



## International Journal of Research in Pharmacology & Pharmacotherapeutics



ISSN Print: 2278-2648 IJRPP |Vol.4 | Issue 1 | Jan-Mar-2015  
ISSN Online: 2278-2656 Journal Home page: www.ijrpp.com

Research article

Open Access

### A review on traditional ayurvedic medicinal plants used in the sundarban mangrove forest in bangladesh

Md.Shariful Islam\*, Md.Farzanoor Rahman, Md.Amir Hamja Raju, Masum Parvez, Hasibul Haque Rakib, Binita Shome

Department of Biotechnology and Genetic Engineering, Faculty of Life Science, Mawlana Bhashani Science and Technology University, Tangail-1902, Dhaka, Bangladesh

\*Corresponding author: Md.Shariful Islam

E-mail id: goldenrice8@gmail.com

#### ABSTRACT

Medicinal Plants have been used for thousands of years to flavor and conserve food, to treat health disorders and to prevent diseases including epidemics. Recently, dramatic changes have taken place in the primary health care system of world population through the development of science, technology and medical science, but till to day 400 cores of people of the worldwide are totally dependent on herbal medicine. In Bangladesh, various types of diseases affect thousands of people every year, especially children are so much vulnerable. In this review, we have choosen 6 plant species that are used in the treatment of various types of eruptions, gastrointestinal infection etc. Bacterial toxins or viral infections are the most common cause of the diseases. The diarrheal outbreaks are often associated with flood affected areas with contaminated drinking water and an increased risk of spreading the water-borne disease. Not surprisingly, plants found in the near surroundings have been taken into use by the local community as medicine to treat diarrhoeal symptoms. These plants are cheaper and more easily available than conventional medicine. We just here figure out some so much beneficial ayurvedic plants (*Diospyros peregrina* Gürke, *Heritiera littoralis* Dryand, *Ixora coccinea*, *Pongamia pinnata*, *Rhizophora mucronata*, *Xylocarpus granatum*) traditional uses against gastrointestinal infection, eruptions, catarrhal bronchitis, dysentery, and as an anti inflammatory agent. Appearance and geographical distribution, traditional uses, and biological studies related to antidiarrhoeal activity will be presented. This review reveals that there is limited scientific evidence supporting the traditional use of these plants.

**Keywords:** Mangrove plants; *Diospyros peregrina* Gürke; *Heritiera littoralis* Dryand; *Ixora coccinea*; *Pongamia pinnat*., *Rhizophora mucronata*; *Xylocarpus granatum*; antidiarrhoeal activity.

#### OVERVIEW

Medicinal plants always played an important role in the health development of mankind. In developing countries, 80% of populations are totally dependent

on plants for their primary health care. Over 25% of prescribed medicines in industrialized countries derive directly or indirectly from medicinal plants. A multidisciplinary approach combining botanical, ethnobotanical, phytochemical and biological

techniques led to Drug discovery from plant. Plants provide us new lead molecules for the development of drugs against various pharmacological targets. Discovery of drugs from plants has traditionally been time-consuming, so faster methods for plant collection, bioassay screening, isolation and development of compound must be adopted. Bangladesh is in particular affected by tropical cyclones due to its geographical position, but mangroves play an important role reducing the impact of the cyclones and accompanying surges [60]. The aim of this review is to summarize the present knowledge of some traditional medicinal plants used against gastrointestinal infection, eruptions, catarrhal bronchitis, dysentery, and as an anti inflammatory agent. Appearance and geographical distribution, traditional uses, and biological studies related to antidiarrhoeal activity will be presented. The literature sources used in this

review are the SciFinder and PubMed databases and Google searches in the “grey” literature, as well as handbooks, reference works and articles from the archives of the authors.

## **Traditional Medicinal Plants from Bangladesh**

### **GAB**

Local name by Bangladeshi: - GAB

Scientific name: - *Diospyros peregrina* Gürke

English name: - Gaub Persimmon

Family: - Ebenaceae

Gab is a large-sized ever green (fig-1) tree up to 15m high. It has bell-shaped flowers; the fruits are yellow when ripe, round and 4–8 cm in diameter. It is indigenous to Bangladesh and India, and is also found in many other countries of Asia and America [1].

**Figure 1.** *Diospyros peregrina* [2]



### **Traditional Use**

The bark has traditionally been used against dysentery and intermittent fevers. The ripe fruit has been used against biliousness, diseases of the blood, urinary losses, and stones in the urinary tract. The seeds and the oil from the seeds are given as an astringent agent against diarrhoea. The juice of the unripe fruit is used on wounds and ulcers, it has astringent properties, and it has also been used for the treatment of diabetes. The flowers and fruits are given to children with hiccough [1, 3, and 4].

Tannins from *D. peregrina* are used for dyeing and in the tanning industry [5]. In Namibia, *D. peregrina* is employed against malaria [6]. An antiplasmodial

activity of a stem bark extract of *D. peregrina* has been reported [7]. Bark contains Triterpenoids, Sterol, and Long-chain alcohol [8]. An extract of unripe fruits of the related species *D. melanoxylon* in milk has been reported to be used against diarrhoea in Madhya Pradesh, India [9]. Heartwood contains Lupeol [10]. Stems contain  $\beta$ -sitosterol, leucopelargonidin-3-O- $\alpha$ -L-rhamnopyranoside [11], and Aliphatic ketone [12]. Leaves contain betulin, oleanolic acid, peregrinol [13, 14] and  $\beta$ -sitosterol [13, 14]. Fruits contain peregrinol, lupeol, betulin, betulinic acid, taraxerone, marsformosanone [15, 16].  
Flavonoids: furano-(2'',3'',7,8)-3',5'-dimethoxy-5-

hydroxyflavone, 3,6-dimethoxy-2-(3',5'-dimethoxy-4'-hydroxyphenyl)-8,8-dimethyl-4H,8H-benzo[1,2-b:3,4-b']dipyran-4-one, pongaflavone, 5-hydroxy-3,6,7-trimethoxyflavone, 4'-O-methyluteolin 7-glucoside, quercetin 3-O-glucosyl glucoside [17, 18]. An antidiarrhoeal effect has been investigated from the methanol extracts of the bark and the seeds of *D. peregrine* [19].

### DUNGUN

Local name by Bangladeshi: - Dungun

Scientific name: - *Heritiera littoralis* Dryand

English name: - Looking-glass mangrove

Family: - Sterculiaceae

*Heritiera littoralis* is an evergreen mangrove tree, up to 25 m in height and with a buttressed trunk up to 60 cm in diameter. The bark is fissured, dark or gray. Leaves are 10–20 cm long, and they have a green upper surface and a silvery-white lower surface. The tree has numerous small bell-shaped, yellowish-green flowers. The fruits are hard and shining, 4–8 cm long [20]. *Heritiera littoralis* is distributed from Madagascar and East Africa to Hong Kong, the Pacific and Australia.

Figure 2. *Heritiera littoralis*[28]



### Traditional use

Traditionally *H. littoralis* seed extracts are used to treat diarrhoea and dysentery [21]. The stems and leaves have also been used against diarrhoea and dysentery. In addition, they have been used to control mosquitos and as a piscicide[22, 23, 24]. The tree is used as tooth brushes and chew sticks. The wood is also valuable for its timber [25]. The seeds and leaves are, however, regarded as edible in the Andaman and Nicobar Islands [26]. The sap is reported to be a fish poison and arrowhead and spearhead poison [27]. Aqueous leaf and stem extracts of the plant have shown antibacterial activity against *Salmonella paratyphoid*, while the ethanol extract was inactive. Some other bacteria, e.g., *S. aureus* and *P. aeruginosa* were also inhibited [29]. Several triterpenoids and steroids showed anti-inflammatory activity

determined as NO inhibitory effect and anti-PGE2 activity, with ergosterol peroxide being the most active substance [30].

### KANGAN

Local name by Bengali: - kangan

Scientific name: - *Ixora coccinea*

English name: - Jungleflame ixora

Family: - Rubiaceae

*Ixora coccinea* is a perennial shrub 0.6–0.9 m in height, widely grown in gardens as an ornamental. The flowers are bright scarlet red, sometimes yellow, pink or orange-yellow. The bush has small globular fruits which are purple when ripe. The shrub is native to tropical Asia. However, it is cultivated for ornamental purposes in tropical and subtropical areas [1, 31].

**Figure 3.** *Ixora coccinea* [32]



### **Traditional Use**

The roots, bark, leaves and flowers are used in traditional medicine in South East Asia from India to the Philippines [33, 34, 35, 36]. The roots of *Ixora coccinea* are used to treat hiccoughs, nausea, fever, ulcers, gonorrhoea, and loss of appetite. The flowers of *Ixora coccinea* are used against reddened eyes, eruptions, catarrhal bronchitis, dysentery, and as an anti-inflammatory agent. The leaves have been utilized in the treatment of diarrhoea. A paste from the root of an unspecified *Ixora* species is used against diarrhoea in children [37]. *Ixora coccinea* has been investigated for antimicrobial effects. In a study by Annapurna et al [38]. methanol extracts of the leaves were tested against a selection of bacteria and fungi. The ether extract was found to have higher

activity than the methanol extract, and both Gram-negative and Gram-positive bacteria were inhibited. The activity against fungi was not significant [38].

### **KARANJA**

Local name by Bengali:-Karanja

Scientific name: - *Pongamia pinnata*

English name: - Pongam tree

Family: - Fabaceae

Pongam tree is a medium sized tree, 15–25 m in height, with white, purple and pink flowers growing in clusters and maturing into brown seed pods. The species is distributed from India to Philippines and the north of Australia. “Karanja” is the local name used in Bangladesh [1].

**Figure 4.** *Pongamia pinnata* [39]



### **Traditional Use**

Both the leaves, bark, flowers, seeds, and roots are reported to have a healing effect and it has been widely used as a traditional medicinal agent [40].the leaves of these plant are used against flatulence, dyspepsia [41]. A poultice of the leaves is applied to ulcers infested with worms. A decoction of the leaves is used for medicated baths and fomentations in cases of rheumatic pains. The juice from the roots is used for closing fistulous sores and for cleaning foul

ulcers. It is used for cleaning the teeth and strengthening the gums. It is also given internally mixed with coconut milk and lime water for the cure of gonorrhoea. The oil from the seeds is useful in skin diseases such as herpes and scabies, and in rheumatism [41]. A paste from the seeds of the plant has also been used in rheumatism [42]. The use of the bark or leaves of the plant against fever in humans are available [43] and also used in animals [44] and against malaria [45]. The fresh bark of this plant is

used internally in the treatment of bleeding piles [41]. This plant is recommended for the treatment of snake bites and scorpion stings. However, the efficacy of this treatment has been debated [1].

### **BHORA**

Local name by Bengali: - Bhora

Scientific name: - *Rhizophora mucronata* Lam

English name: - True mangrove

Family: - Rhizophoraceae

*Rhizophora mucronata* is an evergreen small tree up to 15 m tall, with small white flowers and long ovoid-conical fruits. The tree is distributed along muddy shores and tidal creeks in tropical zones of East- and South Africa, Asia, Northeast Australia and Central America [1]. “BHORA” is the local name in Bangladesh.

**Figure 5.** *Rhizophora mucronata*[46]



### **Traditional Use**

The bark of this plant is known as an astringent. It has traditionally been used in the treatment of diabetes, diarrhoea, nausea, haematuria, haemorrhages and angina [41, 1]. The traditional use of several mangrove plants including *R. mucronata* has recently been reviewed [47]. The most usefulness use of this plant is Antiviral activity [48, 49, and 50]. The ethanol bark extract was found to have high activity against the Newcastle disease, vaccinia, encephalomyocarditis and Forest viruses. Also the ethanol flower extract showed good activity in human health [50]. Among 73 extracts of marine plants and mangroves, the bark of *Rhizophora mucronata* was

the most promising antiviral agent [50]. Honey from the flowers is reported to be poisonous [41].

### **DHUNDUL**

Local name by Bengali: - Dhundul

Scientific name: - *Xylocarpus granatum* Konig

English name: - Puzzle nut tree

Family: - Meliaceae

“Cannonball tree” or “puzzle nut tree”, is an evergreen tree with gray bark, up to 15 m in height. The fruits can be up to 25 cm in diameter [51]. The bark possesses extreme bitterness [1]. - *Xylocarpus granatum* is distributed in mangrove forests in East Africa, tropical Australia and Southeast Asia [52].

**Figure 6.** *Xylocarpus granatum* [53]



### Traditional Use

The bark is used to treat fever, cholera, colic, diarrhoea and other abdominal affections [54, 55]. The bark is used traditionally as a water decoction prepared overnight for prevention of diarrhoea [56]. The fruits are also used against diarrhoea and externally to soothe inflammation [56, 57]. The fruit seed coats of *Xylocarpus granatum* is used for making an antidiarrhoeal drug [58]. The seeds are used in tonics, and the bitter and astringent oily fluid [59].

### CONCLUSION

Bioactive constituents extracted from these plants have got a number of beneficial medicinal effects for different kinds of ailments, with no side effects and also they are very cost effective as compared to allopathic medicines. Especially for anti diarrhoeal

event these types of plants are so much beneficial. Recently in Bangladesh the study of ayurvedic plants in case of severe diseases which is so rapid in localism gradually increasing by extraction of bioavailability from ayurved plants in mangrove forest or tribal region.

### ACKNOWLEDGEMENTS

We thank Dr.A.K.M. Mohiuddin, The associate professor of biotechnology and genetic engineering department, MBSTU, for infrastructure support is acknowledged. We thank the anonymous reviewers for their helpful comments. We also thank from our heart to Dr. M Shafiqul Islam, department of nuclear engineering, university of Dhaka, for his brilliant guidelines. The authors are grateful to Wikipedia journals for pictures.

### REFERENCES

- [1] Kirtikar, K.R.; Basu, B.D. Indian Medicinal Plants; Lalit Mohan Basu: Allahabad, India, 1935.
- [2] Male Flowers of *Diospyros malabarica* from Ebenaceae. Rarely Seen in Cultivation. Available online: [http://en.wikipedia.org/wiki/File:Malabar\\_Ebony.jpg](http://en.wikipedia.org/wiki/File:Malabar_Ebony.jpg) (accessed on 14 April 2013).
- [3] Chopra, R.N.; Nayar, S.L.; Chopra, I.C. Glossary of Indian Medicinal Plants; Council of Scientific & Industrial Research: New Dehli, India, 1956.
- [4] Sinha, B.N.; Bansal, S.K. A review of phytochemical and biological studies of *Diospyros* species used in folklore medicine of Jharkand. *J. Nat. Remedies* 2008, 8, 11–17.
- [5] Misra, P.S.; Misra, G.; Nigam, S.K.; Mitra, C.R. Constituents of *Diospyros peregrina* fruit and seed. *Phytochemistry* 1971, 10, 904–905.
- [6] Chinsebu, K.C.; Hedimbi, M. An ethnobotanical survey of plants used to manage HIV/AIDS opportunistic infections in Katima Mulilo, Caprivi region, Namibia. *J. Ethnobiol. Etnomed.* 2010, 6, 25.
- [7] Kantamreddi, V.S.S.; Wright, C.V. Investigation of *Diospyros* species for antiplasmodial properties. *Evid. Based Complement. Altern. Med.* 2008, 5, 187–190.
- [8] Gupta, R.K.; Tiwari, R.D. Chemical examination of the bark of *Diospyros peregrina*. *Proc. Indian Nat. Sci. Acad. Sect. A* 1964, 34, 180–181.
- [9] Wagh, V.V.; Jain, A.K.; Kadel, C. Ethnomedicinal plants used for curing dysentery and diarrhea by tribals of Jhabua district (Madhya Pradesh). *Indian J. Nat. Prod. Resour.* 2011, 2, 256–260.
- [10] Sundararamaiah, T.; Ramraj, S.K.; Rao, K.L.; Vimalabai, V. Isolation of the lupeol group of triterpenes from *Dillenia indica* Linn. and *Diospyros peregrina*. *J. Indian Chem. Soc.* 1976, 53, 638.
- [11] Chauhan, J.S.; Kumari, G. A new leucoanthocyanin from the stem of *Diospyros peregrina*. *J. Indian Chem. Soc.* 1978, 55, 1068–1070.
- [12] Chauhan, J.S.; Kumari, G. Nonadecan-7-ol-2-one, an aliphatic ketol from *Diospyros peregrina*. *Phytochemistry* 1980, 19, 2637–2638.
- [13] Gupta, R.K.; Tiwari, R.D. Chemical examination of the leaves of *Diospyros peregrina* Gurke. *Indian J. Chem.* 1964, 2, 129–130.
- [14] Jain, N.; Alam, M.S.; Kamil, M.; Ilyas, M.; Ali, M. Peregrinol: A new lupene type triterpene from *Diospyros peregrina*. *Pharmazie* 1992, 47, 559–560.

- [15] Bhaumik, T.; Dey, A.K.; Das, P.C.; Mukhopadhyay, A.K.; Chatterjee, M.A. Triterpenes of *Diospyros peregrina* Gurke: Partial syntheses of olean-9(11),12-dien-3-one and ursan-9(11), 12-dien-3-one (marsformosanone). *Indian J. Chem. Sect. B Org. Med. Chem.* 1981, 20B, 664–668.
- [16] Pareek, R.B.; Vidyapati, T.J.; Bhutani, K.K. Chemical examination of the fruits of *Diospyros peregrina*. *J. Teaching Res. Chem.* 2008, 15, 6–11.
- [17] Jain, N.; Yadava, R. A novel chromenoflavone from the fruits of *Diospyros peregrina*. *Fitoterapia* 1996, 67, 348–350.
- [18] Sahu, R.; Dewanjee, S.; Dua, T.K.; Gangopadhyay, M.; Das, A.K.; Dey, S.P. Dereplication coupled with in vitro antioxidant assay of two flavonoid glycosides from *Diospyros peregrina* fruit. *Nat. Prod. Res.* 2012, 26, 454–459.
- [19] Rouf, R.; Uddin, S.J.; Shilpi, J.A.; Toufiq-ur-rahman, M.; Ferdous, M.M.; Sarker, S.D. Anti-diarrhoeal properties of *Diospyros peregrina* in the castor oil-induced diarrhoea model in mice. *Ars. Pharm.* 2006, 47, 81–89.
- [20] Tomlinson, P.B. *The Botany of Mangroves*; Cambridge University Press: Cambridge, UK, 1986
- [21] Daengrot, C.; Ponglimanont, C.; Karalai, C. Chemical Constituents from the Barks of *Heritiera littoralis*. In *Proceedings of the 31st Annual Congress on Science and Technology of Thailand*, Suranaree, Thailand, 18–20 October 2005.
- [22] Bandaranayake, W.M. Traditional and medicinal uses of mangroves. *Mangroves Salt Marshes* 1998, 2, 133–148.
- [23] Bandaranayake, W.M. Bioactivities, bioactive compounds and chemical constitutions of mangrove plants. *Wetlands Ecol. Manag.* 2002, 10, 451–452.
- [24] Pattanaik, C.; Reddy, C.S.; Dhal, N.K.; Das, R. Utilisation of mangrove forests in Bhitarkanika wildlife sanctuary, Orissa. *Indian J. Tradit. Knowl.* 2008, 7, 598–603.
- [25] Dahdouh-Guebas, F.; Collin, S.; lo Seen, D.; Rönnbäck, P.; Depommier, D.; Ravishankar, T.; Koedam, N. Analysing ethnobotanical and fishery-related importance of mangroves of the East-Godavari Delta (Andhra Pradesh, India) for conservation and management purposes. *J. Ethnobiol. Ethnomed.* 2006, 2, 24.
- [26] Bhargava, N. Ethnobotanical studies of the tribes of Andaman and Nicobar Islands, India. *I. Onge. Econ. Bot.* 1983, 37, 110–119.
- [27] Miles, D.H.; Lho, D.S.; de la Cruz, A.A.; Gomez, E.D.; Weeks, J.A.; Atwood, J.L. Toxicants from mangrove plants. 3. Heritol, a novel ichthyotoxin from the mangrove plant *Heritiera littoralis*. *J. Org. Chem.* 1987, 52, 2930–2932.
- [28] *Heritiera littoralis* (Green Fruit). Location: Oahu, Keehi Lagoon. Available online: [http://en.wikipedia.org/wiki/File:Starr\\_080530-4634\\_Heritiera\\_littoralis.jpg](http://en.wikipedia.org/wiki/File:Starr_080530-4634_Heritiera_littoralis.jpg) (accessed on 14 April 2013).
- [29] Tao, W.Q.; Xu, M.B.; Huang, L.Y.; Miao, S.Y. Antibacterial activity of extracts from four mangrove species in vitro. *Med. Plant* 2012, 3, 38–41.
- [30] Tewtrakul, S.; Tansakul, P.; Daengrot, C.; Ponglimanont, C.; Karalai, C. Anti-inflammatory principles from *Heritiera littoralis* bark. *Phytomedicine* 2010, 17, 851–855.
- [31] Latha, P.G.; Panikkar, K.R.; Suja, S.R.; Abraham, A.; Rajasekharan, S. Chemistry, pharmacognosy, pharmacology and botany of *Ixora coccinea*—A review. *J. Med. Arom. Plant Sci.* 2001, 23, 670–676.
- [32] A Specimen of *Ixora coccinea*, Also Known as the Jungle Flame, Shot in Miami, Florida. Available online: <http://en.wikipedia.org/wiki/File:IxoraCoccineaMiami.JPG> (accessed on 14 April 2013).
- [33] Nayak, S.; Udupa, L.; Udupa, S. Altered antioxidant enzyme profile in wound healing. *Indian J. Clin. Biochem.* 2003, 18, 75–79.
- [34] Ragasa, C.Y.; Tiu, F.; Rideout, J.A. New cycloartenol esters from *Ixora coccinea*. *Nat. Prod. Res.* 2004, 18, 319–323.
- [35] Ratnasooriya, W.D.; Deraniyagala, S.A.; Bathige, S.D.N.K.; Goonasekara, C.L.; Jayakody, J.R.A.C. Antinociceptive action of aqueous extract of the leaves of *Ixora coccinea*. *Acta Biol. Hung.* 2005, 56, 21–34.
- [36] Khare, C.P. *Indian Medicinal Plants: An Illustrated Dictionary*; Springer: New York, NY, USA, 2007.

- [37] Alam, M.K. Medical ethnobotany of the Marma tribe of Bangladesh. *Econ. Bot.* 1992, 46, 330–335.
- [38] Annapurna, J.; Amarnath, P.V.S.; Amar Kumar, D.; Ramakrishna, S.V.; Raghavan, K.V. Antimicrobial activity of *Ixora coccinea* leaves. *Fitoterapia* 2003, 74, 291–293.
- [39] *Pongamia pinnata*—Karanj, Indian Beech Tree, Honge Tree, Pongam Tree or Panigrahi at Deer Park in Shamirpet, Rangareddy District, Andhra Pradesh, India. Available online: [http://en.wikipedia.org/wiki/File:Pongamia\\_pinnata\\_%28Karanj%29\\_near\\_Hyderabad\\_W\\_IMG\\_7633.jpg](http://en.wikipedia.org/wiki/File:Pongamia_pinnata_%28Karanj%29_near_Hyderabad_W_IMG_7633.jpg) (accessed on 14 April 2013).
- [40] Khatri, P.; Patel, R. A phytochemical overview of various parts of *Pongamia pinnata* (Karanj). *World J. Pharm. Res.* 2013, 2, 146–165.
- [41] Khare, C.P. *Indian Medicinal Plants: An Illustrated Dictionary*; Springer: New York, NY, USA, 2007.
- [42] Ragupathy, S.; Newmaster, S.G. Valorizing the “Iruulas” traditional knowledge of medicinal plants in the Kodiakkal Reserve Forest, India. *J. Ethnobiol. Ethnomed.* 2009, 5, 10.
- [43] Awashti, A.K. Ethnobotanical studies of the Negrito islanders of Andaman islands, India—The great Andamanese. *Econ. Bot.* 1991, 45, 274–280.
- [44] Kumar, A.; Pandey, V.C.; Tewari, D.D. Documentation and determination of consensus about phytotherapeutic veterinary practices among the Tharu tribal community of Uttar Pradesh, India. *Trop. Animal Health Prod.* 2012, 44, 863–872.
- [45] Bhargava, N. Ethnobotanical studies of the tribes of Andaman and Nicobar Islands, India. I. Onge. *Econ. Bot.* 1983, 37, 110–119.
- [46] *Rhizophora mucronata* Propagules at Iriomote is. Okinawa, Japan. Available online: [http://en.wikipedia.org/wiki/File:Rhizophora\\_mucronata\\_Propagules.jpg](http://en.wikipedia.org/wiki/File:Rhizophora_mucronata_Propagules.jpg) (accessed on 14 April 2013).
- [47] Puspitasar, Y.E.; Hartiati, A.M.; Suprayitno, E. The potency of *Rhizophora mucronata* leaf extract as antidiarrhea. *J. Appl. Sci. Res.* 2012, 8, 1180–1185.
- [48] Premanathan, M.; Kathiresan, K.; Chandra, K. Antiviral evaluation of some marine plants against Semliki forest virus. *Pharm. Biol.* 1995, 33, 75–77.
- [49] Premanathan, M.; Kathiresan, K.; Yamamoto, N.; Nakashima, H. In vitro anti-human immunodeficiency virus activity of polysaccharide from *Rhizophora mucronata* Poir. *Biosci. Biotechnol. Biochem.* 1999, 63, 1187–1191.
- [50] Premnathan, M.; Chandra, K.; Bajpai, S.K.; Kathiresan, K. A survey of some Indian marine plants for antiviral activity. *Bot. Mar.* 1992, 35, 321–324.
- [51] Tomlinson, P.B. *The Botany of Mangroves*; Cambridge University Press: Cambridge, UK, 1986.
- [52] Johnson, T. *CRC Ethnobotany Desk Reference*; CRC Press: Boca Raton, FL, USA, 1999
- [53] Cannonball Mangrove (*Xylocarpus granatum*) in a Mangrove Swamp in the Daintree Region of Queensland, Australia. Located on the Mardjja Botanical Walk (Coordinates Imprecise). Available online: [http://en.wikipedia.org/wiki/File:Xylocarpus\\_granatum.jpg](http://en.wikipedia.org/wiki/File:Xylocarpus_granatum.jpg) (accessed on 14 April 2013).
- [54] Alvi, K.A.; Crews, P.; Aalbersberg, B.; Prasad, R. Limonoids from the Fijian medicinal plant dabi (*Xylocarpus*). *Tetrahedron* 1991, 47, 8943–8948.
- [55] Weiner, M.A. Ethnomedicine in Tonga. *Econ. Bot.* 1971, 25, 423–450.
- [56] Rouf, R.; Uddin, S.J.; Shilpi, J.A.; Alamgir, M. Assessment of antidiarrhoeal activity of the methanol extract of *Xylocarpus granatum* bark in mice model. *J. Ethnopharmacol.* 2007, 109, 539–542.
- [57] Wiart, C. *Medicinal Plants of Asia and the Pacific*; Taylor & Francis: Boca Raton, FL, USA, 2006.
- [58] Lakshmi, V.; Saxena, A.; Singh, S.; Pal, R.; Srivastava, S.; Srivastava, M.N. A Process for the Isolation of Standardized Antidiarrhoeal Fraction and Its Active Compounds from the Fruit Seed Coat of *Xylocarpus granatum* Koen and Its Use Thereof. Indian Pat. Appl. No. 1937/DEL/ 2006 A, 2006
- [59] Zaridah, M.Z.; Idid, S.Z.; Wan Omar, A.; Khozirah, S. In vitro antifilarial effects of three plant species against adult worms of subperiodic *Brugia malayi*. *J. Ethnopharmacol.* 2001, 78, 79–84.
- [60] Uddin, S.J.; Grice, I.D.; Tiralongo, E. Cytotoxic effects of Bangladeshi medicinal plant extracts. *Evid. Based Complement. Altern. Med.* 2011, 2011, doi:10.1093/ecam/nep111.