugar, fight against infections, fight inflammation, ease pain, fight cancer, inhibit reverse transcriptase, fight infection, and guard against DNA damage. Different plant sections produced a variety of chemically biologically active substances that fit into numerous chemical categories. The bulk of identified terpenoids were of the labdane, isopimarane, kaurane, Beyerane, artisane, Daphnane, and Tigliane kinds. The bulk of the other phytoconstituents that have been isolated include triterpenoids, flavonoids, alkaloids, sterols, tannins, and a few additional unknown substances including organic acids, organic acid esters, and alcohol derivatives. This research highlights several pharmacological and phytochemical studies that have demonstrated the therapeutic effects and phytochemical particles of E. agallocha L.

6. References

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