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Research Article

Importance of Threatened and Common Mangrove Species, *Excoecaria* agallocha [L.], *Sonneratia alba* [L.] from Teramura Faliyu Near Varoli River Estuary, Khattalwada Village, Valsad District, South Gujarat

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Abstract

We have studied the area of Mangroove forest near Varoli river Estuary of Teramura faliya, Khattalwada Village, Valsad District, South Gujarat. We have collected the mangroves species, *Excoecaria agallocha* (L.) is Threatened species according to the Gujarat Biodiversity Board. The estuarine area of Valsad District is an open mangrove region. The ENVIS (Environmental Information System) biodiversity data indicates that the mangrove region in Valsad District has consistently exhibited low density throughout its historical records. The genus *Excoecaria agallocha* (L.) comprise nearly forty species which are distributed in the Mangroove region of Asia and northwest Australia. (Poorna, *et al*., 2012) *Excoecaria agallocha* (L.) usually shed their leaves annually. Unlike most mangroves species, they do not have specialized aerial roots called pneumatophores that extend above the soil surface and supply the underground roots with oxygen. Different parts of *Excoecaria agallocha* (L.) including leaf and stem have therapeutic potential in traditional medicine for the treatment of various diseases it is helpful in future. *Excoecaria agallocha* (L.) leaf extract is useful in Antimicrobial activity, Anti-inflammatory activity, Anaglesic activity, Antiulcar activity, Antifilarial activity, DNA damage protective activity, Antidiabetic activity and stem extract is useful in Antireverse transcriptase activity, Antihistamine- release activity, Antitumor protecting activity, ideified by phytocompound throught GCMS (Gas Chromatography Mas Spectrometry) analysis.

Keywords: *Mangrooves, Exoecaria agalocha, Traditional medicine, Khattalwada.*

Introduction

An estuary can be defined as 'a semi enclosed coastal body of water which is connected to the sea either permanently or periodically, has a salinity that is different from that of the adjacent open ocean due to freshwater inputs, and includes a characteristic biota' (Whitfield and Elliott). The difference in density between fresh and marine water by gravity produces a vertical stratification of salinity and a convective flow (Bruner, *et al., 2017).* Coastal landforms fortier a rich variety of flora and fauna, playing a crucial role in the food chain. One of the important resources that the coast offers is the mangrove ecosystem, which is among the world's most productive ecosystems (Mitch & Gosselink 1993; Odum, *et al*., 1982).

The term 'Mangrove' is derived from the word 'mangal' and Portuguese word for mangrove is 'mangue'. According to Chapman (1976), 'mangal'-means the forest formation and Mangrove-indicates intertidal plants. Mangroves are plant species, including tress and bushes, that grow at levels ranging from close to sea level to slightly above the

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mean sea level (Macnae, 1968). Mangroves are wonderful plants that have devised several morphological, physiological and biochemical adaptions. Mangroves are prolific seed producer that has higher viability as compared to other types of plants; also they are quick to attain height and biomass (Alongi, 2002). They are one of the most productive ecosystems in the terms of global biomass production, playing a critical role in coastal protection, water purification, biodiversity conservation, and carbon sequestration (Zedler, *et al*., 2005, Kirwan, *et al*., 2013, Li, *et al*., 2018, Wang, *et al*., 2019).

Mangroves are widely acknowledged as ecosystems that have become threatened and vulnerable, experiencing growing ecological pressure due to intensive human activities (Christensen, *et al*., 2008). However, with the intensification of human activities, global wetland areas have experience a net loss of 21% over the past 300 years (Fluet-Chouinard, *et al*., 2023). And global coastal wetland areas were reduced by more than 50% in the 20th century (Li, *et al*., 2018). More recently, mangrove have been shown to act as a globally significant sink for carbon (Donato, *et al*., 2011, Alongi, *et al*., 2014) to the extent that their conservation and restoration have become important in the context of the global effort to mitigate the impact of climate change (Duarte, *et al*., 2011).

Around the world, mangrove forest have covered over 200,000km2 of tropical and subtropical coastal areas (Duke, *et al*., 2007). Preliminary observation (Singh, 2002) suggest that the estuaries of south Gujarat also harbor a rich diversity of mangroves. The state of Gujarat boasts a coastline spanning approximately 1650 km and encompasses around 960 sq.km of mangrove, constituting the second-largest expanse of tidal forest in India (Anon, 2005b).

Mangrove in the Gujarat coast were first mapped using satellite data of 1986 at 1:250,000 scales (Nayak, *et al*., 1992). Later maps were prepared at 1:50,000 scales using IRS (Indian Remote Sensing) LISS II (Linear Imaging and Self Scanning Sensor) data and at 1:25,000 scales using SPOT data (Nayak and Bahuguna 2001). Mangroves are distributed based on the geomorphic setting, tidal regime, topographic level and sediment properties (salinity, chemical composition, water content, texture and nutrient availability) tropographic level, frequency, tidal inundation (Bahuguna and Nayak, 1996).

Mangroves are salt-tolerant estuarine forest ecosystems found in the tropical and subtropical intertidal regions globally, covering 75% of the world's tropical coastal areas (Banerjee and Ghosh 1998). Indian mangroves make up 3.1% of the total global cover and are distributed along all the maritime state except the union terriotory of Lakshwadeep, covering an area of about 4461 sq.km along the 7,500 km long Indian coastline (Anon, 2005). Mangroves in Gujarat are mostly confined to [a] Indus deltaic region i.e kori creek and sir creek area, [b]The Gulf of Kachchh and [c] The Gulf of cambag (Chavan 1985, Shah, *et al*., 2005, Singh 2002, Singh 2006).

During the recent floristic survey carried out by Gujarat Ecological Education and Research [GEER] foundation in June 2009 for the project study of floristic diversity and natural recruitment of mangrove species in the selected mangrove habitat of south Gujarat sponsored by IUCN, a single tree of Kandelia candel (L.) Druce was found (Pandey, *et al*., 2009). Bhatt, *et al*., (2009), reported seven species of mangroves along the Purna Estuary, South Gujarat India. At present, total 14 mangroves species *viz*. *Avicennia officinalis*, *A. marina*, *A. alba*, *Rhizophora mucronata*, *Ceriops tagal*, *Ceriops decandra*, *Aegiceras corniculatum*, *Bruguiera gymnorhiza, Sonneratia apetala, Acanthus ilicifolius, Bruguiera cylindrical, Kandelia candel, Lummnitzera racemosa* and *Exocoecaria agallocha* have been reported from the mangrove forests of Gujarat (MFF, 2009).

We have studied the area of Mangrove forest near Varoli river Estuary of Teramura faliyu, Khattalwada village, Valsad district, South Gujarat. We collected the mangeoves species, *Excoecaria agallocha* [L.], *Sonneratia alba* [L.],

Acanthus illicifolius [L.], *Aegiceras corniculatum* [L.], *Salvadora persica* [L.], from there. Where, *Excoecaria agallocha* [L.] is Threatened species according to the Gujarat Biodiversity Board.

The genus *Excoecaria agallocha* [L.] comprises nearly forty species which are distributed in the mangrove region of Asia, and northwest Australia (Poorna, *et al*., 2012). *Excoecaria agallocha* [L.] usually shed their leaves annually. Unlike most mangrove species, they do not have specialized aerial roots called pneumatophores that extend above the soil surface and supply the underground roots with oxygen. (Clough B, 2013).

Aim and Objective

To determine the importance of threatened mangrove species from Khattalwada Village, Valsad District, South Gujarat.

To Deteremine the Phytochemical compound of Threatened species *Excoecaria agallocha* by GCMS (Gas Chromatography Mass Spectromrtry).Also determine phytochemical compound of Sonneratia Alba.

Materials and Method

The estuaries of varoli river located in south Gujarat is considered for the study which has high diversity of mangroves and near this estuary mangroves forest area of khattalwada villege, Umbergaon , Valsad district of south Gujarat lies at (20˚12′46.01 N latitude 72˚46′59.5E longitudes) have been taken up for this study. The estuarine area of Valsad distric is an open mangrove region. The ENVIS (Environmental Information System) biodiversity data indicates that the mangrove region in Valsad district has consistently exhibited low density throughout its historical records.

Top 10 Mangrove Forest in India.

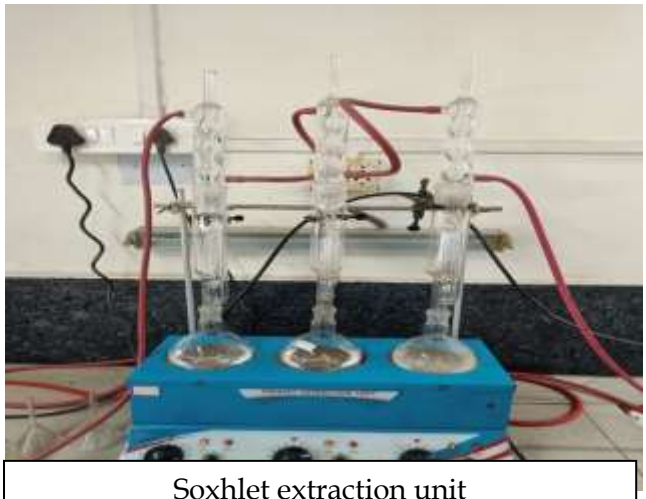
Gujarat State, India

Varoli River, Estuary, Khatalwada Village.

Khattalwada village.

Extensive fieldwork on the varoli estuary wetland was carried out to study the mangroves diversity. The study area was visited in the month of January 2024. The

mangroves species were collected and labeling from the coastal wetland from varoli estuary at Khattalwada village. We have collected, *Excoecaria agallocha* [L].,*Sonneratia alba*[L].,*Acanthus illicifolius*[L]., *Aegiceras corniculatum*[L].,*Salvadora persica*[L]. from the Khattalwada village. The mangroves species were brought back to the laboratory where few species were preserved as herbaria.



Soxhlet extraction unit

According to Gujarat Biodiversity Board *Excoecaria agallocha* is threatened species. *Sonneratia alba* also deviated from the typical mangrove vegetation as it exhibits a growth pattern reminiscent of gymnosperm rather than the conventional mangrove shrub or hurb characteristic. The mangroves species were initiating subjected to through washing in water ensure cleanliness, followed by a meticulous drying process to safeguard against fungal and other disease contamination. Initially, the leaves and stem of both species were meticulously separated followed by placement in a hot air oven set at 50 degree Celsius for thorough drying. The stem of *Excoecaria agallocha* required 96 hours for complete drying, while those of *Sonneratia alba* necessitated 48 hour for proper desiccation. The drying period for *Excoecaria agallocha* leaves required 48 hour, while *Sonneratia alba* leaves required 72 hour for proper drying. Subsequently, the processed materials underwent mechanical blending in a mixing apparatus to transform them into a powder foam substrate, 15 gm of the powder substrate were introduced into 250ml of distilled water, and the extraction process was conducted using a soxhlet apparatus at 100 Degree Celsius for 4 hours. This both species are undergoing for GCMS (Gas Chromatography Mass Spectrometry) analysis. Prior to subjecting them to GCMS procedure, an extraction method using the soxhlet apparatus was applied to the specimens.

Excoecaria agallocha leaf

Excoecaria agallocha

Sonneratia alba stem

Sonneratia alba

Aegiceras corniculatum

Acanthus illicifolius

Acanthus illicifolius

Acanthus illicifolius

Results

Table 1: Phytochemical compounds of *Excoecaria agallocha*[L.] Leaf

Sr No	Phytochemical Name	Pubchem ID	Molecular Weight	Molecular Formula
1	3,5-dihydroxy-6-methyl-2,3-dihydropyran-4-one	119838	144.12 g/mol	C6H8O4
2	2,4,5-Trimethyl-1,3-dioxolane	102967	116.16 g/mol	C6H12O2
3	palmitic acid	985	256.42 g/mol	$C_{16}H_{32}O_2$
4	L-Ascorbyl 2,6-Dipalmitate	54722209	652.9 g/mol	C38H68O8
5	Pentadecyclic acid	13849	242.40 g/mol	C15H30O2
6	stearic acid	5281	284.5 g/mol	C18H36O2
7	Arachidic acid	10467	312.5 g/mol	C20H40O2
8	9-hydroxy-10E,12Z-octadecadienoic acid	5282944	296.4 g/mol	C18H32O3
9	7-Tetradecyne	141979	194.36 g/mol	C14H26
10	Isolinoleic acid	5282796	280.4 g/mol	**C18H32O2**
11	Icosadienoic acid	6439848	308.5 g/mol	C20H36O2
12	Petroselic acid	5281125	282.5 g/mol	$C_{18}H_{34}O_2$
13	cis-9-Hexadecenal	5364643	238.41 g/mol	C16H30O
14	oleic acid	445639	282.5 g/mol	$C_{18}H_{34}O_2$
15	Olealdehyde	5364492	266.5 g/mol	C18H34O

16	cis-vaccenic acid	5282761	282.5 g/mol	$C_{18}H_{34}O_2$
17	cis-10-Heptadecenoic acid	5312435	268.4 g/mol	C17H32O2
18	cis-10-Nonadecenoic acid	5312513	296.5 g/mol	C19H36O2
19	gondoic acid	5282768	310.5 g/mol	C20H38O2
20	10-trans,12-cis-Linoleic acid	5282800	280.4 g/mol	C18H32O2
21	Linoelaidic acid	5282457	280.4 g/mol	C18H32O2
22	Naphthalene-2,6-dicarboxylic acid, bis(4-methylcyclohexyl) ester	612156	408.5 g/mol	C26H32O4
23	9-(2-Phenylethyl)-3,4,5,6,7,9-hexahydro-1H-xanthene-1,8(2H)-dione	612507	322.4 g/mol	C21H22O3
24	5-[2-(4-Bromo-3,5-dimethyl-pyrazol-1-yl)-ethyl]-4-m-tolyl-4H-[1,2,4]triazole-3-thiol	999620	392.3 g/mol	C16H18BrN5S
25	Palustrol	110745	222.37 g/mol	C15H26O
26	(7a-Isopropenyl-4,5-dimethyloctahydro-1H-inden-4-yl)methanol	605599	222.37 g/mol	C15H26O
27	Cholesterol chloroformate	111262	449.1 g/mol	C28H45ClO2
28	Stigmast-5-en-3-ol, oleate	20831071	679.2 g/mol	$C_{47}H_{82}O_2$
29	Sitosterol acetate	5354503	456.7 g/mol	C31H52O2
30	Sitosterol	222284	414.7 g/mol	C29H50O
31	Sitostenone	579897	412.7 g/mol	C29H48O
32	beta-sitostenone	5484202	412.7 g/mol	$C_{29}H_{48}O$

Table 2: Phytochemical Compounds of *Excoecaria agallocha*[L.] Stem

Sr NO	Phytochemical Name	Pubchem ID	Molecular Weight	Molecular Formula
1	S-Methyl-L-cysteine	24417	135.19 g/mol	$C_4H_9NO_2S$
2	2,2'-oxydiethanamine	75982	104.15 g/mol	$C_4H_{12}N_2O$
3	Methyl N-hydroxybenzimidate	9602988	151.16 g/mol	$C_8H_9NO_2$
4	4-Ethylbenzoic acid, cyclopentyl ester	583887	218.29 g/mol	$C_{14}H_{18}O_2$
5	6-Amino-m-toluic acid	76255	151.16 g/mol	$C_8H_9NO_2$
6	4-Methylanthranilic acid	75316	151.16 g/mol	$C_8H_9NO_2$
7	4-Ethylbenzoic acid, 2-butyl ester	583886	206.28 g/mol	$C_{13}H_{18}O_2$
8	Homoserine	779	119.12 g/mol	$C_4H_9NO_3$
9	1-Amino-3-methoxypropan-1-ol	53920246	105.14 g/mol	$C_4H_{11}NO_2$
10	2(3H)-Furanone, dihydro-4-hydroxy-	95652	102.09 g/mol	$C_4H_6O_3$
11	1,2,4,5-Tetraazacyclohexane, 1,2,4,5-tetramethyl-	140744	144.22 g/mol	$C_6H_{16}N_4$
12	1,1-Dimethylsilanediol	14014	92.17 g/mol	$C_2H_8O_2Si$
13	Trimethylfluorosilane	9869	92.19 g/mol	C_3H_9FSi
14	Trimethylphosphine oxide	69609	92.08 g/mol	C_3H_9OP
15	Pyruvaldehyde	880	72.06 g/mol	$C_3H_4O_2$
16	methyl carbamimidothioate	5142	90.15 g/mol	$C_2H_6N_2S$
17	Diethoxymethyl acetate	84166	162.18 g/mol	$C_7H_{14}O_4$
18	Methyl N-hydroxybenzimidate	9602988	151.16 g/mol	$C_8H_9NO_2$
19	4-Ethylbenzoic acid, cyclopentyl ester	583887	218.29 g/mol	$C_{14}H_{18}O_2$
20	2-Amino-5-methylbenzoic acid	76255	151.16 g/mol	$C_8H_9NO_2$
21	4-Ethylbenzoic acid, 2-butyl ester	583886	206.28 g/mol	$C_{13}H_{18}O_2$
22	2-Amino-4-methylbenzoic acid	75316	151.16 g/mol	$C_8H_9NO_2$
23	1,2-Cyclopentanedione	566657	98.10 g/mol	$C_5H_6O_2$

24	3-Ethyl-2-hydroxycyclopent-2-en-1-one	62752	126.15 g/mol	$C_7H_{10}O_2$
25	1,3-Cyclopentadione	77466	98.10 g/mol	$C_5H_6O_2$
26	Pimelic ketone	7967	98.14 g/mol	$C_6H_{10}O$
27	Aziridine, 2-(1,1-dimethylethyl)-3-methyl-, trans-	22215354	113.20 g/mol	$C_7H_{15}N$
28	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl	119838	144.12 g/mol	$C_6H_8O_4$
29	2,4,5-Trimethyl-1,3-dioxolane	102967	116.16 g/mol	$C_6H_{12}O_2$
30	3-Ethoxybenzoic acid ethyl ester	221905	194.23 g/mol	$C_{11}H_{14}O_3$
31	2-AMINO-3-HYDROXYPYRIDINE	28114	110.11 g/mol	$C_5H_6N_2O$
32	Acetic acid ethenyl ester	7904	86.09 g/mol	$C_4H_6O_2$
33	decahydroquinolin-2-one	317664	153.22 g/mol	$C_9H_{15}NO$

Table 3: Phytochemical Compounds of *Sonneratia alba* [L.] Leaf

Sr no	Phytochemical Name	Pubchem ID	Molecular Weight	Molecular Formula
1	ethyl 2-hydroxyethyl sulfoxide	352593	122.19 g/mol	$C_4H_{10}O_2S$
2	Acetoaceti acid,	536249	176.3 g/mol	$C_7H_{12}OS_2$
3	Cyclohexan-1,4,5-triol-3-one-1-carboxylic acid $$ 1,3,4-Trihydroxy-5-oxocyclohexanecarboxylic acid	536249	176.3 g/mol	$C_7H_{12}OS_2$
4	1,1-Dimethylsilanediol	14014	92.17 g/mol	$C_2H_8O_2Si$
5	Trimethylfluorosilane	9869	92.19 g/mol	C_3H_9FSi
6	Oxime-, methoxy-phenyl-_	9602988	151.16 g/mol	$C_8H_9NO_2$
7	4-Ethylbenzoic acid, cyclopentyl ester	583887	218.29 g/mol	$C_{14}H_{18}O_2$
8	2-Amino-5-methylbenzoic acid	76255	151.16 g/mol	$C_8H_9NO_2$
9	2-methylbutyl ester	21022135	220.31 g/mol	$C_{14}H_{20}O_2$
10	Dianhydromannitol	23619611	146.14 g/mol	$C_6H_{10}O_4$
11	2-Oxiraneethanol, 2-t-butyldimethysilyloxymethyl- acetate	554546	274.43 g/mol	$C_{13}H_{26}O_4Si$
12	Dimethyl(bis[(2Z)-pent-2-en-1-yloxy])silane	89941326	228.40 g/mol	$C_{12}H_{24}O_2Si$
13	Silane, [(1,1-dimethyl-2-propenyl)oxy]dimethyl-	6329112	143.28 g/mol	$C_7H_{15}OSi$
14	dimethyldi(but-2-enyloxy)-	91697224	200.35 g/mol	$C_{10}H_{20}O_2Si$
15	dimethyl(but-2-enyloxy)isobutoxy-	91697286	202.37 g/mol	$C_{10}H_{22}O_2Si$
16	Ethyl 4-ethoxybenzoate	90232	194.23 g/mol	$C_{11}H_{14}O_3$
17	3-Ethoxybenzoic acid ethyl ester	221905	194.23 g/mol	$C_{11}H_{14}O_3$
18	Acetin, bis-1,3-trimethylsilyl ether	91696644	278.49 g/mol	$C_{11}H_{26}O_4Si_2$

Table 4: Phytochemical Compounds of *Sonneratia alba*[L.] Stem

Sr NO	Phytochemical Name	Pubchem ID	Molecular weight	Molecular Formula
1	3-dehydroquinic acid	439351	190.15 g/mol	$C_7H_{10}O_6$
2	acetic acid	176	60.05 g/mol	$C_2H_4O_2$
3	propanedioic acid	867	104.06 g/mol	$C_3H_4O_4$
4	1,1-Dimethylsilanediol	14014	92.17 g/mol	$C_2H_8O_2Si$
5	Dimethyldiethoxysilane	62322	148.28 g/mol	$C_6H_{16}O_2Si$
6	Trimethylsilyl pentafluoropropionate	12452932	236.21 g/mol	$C_6H_9F_5O_2Si$
7	Trimethylsilyl trifluoroacetate	67863	186.20 g/mol	$C_5H_9F_3O_2Si$
8	Methyl N-hydroxybenzimidate	9602988	151.16 g/mol	$C_8H_9NO_2$

9	4-Ethylbenzoic acid, cyclopentyl ester	583887	218.29 g/mol	$C_{14}H_{18}O_2$
10	6-Amino-m-toluic acid	76255	151.16 g/mol	$C_8H_9NO_2$
11	4-Ethylbenzoic acid, 2-butyl ester	583886	206.28 g/mol	$C_{13}H_{18}O_2$
12	4-Methylanthranilic acid	75316	151.16 g/mol	$C_8H_9NO_2$
13	Sorbitan monooleate	9920342	428.6 g/mol	$C_{24}H_{44}O_6$
14	4-Ethoxybenzoic Acid Ethyl Ester	90232	194.23 g/mol	$C_{11}H_{14}O_3$
15	Ethyl 3-ethoxybenzoate	221905	194.23 g/mol	$C_{11}H_{14}O_3$
16	Diacetin, 1-trimethylsilyl ether	91709764	248.35 g/mol	$C_{10}H_{20}O_5Si$
17	Silane, dimethyl(2-methylpent-3-yloxy)propoxy-	91709966	218.41 g/mol	$C_{11}H_{26}O_2Si$
18	palmitic acid	985	256.42 g/mol	$C_{16}H_{32}O_2$
19	Pentadecylic acid	13849	242.40 g/mol	$C_{15}H_{30}O_2$

Discussion

The mangrove forest of Teramura faliyu near Varoli River Estuary, Khattalwada village is abundant with Mangrove species. We found and collected the species , *Sonneratia alba*[L.], *Acanthus illicifolius*[L.], *Aegiceras corniculatum*[L.], *Salvadora persica*[L.], *Excoecaria agallocha*[L.].

In previous study Sharma, S. *et al*., (2011) conducted research in Khattalwada Villege utilizing IRS-LISSIII satellite remote sensing data.Their findings corroborate the presence of all aforementioned mangrove species,that mension in their article.

According to Gujarat Biodiversity Board *Excoecaria agallocha* is Threatened species.We had doing GCMS analysis and found numerous beneficial chemical components in this species, underscoring the imperative for its conservation.

Conclusion

Different Parts of *Excoecaria agallocha* [L.] including Leaf and Stem have therapeutic potential in traditional medicine for the treatment of various diseases it is helpful in future. *Excoecaria agallocha* [L.] Leaf extract is useful in Antimicrobial activity, Anti-inflammatory activity, Analgesic activity, Antiulcer activity, Antifilarial activity, DNA damage protective activity, Antidiabetic activity and Stem extract is useful in Antireverse transcriptase activity, Antihistamine-release activity, Antitumor protecting activity, identified by phytocompound throught GCMS (Gas Chromatography Mass Spectrometry) analysis. *Sonneratia alba*[L.] also have Antibacterial, Antifungal, Antiprotozoan, Antiviral, Anticancer properties that beneficial for various diseases treatment. Apart from medicines, toxins or poisons are also prepared from mangroves plants, Mostly insecticides, larvicidal, piscicidal, molluscicidal these are prepared from mangrove plant.

Future uses:- In our investigation, we have identified *Excoecaria agallocha*[L.] as a species rich in diverse phytochemical compounds with various potential applications. When we studying the area only one individual plant of this species is found and one plant of this species is associate with *Aegiceras corniculatum*[L.] species. Given the rarity of this threatened species and its singular association, conservation efforts are vital to safeguard its significance for future research work.

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