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Research Article

Ethnobotanical survey of mangrove biodiversity and traditional medicinal practices in North Goa and the Konkan region of Maharashtra, India

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Abstract

Mangroves are unique tropical and subtropical intertidal ecosystems that play a vital role in biodiversity conservation, carbon sequestration, coastal protection, food security, and traditional healthcare systems. Though India has third highest mangrove diversity globally, threats like deforestation and climate change rendering this ecosystem vulnerable including West coast of India however, systematic ethnomedicinal documentation is still limited. This study aimed to document mangrove species diversity and their traditional medicinal uses in selected coastal villages of North Goa and some villages of Ratnagiri–Sindhudurg districts of Maharashtra. Field surveys were conducted between September 2024 and January 2025, using purposive sampling for site selection recommended by Goa State Biodiversity Board and Mangrove Cell, Maharashtra while ethnomedicinal data were gathered through semi-structured interviews employing snowball sampling. Botanical identification was achieved through regional floras, expert consultation, and herbarium validation. A total of 16 mangrove species from 8 families were recorded, including 13 trees, 2 shrubs, and 1 fern. Several species, such as *Bruguiera gymnorhiza*, *Acanthus ilicifolius*, and *Xylocarpus granatum*, were found to have significant traditional therapeutic applications for skin, gastrointestinal, and respiratory disorders. The study underscores the importance of conserving mangrove ecosystems and preserving associated traditional knowledge systems. The findings provide baseline data for future pharmacological validation and conservation planning.

Keywords: Coastal Biodiversity, Ethnomedicine, Goa, Konkan Coast, Mangroves, Traditional Knowledge

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Introduction

Mangroves constitute salt-tolerant ecosystems primarily occurring in tropical and subtropical intertidal zones. These ecosystems are dominated by evergreen trees and shrubs that have evolved comparable structural and functional adaptations to thrive in water logged soils, high salinity, tidal surges and frequent cyclonic storms. Notably, mangroves exhibit remarkable resilience in the extreme transitional zone, which represents a dynamic interface between marine and terrestrial habitats. (1) These ecosystems occupy diverse habitats including shores, estuaries, tidal creeks, backwaters, marshes, lagoons, and mudflats, extending even to upstream reaches where salinity persist. (2) India globally ranks third in mangrove diversity, following Indonesia and Australia, with 46 true mangrove species belonging to 14 families and 22 genera. (3) As per recent assessments 4992 km² mangrove forests in India, covers at along the coastline of 9 States and 4 Union Territories which accounts for 0.15 % of the country's total geographical area and approximately 3.3 % of the world's mangrove forests. The major mangrove ecosystems include the Sundarbans at the mouth of the Ganges and Brahmaputra rivers in West Bengal, the Bhitarkanika mangroves in the Mahanadi Delta in Odisha, Krishna-Godavari Delta in Andhra Pradesh and Pichavaram-Coleroon estuaries in Tamil Nadu. (4) Indian mangrove habitats are broadly classified into three categories namely, Deltaic (East Coast Mangroves), Estuarine & Backwater (West Coast Mangroves) and insular mangroves (Andaman & Nicobar Islands). (5)

Mangroves store an impressive average of 394 tones carbon per hectare, combining the carbon held in their living biomass and the top meter of soil, making them one of the most efficient natural carbon sinks on the planet. (6) Mangroves support an extraordinary diversity of life due to their unique connection to marine, freshwater, and terrestrial ecosystems. In India alone, over 5,700 plant and animal species across 21 phyla have been

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documented in mangrove habitats, highlighting their vital role in sustaining biodiversity. (6) Flooding, the most common natural disaster globally, is worsening due to climate change. A study using 2D modeling revealed that mangroves can reduce flood depths by 15–20% on average during more intense (i.e. 1-in-100-year) storms, with reductions exceeding 70% in certain areas. (7) Mangroves are highly productive ecosystems that play a crucial role in food security, providing coastal communities with income, employment, and resources like fodder, fiber, and fuelwood. (8) They offer stable year-round supplies of protein and other essential nutrient rich fish and invertebrates, as well as non-aquatic foods such as honey, fruits. (8) Also many mangrove species extensively used as medicine. With sustainable management, mangrove timber and fuelwood can also be valuable long-term resources. (6) Mangrove ecosystems play a vital role in reducing coastal disaster_risks by protecting 14.5% of the currently exposed population and 35.7% of property values. (9) Mangroves contribute significantly to carbon storage by holding 17% of the current global carbon. It supports 14% of current fishing efforts and plays a crucial irreplaceable role for environmental stability and human well-being. (9) Besides these advantages, mangroves provide protection against intense sunlight and UV-B radiation, reduce coastal soil erosion, and support the stability of adjacent ecosystems like coral reefs, seagrasses, and seaweeds. They also contribute to the maintaining and deepening of creeks. (5)

Mangrove ecosystems face significant threats from deforestation, pollution, infrastructure development, dam construction, rising sea levels, and intense storms linked to climate change**.** (9) Conversion to aquaculture, oil palm plantations, and rice cultivation together explain 43% of mangrove losses between 2000 and 2020. Natural retraction, influenced by climate change, sediment shifts and sea-level rise, also significantly impacted mangrove areas. (6) Together, these pressures are accelerating the degradation and potential loss of these ecologically crucial habitats. The loss of mangroves has devastating consequences for the environment and human well-being, impacting global health and ecosystems. (9) (10) Protecting these fragile ecosystems is essential for preserving biodiversity, mitigating the impacts of climate change, and advancing the goals of the Global Biodiversity Framework for a sustainable future. (11), (12)

According to the IUCN Red List of Ecosystems, 50% of the world's mangrove ecosystems are at risk of collapse and have been classified as vulnerable, endangered, or critically endangered. Among these, the west coast of India falls under the vulnerable category, highlighting the urgent need for focused conservation efforts in the region. (9)

In light of rapid habitat degradation and the erosion of traditional ecological knowledge, there is urgent need for comprehensive documentation of mangrove biodiversity and its associated ethnomedicinal practices. Although previous studies have reported the diversity of mangrove species in regions of Goa (13) (14) and Maharashtra (15), they largely lack comprehensive information regarding their ethnomedicinal uses. To address this gap, the present study was designed to document the diversity of mangrove species and their traditional medicinal uses in selected coastal villages of Goa and Maharashtra. Such documentation serves as a step toward conservation planning and policy development aligned with the Global Biodiversity Framework.

Materials and Methods

Field surveys were conducted in selected mangrove-dominated villages of North Goa (including Nevra, Siridao, Dhargal, Pernem, Virnoda, Malpe, Tuye, Parse, Manshi, and Varkhand), Dabhil Ambere in Ratnagiri district, and Padel and Trilot villages of Sindhudurg district, Maharashtra, during September 2024 and January 2025. A purposive sampling method was employed to select sites known for mangrove biodiversity based on the recommendations of authorities such as Goa State Biodiversity Board, Mangrove cell, Maharashtra Forest Department and recommendation from local informants. (16) (17) For documenting traditional knowledge, semi-structured interviews were conducted with local informants such as elderly residents, fishermen, and traditional healers. A snowball sampling approach was followed to identify additional knowledgeable participants. (18)

Photographic documentation of each mangrove species along with GPS tagging was performed. The botanical identification was carried out with the help of local field experts Dr. Pradeep Sarmokadam (Member secretary, GSBB), Dr. Apoorva Sawant (Project Scientist I, GSBB), Mr. Swastik Gawade (Mangrove Cell, Maharashtra Forest Department, Ratnagiri), Mr. Vasant Kale (Naturalist, Padel, Sindhudurg) and using regional floras. (19), (20), (21), (22) standard taxonomic keys, and confirmed with herbarium records wherever possible such as Indian Virtual Herbarium of Botanical Survey of India. (23) Voucher specimens of collected plant species were prepared and deposited in the herbarium of the Department of Dravyaguna, All India Institute of Ayurveda, New Delhi, for future reference. Each species was recorded with its current accepted botanical name, family, habit, locality, local and English names.

The ethnomedicinal data pertaining to each species, including part used, dosage forms, and traditional applications, were compiled from both field interviews and validated through cross-referencing with published ethnobotanical literature. Ethical considerations were observed by obtaining verbal prior informed consent from local informants, and care was taken to respect the intellectual property and cultural sensitivity of the communities involved.

Observations

A total of sixteen mangrove species belonging to eight botanical families were identified during the field surveys conducted in the selected coastal villages of Goa and Maharashtra. These species include trees, shrubs, and a fern, representing the structural diversity of mangrove ecosystems in the region. Details such as botanical name, family, growth habit, locality, vernacular name, and English name of each species are systematically presented in Table 1. With photographs in Fig. 2. Among observed species, *Avicennia* spp., *Rhizophora* spp., *Sonneratia* spp., *Ceriops tagal* (Perr.) C.B.Rob., and *Kandelia candel* (L.) Druce were commonly found, whereas *Xylocarpus granatum* J. Koenig and *Bruguiera gymnorhiza* (L.) Lam. ex Savigny were comparatively less abundant.

In addition, the ethnomedicinal applications of these mangrove species compiled from both field documentation and corroborated literature are summarized in Table 2. Information includes the plant part used, dosage form or processing method, locality of reported use, and the specific traditional therapeutic indications.

Table 1: Mangroves identified during the survey

SN	Botanical Name	Family	Habit	Locality	Local Name	English Name
1	*Acanthus ilicifolius* L.	Acanthaceae	Shrub	Chapora, Siridao, Nevra, Chorao island Ribandar, Dhargal, Pernem, Terekhol, Virnoda, Malpe, Tuye, Parse, Manshi, Varkhand, Dabhil Ambere, Padel, Trilot	-	Holly Mangrove, Sea Holly
2	*Acrostichum aureum* L.	Pteridaceae	Fern	Nevra, Chorao island Ribandar, Dhargal, Pernem, Terekhol, Virnoda, Malpe, Tuye, Parse, Manshi, Varkhand, Padel, Trilot	-	-
3	*Aegiceras corniculatum* (L.) Blanco	Primulaceae	Shrub	Chorao island Ribandar, Nevra, Dabhil Ambere, Padel, Trilot	Cheep, kajala	River Mangrove, Black Mangrove
4	*Avicennia marina* (Forssk.) Vierh.	Acanthaceae	Tree	Nevra, Chorao island Ribandar, Terekhol, Virnoda, Malpe, Tuye, Parse, Manshi, Varkhand, Padel, Trilot	Tavir, tivar	Grey Mangrove, white mangrove
5	*Avicennia officinalis* L.	Acanthaceae	Tree	Nevra, Chorao island Ribandar, Padel, Trilot	Tavir, tivar	Indian Mangrove, white mangrove
6	*Bruguiera cylindrica* (L.) Blume	Rhizophoraceae	Tree	Chorao island Ribandar	Kandel, kanil, lahan zumbar	White Burma Mangrove
7	*Bruguiera gymnorhiza* (L.) Lam. ex Savigny	Rhizophoraceae	Tree	Dabhil Ambere, Padel, Trilot	Kandel, zumbar	Burma Mangrove, black mangrove, large-leafed mangrove, oriental mangrove
8	*Ceriops tagal* (Perr.) C.B.Rob.	Rhizophoraceae	Tree	Dabhil Ambere, Padel, Trilot	Chauri, kirari	Tagal Mangrove, compound-cymed mangrove, spurred mangrove, yellow mangrove
9	*Excoecaria agallocha* L.	Euphorbiaceae	Tree	Chorao island, Ribandar, Siridao, Nevra, Dabhil Ambere	Geva	Blinding Tree, Milky mangrove, Blind-your-eye mangrove, River poison tree
10	*Kandelia candel* (L.) Druce	Rhizophoraceae	Tree	Chapora, Dabhil Ambere	Kandal	Narrow-Leaved Kandelia, dichotomous cymed mangrove
11	*Lumnitzera racemosa* Willd.	Combretaceae	Tree	Padel, Trilot	Kirpa	Black Mangrove, white-flowered mangrove
12	*Rhizophora apiculata* Blume.	Rhizophoraceae	Tree	Chorao island, Ribandar, Nevra, Dabhil Ambere	-	Tall-Stilt Mangrove
13	*Rhizophora mucronata* Poir.	Rhizophoraceae	Tree	Chorao island, Ribandar, Chapora, Dabhil Ambere, Kasheli, Shirse, Jaitapur	Dumbi, Kamo, Kandal, Kurano	Asiatic Mangrove
14	*Sonneratia alba* Sm.	Lythraceae	Tree	Dabhil Ambere	Karpu, Pandhari Chippi	Sweet-Scented Apple Mangrove
15	*Sonneratia caseolaris* (L.) Engl.	Lythraceae	Tree	Chorao island Ribandar, Dhargal, Pernem, Terekhol, Virnoda, Malpe, Tuye, Parse, Manshi, Varkhand, Dabhil Ambere, Padel, Trilot	-	Apple Mangrove, Crabapple mangrove
16	*Xylocarpus granatum* J.Koenig	Meliaceae	Tree	Dabhil Ambere	Karpa	Cannonball Mangrove, Puzzle Nut, Apple mangrove, Cedar mangrove

Table 2: Reported ethno-medicinal uses of mangroves which found in the survey

Botanical Name	Part Used	Locality / Location	Dosage Form / Processing	Ethno-medicinal claim
***Acanthus ilicifolius* L.**	Root			Expectorant, Coughs, Asthma (24) (25)
	Root		Boiled in milk	Leucorrhoea, General debility(24) (25)
	Root	Siamese and Indo-Chinese		Cordial, Attenuant, Paralysis, Asthma (24)
	Root	Sundarbans	Tied to white thread and worn by expectant mother	Hasten child birth (26)
	Leaf		Decoction	Rheumatism (27)

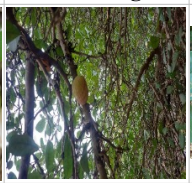
	Leaf		Extract	Body Pain (27)
	Leaf	Sundarbans	Paste	Local application on forehead in acute headache, rheumatism (26)
	Tender shoots, leaves	India		Bite (24)
	Leaves abundant in mucilage	Goa		Emollient fomentation in rheumatism and neuralgia (24)
	Leaf			Snakebite antidote, Neuralgia, Rheumatism (25)
	Fruit		Pulp	Blood Purifier (27) (26)
	Fruit			aphrodisiac, asthma, blood purifier (28)
	Fruit, Leaf, Root			diabetes, diuretic, dyspepsia, hepatitis, leprosy (28)
	Bark, Fruit, Leaf			neuralgia, paralysis, ringworms, rheumatism, skin diseases, snake bites, stomach pains (28)
	Crushed fruit	Tamil Nadu		Snakebite dressing (29)
	Whole plant		Decoction	Kidney stone (29)
	Whole plant		Extract and Paste	Skin diseases, small pox, Health promotion, detoxification, Ulcer (29)
	Whole plant			Cordial, Attenuant, Dyspepsia, paralysis and asthma (25) (24)
	Data not available			Good Nervine Tonic, Expectorant, Stimulant (24)
	Data not available	Odisha		Aphrodisiac, Asthma, Diabetes, Rheumatism, Snakebite (30)
	Whole Plant	Bangladesh		Aphrodisiac, rheumatism, relief for asthma, diabetes, diuretic, dyspepsia, leprosy, hepatitis, blood purifier, cure for cold, gangrenous wounds, skin allergies, snake bites (28) (31)
	Data not available	West Bengal		Analgesic, wound healing effect (32)
	Leaf			Pain reliever (33)
	Leaf	Sundarbans, India		Rheumatism, neuralgia, snake bite, paralysis, asthma (34)
	Whole Plant			Aphrodisiac, astringent, rheumatic pain, leucorrhea (35)
	Fruit	Pichavaram, Tamil Nadu India		Snake Bite (29)
	Whole Plant	Pichavaram, India		Detoxification, kidney stone, small pox, skin diseases, ulcer (36)
	Data not available	South Thialand		Rheumatism, asthma, paralysis, psoriasis, leucorrhea (37)
	Leaf	Thailand		Blood purifier, dressing against snake bites, rheumatism (28)
***Acrostichum aurem* L.**	Leaf			Rheumatism (28)
	Rhizome			boils and wounds (28), Stop bleeding, relieve pain (38)
	Data not available	Odisha		Wounds, Boils, Rheumatism, Dried fronds for thatching (30)
	Whole Plant	Kerala		Astringent in hemorrhage, worm remedy (39)
***Aegiceras corniculatum* (L.) Blanco**	Leaf		Decoction	Washing septic wounds (26)
	Leaf, Bark			asthma, diabetes, rheumatism (28)
	Old Leaves			Treating urine claudine in women (38)
	Hypocotyle		Paste	Hyperacidity (27)
	Data not available			Asthma, Diabetes, Rheumatism, Fish poison (Leaf 20) (24), (26), (30)
	Stem	Sindh Pakistan		Rheumatism, painful arthritis, inflammation (40)
	Data not available	Sindh Pakistan		Inflammatory diseases (41)
***Avicennia marina* (Forssk.) Vierh.**	Stem			Rheumatism, Small pox, Ulcers (28)
	Fruit		Paste from green fruit	Applied to treat boils (25)
	Whole plant		Juice	Abortifacient (25)
	Data not available			Skin diseases (24), Small pox, Fodder, Honey Collection (30)
	Bark, Leaf			Small pox, skin diseases, treatment for ulcers, throat pains (31)
	Leaf	Iran		Ulcers, rheumatism, burns (42)
***Avicennia officinalis* L.**	Root			Aphrodisiac (28)
	Bark		Paste	Wound and skin diseases (27)
	Bark			Leprosy (28), Astringent (25)
	Leaf		Paste	Sprain (27)
	Leaf	Pichavaram TN		Joint pain, Urinary Disorder, Bronchial Asthma, Stomach Disorder, Detoxification (29)

		Tamil Nadu		Asthma, paralysis, dyspepsia, rheumatism, ulcer, snake bite, skin disease, small pox sores, tumor (43)
	Fruit, Leaf			Aphrodisiac, Diuretic, Hepatitis (28)
	Fruit, Seed		Paste from green fruit	Hasten suppuration of boils and abscesses, Small pox (24)
	Heart Wood	Sundarbans	Paste	Scabies (26)
	Ash obtained after burning wood		with water	Antacid (26)
	Flowers			Source of honey (26)
	Heartwood		Extract	Tonic (28)
	Resin			Contraceptive (24)
	Data not available			Aphrodisiac, diuretic, hepatitis, leprosy (24)
	Fruit	Tamil Nadu		Tumor, Boil (44)
	Stem	Tamil Nadu		Inflammation, ulcer (44)
	Root	Tamil Nadu		Aphrodisiac (44)
	Bark	Tamil Nadu		Skin disease (scabies), contraceptive, astringent, hepatitis (44)
	Resin	Tamil Nadu		Snake bite, wound healing, contraceptive (44)
***Bruguiera cylindrica* (L.) Blume**	Root, Leaf, Fruit			Hepatitis (28)
	Leaf		Decoction	Conjunctivitis, Eye irritation (27)
	Bark		Decoction	Diarrhea, Jaundice (27)
	Fruit		Pulp	Wild Ant Bite (27)
	Bark			Hemorrhage, ulcers (45)
***Bruguiera gymnorhiza* (L.) Lam. ex Savigny**	Bark		Decoction	Diarrhea (27), (24), Diabetes (24)
	Leaf		Decoction	Conjunctivitis, Eye swelling (27)
	Leaf	TN		Tumor inhibition (29)
	Tender leaf, Flower			Hypotensive (25)
	Flower			Ear infection (38)
	Fruit		Pulp	Wild Ant Bite (27)
	Fruit			Eye diseases (28)
	Hypocotyle	Odisha		Vegetable (30)
	Whole Plant	TN	Decoction twice daily after meals	Constipation (29)
	Plant		Decoction	*Haza* (kind of sore caused by mud and wet sand), Washing Septic Wound (26)
	Data not available			Eye diseases (24)
	Bark, Leaf	Sundarbans		Diarrhea, fever (46)
	Bark, Root	India		Diabetes, viral fever (47)
	Stem	Selangor, Malaysia		Burns, intestinal worms, liver disorders (48)
	Leaf	China		Diarrhea (31), (49)
	Fruit			Shingles, eye disease, malaria (50)
	Fruit	Indonesia		Angina, hemorrhage, hematuria (51)
	Leaf, Root	South Andaman		Eye diseases, shingles (52)
	Fruit			Diarrhea, malaria, burns (53)
	Bark, Root, Leaf			Diabetes, hemorrhage, hypertension, stings of toxic lagoon fish (53)
	Root	Mauritius		Eye diseases (54)
	Leaf	TN Pichavaram		Constipation (29)
	Whole Plant			Diabetes, fever, burns, intestinal worms (55)
	Bark, Leaf, Fruit			
***Ceriops tagal* (Perr.) C.B.Rob.**	Root	Sundarbans	Decoction	Black fever, Dysentery (26)
	Stem bark		Decoction	Stop bleeding from fresh cuts, washing ulcers (26)
	Bark			Stop hemorrhage (28)
	Shoot	Odisha	Decoction	Malaria (30)
	Data not available			Purgative, Anti-hemorrhagic, Leprosy (30)

***Excoecaria agallocha* L.**	Roots	TN		Anti-inflammation (29)
	Twigs	Sundarbans	Tooth brush	Loosening of gums (26)
	Stem, Leaf, Sap			Conjunctivitis, Dermatitis, Hematuria, Leprosy (28)
	Leaf, Sap			Epilepsy, Purgative (28)
	Wood smoke	TN		Anti-epileptic (29)
	Sap			Toothache (28)
	Seed	Sundarbans		*Haza* (sore caused by wet sand in rainy season) (26)
	Latex	TN	Raw	Cut wound, Paralysis (27), (30) Toothache (29) – TN
	Latex	Sundarbans	Raw	Blisters on skin, blindness (26)
	Data not available			Utero-tonic, Epilepsy, conjunctivitis, dermatitis, hematuria, leprosy, toothache (24)
	Data not available			Epilepsy, ulcers, leprosy, rheumatism, paralysis (56)
***Kandelia candel* (L.) Druce**	Stilt Root		Powder	Hypertension (27)
	Data not available	Odisha		Diabetes (30)
	Data not available			Cardiovascular disease, cancer, neurodegenerative disorders (57)
***Lumnitzera racemosa* Willd.**	Data not available / Fruit			Antifertility, asthma, diabetes, snake bite (24), (30), (28)
	Data not available	Odisha		Snake bites, Rheumatism, Skin allergies, Blood purifier, Asthma, Diabetes, Anti-fertility (30)
***Rhizophora apiculata* Blume.**	Bark		Decoction	Hematuria, Diarrhoea, Dysentry (27), Nausea, Vomiting, Amoebiasis, Antiseptic, Anti-hemorrhagic (29)
	Bark			Antiemetic, Antiseptic, Diarrhoea, Haemostatic, Thyphoid (28)
	Bark		Decoction	Bleeding, Neck Inflammation (27)
	Bark, Flower, Fruit, Leaf			Hepatitis (28)
	Leaf			Wound, Neutralize poison (38)
	Viviparous seeds			Edible (24)
	Wood, Tannin			Substitute of petroleum coke (24)
	Tannin from bark			Mosquito repellent, Diarrhoea, Nausea and vomiting, Antiseptic, Anti-hemorrhagic, Typhoid fever, Diabetics (24)
	Data not available	Odisha		Diarrhoea, Skin Diseases (30)
	Whole Plant	Tamil Nadu		Prevent colitis, inflammatory bowel disease (IBD) (58), (59)
	Bark	TN Pichavaram		Amoebiasis, Diarrhea, nausea, Vomiting (29)
***Rhizophora mucronata* Poir.**	Bark	TN	Decoction	Hematuria, Diarrhoea, Dysentery (27), Nausea, Vomiting (29)
	Bark		Decoction	Bleeding (27)
	Bark			Hematuria (38)
	Bark			Astringent, Diabetes, Haematemesis, Haematuria, Haemoptysis (25)
	Bark			Elephantiasis, Febrifuge, Haematoma, Ulcers (28)
	Bark, Flower, Fruit, Leaf, Root			Hepatitis (28)
	Data not available	Odisha		Hepatitis, Diabetes (30)
	Whole Plant			Angina, dysentery, hematuria, hepatitis, ulcers, diabetes, hemorrhage (60)
		Indonesia		Elephantiasis, hematoma, hepatitis, ulcer, febrifuge (60), (61)
				Diarrhea, elephantiasis, hematuria (28)
	Bark	Tamil Nadu		Diarrhea, nausea, vomiting, amoebiasis, antiseptic, stop bleeding (29)
		China		Diarrhea (62)
		Japan		Diarrhea (62)
		Pichavaram		Diarrhea, nausea, vomiting (29)
		Thialand		Diarrhea, dysentery, leprosy (37)
	Leaf, Root	Mauritius		Astringent, antidote against toxic fish stings, diabetes, fever, hypertension (53)
		India		Angina, blood in urine, diabetes, diarrhea, dysentery, fever (63)
		Malaysia		Childbirth, hemorrhage (62)
	Leaf			Astringent, antiseptic (62)
	Stem	New Guinea		Constipation, cure fertility, menstruation disorders (64)
	Fruit Sap			Mosquito repellent (37)

***Sonneratia alba* Sm.**	Fruit		Poultice	Swelling, Sprain (28)
***Sonneratia caseolaris* (L.) Engl.**	Fruit			Bleeding, Hemorrhages, Piles, Sprain poultices (28)
***Xylocarpus granatum* J. Koenig**	Bark		Paste	Cholera (27), (29) Diarrhoea (29)
	Bark	TN	Extract	Dysentery (29)
	Bark			Cholera, Fever, Malaria (28)
	Bark			Astringent, Diarrhoea, Dysentery, Colic, Cholera, Other abdominal troubles, fever (25)
	Fruit		Paste	Elephantiasis (27)
	Fruit		Rubbing	Rheumatism (25)
	Fruit, Seed		Decoction	Anti-diarrhoeal (25)
	Fruit / Seed			Prevent bleeding, stomach pain, digestive problems (25)
	Seed		Paste	Breast tumor (27)
	Seed oil	Sundarbans, TN		Promote hair growth, Rheumatism, Breast tumor (26), Hair illuminant (29)
	Data not available	Odisha		Malaria, Insect Bite (30)
	Data not available			Cholera, diarrhea, elephantiasis, inflammation, pain, swelling of breasts (65)
	Bark	East Africa		Cholera, diarrhea, fever, malaria (65)
	Leaf	South East Asia		Diarrhea (65)
	Fruit	Indian Coastal Region		Diarrhea, dyslipidemia, hyperglycemia (65)
	Bark	Pichavaram		Cholera, diarrhea, dysentery (29)
	Bark	Thailand		Cholera (37)

Figure 1: Photographs of mangroves documented during survey

1.1 *Avicennia marina* (Forssk.) Vierh.	1.2 *Avicennia officinalis* L.	1.3 *Bruguiera cylindrica* (L.) Blume	1.4 *Bruguiera gymnorhiza* (L.) Lam. ex Savigny	1.5 *Excoecaria agallocha* L.	1.6 *Xylocarpus granatum* J.Koenig	1.7 *Acanthus ilicifolius* L.	1.8 *Kandelia candel* (L.) Druce
							
1.9 *Acrostichum aurem* L.	**1.10 *Lumnitzera racemosa* Willd.**	**1.11 *Sonneratia caseolaris* (L.) Engl.**	**1.12 *Sonneratia alba* Sm.**	**1.13 *Rhizophora apiculata* Blume.**	**1.14 *Rhizophora mucronata* Poir.**	**1.15 *Aegiceras corniculatum* (L.) Blanco**	**1.16 *Ceriops tagal* (Perr.) C.B.Rob.**
							

Discussion

In the current survey, a total of 16 mangrove species were recorded in the field. These species belong to eight different families: six species from Rhizophoraceae, three from Acanthaceae, two from Lythraceae, and one species each from the Euphorbiaceae, Myrsinaceae, Meliaceae, Combretaceae, and Pteridaceae families. Among the 16 species identified, 13 were trees, two were shrubs, and one was a fern. *Bruguiera gymnorhiza* (L.) Lam. ex Savigny and *Xylocarpus granatum* J. Koenig, traditionally used in gastrointestinal and inflammatory disorders, were among the significant species documented. *Acanthus ilicifolius* L. was widely cited for use in asthma and neuralgia.

Surveyed all six species from Rhizophoraceae member having non-endospermous seed, large and protruding radicle. *Bruguiera, Ceripos* and *Kandelia* possess 5-14 lobed calyx. Among them, bracteoles were absent and 8-14 lobed calyx present in *Bruguiera* on the other hand bracteoles were present at the base of calyx and calyx possess 5-6 lobes in *Ceriops* and *Kandelia. Bruguiera* genus buttressed with knee like pneumatophores and leaves dotted black beneath. Amid them, *B. cylindrica* has 2-3 greenish flowers in axillary cyme, fruit with persistent calyx and cylindrical, slender, curved radicle. *B. gynorhiza* possess solitary drooping flower with reddish calyx, brown coloured petals and fusiform brown angled radicle. *C. tagal* has obovate leaves which are emarginated at apex, white flowers in loose axillary cymes bearing simple stigma during July to December, fruits slightly conical and club shaped, angular radicle. Wherein *K. candel* leaf

is obtuse at apex and narrowed at base, long, white flowers in axillary cyme during June-July with 5-6 petals, tri-fid stigma, ovoid fruit and radicle up to 37 cm long, acuminate.

On contrary, *Rhizophora* genus possess 4 lobed calyx, supported with aerial roots from stem and branches with large flowers in axillary cymes having 4 petals. Among them, leaves are apiculate at apex with 2 flowered cyme, bearing glabrous petals, 2-4 cm long fruit with persistent calyx and cylindric, up to 50 cm long radicle, thick towards tip in *R. apiculata.* In *R. mucronata* leaf is long, thick, mucronate at apex, bearing tiny red spots, cyme bears 3-7 flowers with hairy petals, 50 cm long ovate, conical fruit and 60 cm long radicle. (20)

All mangrove species were listed as least concern (LC) in IUCN red list but showing decreasing population trend except *A. ilicifolius* which registered as least concern (LC) with unknown population trend. (66) The convergence of critical threats including coastal development, expanding aquaculture, deforestation, climate change, eutrophication, disease outbreaks, pollution, and limited community awareness raises significant concern and necessitate close monitoring to ensure the long-term survival of mangrove ecosystems. Without proactive intervention, there is a risk of these ecosystems being reclassified as Near Threatened or into higher threat categories. Therefore, collaborative and integrated approach involving stakeholders across government, non-governmental organizations, and academic institutions is essential. This should encompass in-situ conservation strategies, public awareness initiatives, stringent regulatory policies, and a robust governance framework to promote the sustainable restoration and management of mangrove habitats. (67)

Conclusion

The coastal regions of North Goa and the Konkan coast of Maharashtra harbor a rich diversity of medicinally significant mangrove flora. Field explorations conducted in September 2024 and January 2025 across selected villages of North Goa and the Ratnagiri and Sindhudurg districts of Maharashtra revealed a rich diversity of mangrove species, including rare and ecologically significant taxa such as *Xylocarpus granatum* J.Koenig, *Bruguiera gymnorhiza* (L.) Lam. ex Savigny, *Aegiceras corniculatum* (L.) Blanco, and *Lumnitzera racemosa* Willd.. Alongside these, several medicinally valuable species like *Ceriops tagal* (Perr.) C.B.Rob, *Rhizophora mucronata* Poir and *Sonneratia caseolaris* (L.) Engl. were found in abundance. This ethnobotanical documentation reveals their critical role in traditional health practices. Given their therapeutic potential and ecological importance, large-scale in-situ cultivation and conservation initiatives are recommended. This documentation provides a foundational reference for future ethnobotanical and pharmacological research on mangrove ecosystems. Furthermore, future surveys conducted across different seasons and geographical locations, employing structured interviews and validated questionnaires, will be crucial for comprehensive and systematic documentation.

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