Review Article

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POTENTIAL ANTI-DIABETIC MANGROVES IN KERALA, INDIA: A REVIEW

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Received on: 30/04/18 Accepted on: 06/06/18

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DOI: 10.7897/2277-4343.094142

ABSTRACT

Most important character of mangrove s is that they protect vulnerable coastlines from moving ridge activity because they hold the soil together and prevent coastal erosion. Mangroves shield inland orbit during violent storm and minimize damage. Many species in the mangrove forest have medicinal value. Diabetes mellitus is a serious physiological disorder due to relative or complete deficiency of insulin, characterised by abnormally high blood glucose level, which becoming a threat to the entire population of the world. Recently there is an increased interest to develop natural remedies for the treatment of diabetes since many synthetic drugs have serious side effects, many research was now undergoing to identify potent anti-diabetic agent from natural sources. Many mangroves found in Kerala has been reported to show potent anti-diabetic activity but only few plants are scientifically evaluated, investigation of these plants shows the presence of some unique class of compounds like flavonoids, triterpenoids, polyphenols, alkaloids, steroids, glycosides, tannins and polysaccharides. Thus mangroves and associated plants were the richest source of phytochemicals for curing diabetes and its associated complications. Present review emphasise on the potent anti-diabetic mangroves in Kerala which are still not properly utilised but have great value for developing a newer anti-diabetic agent

Keywords: Mangroves, Anti diabetic, Phytochemicals

INTRODUCTION

A recent appraisal shows that mangroves in Kerala is about 25.05 sq. km, its existence is under serious menace due to the developing natural process along the coastal neighborhoods of Kerala and it will cause a sharp decline in mangroves along the coastal belts In Kerala and seriously affect the biodiversity of coastal ecosystem. Mangrove vegetation mainly composed of salt tolerant ever leafy vegetable trees and shrubs which thrive in tropical and subtropical areas where there is constant quantity intertidal exchange of ocean water and fresh water. Generally mangrove ecosystem classified as true mangroves that are limited to the mangrove environment and mangrove fellow that are distributed in other home ground also. Mangroves have wide compass of natural process and it acts as a sieve between sea and river and play an important role in supplying fresh water to coastal region, it resists wind and tempest and helps to protect the sea costs from natural catastrophe and acts as a green wall to protect the sea cost. Mangrove ecotone nourishes and provides food and shelter for marine organisms and also for other terrestrial animals An overall floristic appraisal indicate that, coastal belt from vypin to North Paravur of Ernakulum district is a potential centre of Mangroves and this area constitute the largest patch in Kerala. Coastal belt from Valpattanam to Payyannur of Kannur district frame the richest region with respect to the extent of occurrent abundance, pattern of distribution etc. Asramam and nearby region of Kollam district is another important location due to the presence of true and semi mangrove association. Kadalundi region of Kozhikode districts is distinct because unique faunal association of mangroves.

Among the true mangroves, *Acanthus illicifolius, Excoecaria agallocha, Avicennia officinalis and Rhizophora mucronata* are uniformly distributed throughout Kerala. Species such as *Aegiceras corniculatum, Avicennia marina, Bruguiera cylindrica, Kandelia candel* and *Rhizophora mucronata* are common in the mangroves of north Kerala. *Bruguiera gymnorrhiza* and *Sonneratia caseolaris* are occasionally found in the entire region, where as *Bruguiera sexangula, Shirakiopsis indica, Lumnitzera racemosa* and *Sonneratia alba* are found rare in Kerala. Mangrove associates are confined to one or two localities in Kerala[1]

Traditionally, the mangroves have been exploited for firewood and charcoal and their uses include construction of dwellings, furniture, boats and fishing gear and production of tannins for dying and leather production. Mangroves provide food and a wide variety of traditional products and artefacts for mangrove dwellers. The mangrove leaves are useful contributors to the nutrient system of the mangrove environment. It is known that mangrove leaves contain amino acids, vitamins, minerals which help the growth and development of marine organisms. Traditionally several mangroves and mangrove- associated plants were identified and reported as useful for the treatment diabetes but only few of them are scientifically studied

Mangroves are the richest source of phytochemicals important chemicals compounds present in mangroves are carbohydrates, alcohols, amino acids, different types of fatty acids, lipids, phenolic compounds, steroids, glycosides and triterpenes. The additional newer components like gums and glues to alkaloids and saponins and other phytochemicals are also reported to present in mangroves, products like amino acids, carbohydrates and proteins, are products of primary metabolism and are essential for the maintenance of life processes, while others like alkaloids, phenolics, steroids, terpenoids, are substance of

secondary metabolism and have toxicological, pharmacological and ecological importance. Flavonoid, and flavonol-lignan derivatives inhibit lipid peroxidation and are potent quenchers of triplet oxygen. A variety of modifications of the flavonoid structure lead to a large class of compounds that includes isoflavones, isoflavonones and chalcones, some isoflavones are now been marketed as therapeutic agents for menstrual disorders[2] The curative power of mangroves and associated plants will serve valuable therapeutic agents both in allopathic and other system of traditional medicines practiced in the world [3, 4]

Anti-diabetic Mangroves in Kerala

Acanthus ilicifolius

Local names: Chullikandal, chakkaramullu, Muthalamookku, Payinjachulli

English name: Holy mangrove

Gregarious shrub: nodes with a pair of spines at the base of the petiole; slit root, Leaves are simple, opposite-decussate, 7-15x 6-9 cm, sinuately lobed, margin and apex spinous. Flowers are bluish –violet in terminal 8-20 cm long spikes; flowers sessile, 3.5x3.5 cm across; upper lip obsolete, lower lip broadly 3-lobed to entire. Stamens 4, didynamous; anthers aggregated around style, connectives thickly hairy, bilobed, one lobe sterile. Fruits: shiny green pods in a cluster, seeds 4, compressed, orbicular

This is the one of the most common mangroves of Kerala and occurs in almost all the mangrove habitats, it has a wide range of saline tolerance and high regeneration capacity compared to other mangroves. It shows the astringent nervine tonic, stimulant and expectorant activity and used in the treatment of asthma. The tender leaves and shoots are considered effective in combating insect and snake bites. Leaf juice can also be used in treating liver cancer and rheumatism. Fruit pulp is used as a blood purifier, it is also reported that the root and leaf extract significantly reduce the blood glucose level

General chemical composition of Acanthus ilicifolius includes the benzoxazoline , long chain alcohols, triterpenes, triterpenoidal saponins, alkaloids, steroids and acanthicifolin. Two new cyclolignan glycosides, (+)lyoniresinol 3a-O-β-D-galactopyranosyl-(1→6)-β-D glucopyranoside and (+)-lyoniresinol 2a-O-β-Dgalactopyranosyl-3a-O-β-D-glucopyranoside have been reported from aerial parts of A. ilicifolius.A phenylethanoid glycoside (ilicifolioside A) and an aliphatic alcohol glycoside (ilicifolioside B) have been isolated from the aerial parts .Two lignan glucosides, (+)-lyoniresinol 3a-[2-(3,5dimethoxy-4-hydroxy) benzoyl]-O-beta-glucopyranoside, and dihydroxymethyl-bis (3, 5-dimethoxy-4-hydroxyphenyl) tetrahydrofuran-9(or 9')-O-beta-glucopyranoside have been isolated from the aerial parts[5]

Bruguiera cylindrical

Family: Rhizophoraceae

Synonyms: *Rhizophora cylindrical* L, *Bruguiera malabarica* Arn

Local names: kuttikandal, Kari-kandal, Cherukandal, Pichalakkandal

English name: White Burma mangrove

Small trees; underground roots produce numerous knee roots. Leaves are simple, opposite, decussate, 4-13x2-5.5 cm, exstipulate, elliptic or oblanceolate. Flowers greenish white in axillary cymes, usually of three flowered, rarely six flowered; flowers sessile, rarely middle flowers pedicellate; calyx tube, greenish-white, lobes 6-9; petals 6-9,free,white,apically bilobed, with a long bristle in the sinus between the lobes, lobes equal, tip more or less round with 3 or 4 cilia on each, margin densely hairy in the lower half and at the base except the stalk; stamens 10, in pairs of unequal length. Fruit a drupe, reddish-green; seed one; hypocotyls, cylindric, green with brownish tinge

Compared to other species of *Bruguiera* in Kerala, this middle zone mangrove is common with higher density in the northern part, especially in Kannur district. Commendable populations were also noted in a few locations of Ernakulam and Kollam districts. Plant is a rich source of tannins, the bark of the plant is used as spice and the young shoots are boiled and supplied as vegetables in Thailand. Plants parts such as buds are boiled and taken as vegetable in some islands in Maldives. The wood of the plant is thick and strong and is used for construction; it also used as firewood and can be converted to charcoal. The extracts of the specialized roots system of the plant is used to make some perfume. Bleeding can be prevented by using the skin of the fruit and the leaves are used as anti-hypertensive in traditional system of medicine

Ethanolic extract of stem bark shows anti-diabetic, antifouling, anti-cancer, ant proliferative, antiparkinsonian, anti-malarial activities[6].Phytochemical analysis of the plant shows the presence of protein, amino acids, Lipids, fatty acids, alkaloids, flavonoids, Tannin, triterpenoids, saponins, phenols, glycosides, lignin and volatile oils[6 7]

Ceriops tagal

Family: Rhizophoraceae

Synonyms: *Rhizophora tagal* Perr., *Ceriops candolleana* Arn.

Local names: Anakkandal, Manjakandal

English name: Spur mangrove

It is a small tree with short buttresses and knee-like breathing roots. The bark is pale greyish-brown, smooth in young trees and fissured in old trees. Leaves are simple, shiny, opposite, ovate, and dark green in shade and bright greenish-yellow in full sun. The leaf apex is rounded or notched. Inflorescences are axillary cymes with 5–10 flowers. Flowers have a deeply sunken calyx with five green lobes and five white petals. Fruits are ovoid and dark brown when ripe. Hypocotyls are pendulous, warty and pointed with a yellow collar. The fruit takes four weeks to mature and the collar appears 10 days before detachment of the hypocotyl.

Rare middle zone mangrove species has long been considered vanished from the coastal region of Kerala as there was no report about this species after JS Gamble (1900) until recently rediscovered from Kollam district. At present its population in Kerala is restricted to a small Island in the Neendakara region of Kollam. Bark of the plant is useful for making black dye used in tanning. Fruits are consumed in Andaman Islands and are reported to possess astringent activity and are considered useful for the cure of malaria in folk medicine. The extracts from the shoots of the plant is used as haemostat and it is considered as a substitute for quinine. Malignant ulcers are treated using the lotions made from the bark of the plant. The bark infusion is used to treat the abdominal ailments of the women in folklore

medicines. In Philippines bark is used as a remedy for curing diabetes

Pharmacological investigation of the *Ceriops tagal* shows antibacterial, ant-fouling, anti feedant, anti-diabetic[8, 9] and cytotoxic activities, Phytochemical screening of the *C. tagal* showed that the major constituents are diterpenoids, tagalenes in leaves, stems, twigs and roots[10] and tagalenes in leaves and twigs[11, 12] Triterpenoids of lupeol, betulin, betulinic acid and cereotagalols have been isolated from aerial parts, roots, fruits and hypocotyls of *C. tagal*[13]

Excoecaria agallocha

Family: Euphorbiaceae

Synonym: *Stillingia agallocha* (L) Baill

Local names: Komatti, Kammetti, Kannampotti

English name: River poison

"A dioecious tree to 15 m high with abundant white latex; Habitat - An evergreen shrub common along with higher estuarine banks, cannels, tidal forest and mangrove swamps; Stem-bark greyish, lenticellate; Roots- Lateral roots spreading and intermingled with each other, supraterranean bands produce elbow-shaped pegs instead of pneumatophores; Leaves - leaves alternate, ovate-elliptic or orbicular, apex shortly acuminate, base narrowed, margin entire or sinuate crenate, 3-8 × 1.5-3 cm, glabrous, petiolate; Flowers - Unisexual, Male flowers in catkin spikes, fragrant, yellow, 2-3 mm across; stamens 3, filaments free. Female flowers in axillary raceme, pale green, 2.5-3.5 mm across, pedicellate; calyx 3-lobed; ovary 3-celled, trifid style; Fruit - Capsule, globose 3-lobed, seeds sub-globose" [14]

It is a common species throughout the mangrove areas of Kerala and one of the widely known mangroves by the local people. Higher density is observed in low saline areas and generally in the backwater mangroves. Traditionally it is used as uterotonic, in the treatment of epilepsy, conjunctivitis, dermatitis, hematuria, leprosy, toothache. Phytochemical screening shows the presence phorbol ester, flavanone, glycoside, various di-and triterpenoids,[15] dichloromethane, lignin, pentosan, α cellulose saponin, tannins, phenols, volatile oils.[16,17,18] Pharmacological investigation of the various extracts of the plant shows antibacterial, antioxidant, anti-diabetic, antibacterial, anti-nociceptive effects .it is also reported it has some impact on the treatment of mosquito borne diseases and pandemic diseases.

Kandelia candel

Family: Rhizophoraceae

Synonym: *Rhizophora candel* L, *Kandelia rheedei* Wight & Arn

Local names: Cherukandal, Nallakandal, Vallikandal, Ezhuthanikkandal

English name: Narrow leaved kandelia

It is a Tree to 7 m high; Leaves simple, opposite, decussate, 8.5-12 x3-4.5 cm , stipulate, clustered at shoot apex; lamina oblong or lanceolate, shiny green above and pale green beneath. Flowers white, to 2.2 x3.3 cm in axillary dichotomously branched 4-flowered cymes; calyx white, tub copular, enclosing the ovary; lobes 5, persistent; petals 5, free, white, deeply bilobed, lobes equal with 3-6 cilia at apex; stamens many, free, inserted on the rim of calyx cup, filaments unequal. Fruit a drupe, 1.5-2 cm long, ovoid- conical; peduncle elongating; seed one; hypocotyle to 40 x1.5 cm, spindle shaped, slightly curved with pointed radical, surface smooth, green; cotyledonary collar protruded and exposed on maturity.

A middle zone mangrove sparsely distributed throughout the mangrove habitats of Kerala but higher density is observed in Kannur district. This is commonly seen in undisturbed mangrove areas and has poor regeneration capacity. The bark is suitable for tanning heavy leather and for dyeing in red and brown colours. Bark and leaves are used in the treatment of diabetes and also showing antioxidant activity. The wood is used for temporary constructions. The chemical analysis of the plant shows the presence of flavonoid glycosides, pentacyclic triterpenoids, tannins, saponins, polyphenols[19]

Rhizophora apiculata

Family: Rhizophoraceae

Synonyms: *Rhizopohora candelaria, Rhizophora conjugate*

Local Names: Kaya-kandel, Pee-kandal

English name: Pointed Asiatic mangrove

"Tree up to 8 m high; trunk and lower branches supported by numerous corky, lenticellate, profusely looping stilt roots and prop roots; bark brown, fissured. Leaves simple, opposite, decussate, 13 -17 x4-7 cm, elliptic to oblanceolate, dark green above, pale beneath; stipules interpetiolar, pale red. Flowers greenish- white, to 1.5 cm across, sessile, in axillary 2-flowered cymes; calyx externally fissured; lobes 4, ovate-oblong, acute, fleshy, persistent; petals 4, free, narrow- lanceolate, acute , white, thin, flat, glabrous; stamens 11 or 12, free, sessile, inserted on the margin of the receptacular disc. Fruit 2-4 cm long, conical, pericarp brown; seed one; hypocotyle to 50 x 1.8 cm, cylindric, thick towards the radical tip"[20]

A proximal zone mangrove distributed throughout the Kerala and is a dominating element in the front mangrove ecosystem in southern Kerala. However the population is low compared to the other species. Viviparous seeds are edible. Wood is a source of tannin and used as a substitute for petroleum coke. Tannin from bark is used as mosquito repellent. It is also used as astringent, for the treatment of diarrhoea, nausea and vomiting, antiseptic, antihemorrhagic, cure for typhoid fever and also for the treatment of diabetics the phytochemical screening shows the presence triterpenes, steroids, and a novel triterpenoid ester

Rhizophora mucronata

Family: Rhizophoraceae

Synonym: *Rhizophora mangle*, *Rhizophora Candelaria*

Local names: Panachikandal, pranthankandel

English name: Long fruited stilted mangrove

It is a tree about 8 m high; trunk and lower branches supported by numerous profusely looping stilt-roots and prop roots, lenticellate, bark longitudinally fissured. Leaves are simple, opposite decussate, 10-15 x 5-9 cm, stipulate, elliptic-ovate, green above, pale beneath with numerous black dots, stipules 2, interpetiolar, pale green with pinkish tinge, overlapping the apical bud, subcylindric. Flowers yellowish- white , to 25 cm across, in

axillary dichotomously or trichotomously branched or unbranched 2-4 flowered cymes; peduncle 3-5 cm long, pendulous ; calyx yellowish-white , enclosing the base of the pistil , lobes 4, thick, fleshy; petals 4, white , lanceolate, densely white hairy along the margins, uniseriate; stamens 8, free, inserted on the margin of the receptacular disc. Fruit to 7 cm long , ovoid, pericarp brown , calyx lobes reflexed, brown; seed one, hypocotyle to 50 x1.8 cm, cylindric, tapering towards the radicle end, surface rough warty, green

This species is one of the most common proximal zone dominating mangroves in Kerala. Generally this species is used in various mangrove afforestation programmes due to its high regeneration capacity and ease in seedling production. The bark is astringent and a folk remedy for angina, diabetes, diarrhoea, dysentery, haematuria, haemorrhage,treatment of elephantiasis, haematoma, hepatitis, ulcers, as febrifuge phytochemical analysis shows the presence of saponin, tannins, flavonoids, phenols, volatile oils, alkaloid rhizophorine[21,22] the wood is used for construction, fish traps, house frames, piling and poles. Wood is a source of tannin.

Vigna adenantha

Family: Fabaceae

Synonym: *Phaseolus adenanthus*

Local name: Kandalppayar, Kattupayar

English name: Moth bean, Snail flower

Twining or trailing perennial herbs. Leaves trifoliolate; leaflets 3-8 x 2-4 cm, ovate, ovate-elliptic or elliptic –lanceolate, base rounded, apex acute or acuminate; petiole 3-8 cm long. Racemes 5-14 cm long, 6-10 flowered; flowers 2-3 cm long; petals dark pink or cream coloured; standard 2-3 cm across, suborbicular, emarginate, cream coloured; wings obovate , pink; keels spirally incurved. Pods 6-11 x0.6; to 15 seeded; seeds reniform, black

It is fairly common in mangrove associated areas in southern Kerala. Immature fruits and seeds are edible. The plant is cultivated in various parts for its edible tuberous roots, which are cooked and eaten. In Nigeria a decoction of the whole plant is used against gonorrhoea, and mixed with rice water to treat diabetes. The plant is also grown as an ornamental plant in saline areas due to its showy flower.

CONCLUSION

Mangroves are widely distributed in almost all districts of Kerala, its existence is under serious threat due to the development activities along the coastal area of Kerala, it will cause sharp decline of the mangrove forest in Kerala and seriously affect the biodiversity of coastal ecosystem. Mangroves have wide range of activities and it plays an important role in supplying fresh water to coastal region, it resists wind and storm and helps to protect the sea costs from natural calamities and acts as a green wall to protect the sea cost. Ttraditionally the mangroves are used as firewood and charcoal and also used for construction of dwellings, furniture, boats and fishing gear and production of tannins for dying and leather production, only few species are used traditionally for curing diseases. It is reported that many of the species found in Kerala has anti-diabetic activity, synthetic anti-diabetic agents had many undesirable side effects so the screening and the development of newer and safer anti-diabetic agent from mangroves has great scope in the natural products research.

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Cite this article as:

Muhammed Habeebulla M & Malarkodi Velraj. Potential anti-diabetic mangroves in Kerala, India: A review. Int. J. Res. Ayurveda Pharm. 2018;9(4):194-198 http://dx.doi.org/10.7897/2277-4343.094142

Source of support: Nil, Conflict of interest: None Declared