



Original Research Article

Diversity of fungi in selected mangroves along the east coast of India

¹*R. Thamizhmani, and ²R. Senthilkumaran

¹Department of Microbiology, Regional Medical Research Institute, Port Blair,
Andaman and Nicobar Islands. India.

²Department of Microbiology, King Nandhivarman College of Arts & Science, Thellar,
Thiruvanamalai District, Tamilnadu, India -604 406.

*Corresponding author: mailmethamizh@rediffmail.com

A B S T R A C T

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Diversity of fungi in mangrove along the East coast in India was studied in terms of species diversity, frequency of occurrence in Ariyankuppam (S1), Thenkaihetu (S2), T.R.Pattanam (S3) and Muthukuda (S4) of the estuarine system. Among the 80 species of fungi isolated, totally 43 species were isolated from sediment samples followed by water with 41 species. Among the fungal members *Aspergillus* was common genus represented with 17 species followed by *Cladosporium* 9 species *Alternaria* and *Penicillium* with 7 species respectively.

Introduction

Biological diversity refers the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystem and ecological complexes. The “Mangle” is composed of the wide variety of shoreline trees and bushes belonging to numerous, often unrelated plant families and share the common ability to grown in estuarine and coastal environments. Mangroves as one of the coastal wetland ecosystems offer an ideal environment for fish farming. Several species of flora and fauna are native to mangrove environment, depend on the stability of this environment (Untawale, 1987). Mangroves are open systems with respect to both energy and matter and can be considered “interface” ecosystems coupling upland terrestrial and coastal estuarine ecosystems (Lugo and Snedakar, 1974). Mangrove forests generate considerable amount of detritus such as leaf litter, woody debris and inflorescence (Wafar *et al.*, 1997) and hence constitute an ideal habitat for many detritus – dependant fauna and microbes. Owing to the lack of studies on different location along the Indian coast,

the present study was carried out to understand the ecology and diversity, seasonal variations, frequency of occurrence and distribution fungi in relation to physico - chemical status of mangrove in east coast of India.

Materials and Methods

Study area

Totally four sampling stations were selected depends on the richness of the mangrove vegetation. The stations are Ariyankuppam (S1), Thenkaihetu (S2), T.R.Pattanam (S3) and Muthukuda (S4).

Samples collection and processing

Random sampling of water was carried out at various depths in each sampling station. Besides this, sediment was also collected to isolate and enumerate the fungi. The naturally occurring different wood substrates such as drift wood and intertidal wood found in the crevices of rock along the banks of the estuary were collected (randomly in the study area) in sterile polythene bags and brought to the laboratory

for further processing. In the laboratory the surface fouling organisms were gently scraped off and washed off by exposing under running tap water and the samples were again washed with sterile seawater. Then wood samples were cut into small pieces of different sizes and were again washed with sterile and allowed to drain for 1 hour to remove excess surface waters (Vrijmoed, 2000). The samples were kept at 4°C for further use (Kohlmeyer and Kohlmeyer, 1979).

Isolation and identification of fungi

By employing plating technique, all the collected samples were plated on Potato Dextrose agar, Corn Meal agar, Rose Bengal agar, Low Nutrient Growth Medium, Sabouraud’s Dextrose Agar with addition of mixture antibiotics (Tetracycline + Penicillin). After incubation at room temperature (28°C), the fungal colonies were identified (Kohlmeyer and Kohlmeyer, 1979; Subramanian, 1791; Ellis, 1971 and 1976; Ellis and Ellis, 1985; Gilman, 1959 and 1998).

Analysis of physico – chemical parameters

The water and sediment samples were collected separately to analyse the physico – chemical parameters along with the collection of water and sediment samples for fungal studies. The parameters such as temperature, pH, Dissolved oxygen (DO), Chemical oxygen demand (COD), Salinity, Alkalinity and Total dissolved solids (TDS) of water samples and Nature of soil, pH, Salt concentration, Nitrogen, Alkalinity, Total organic matter of sediment samples were also studied. The methodology of water and sediment samples analysis was followed as per the manual by Venugopalan and Paulpandian (1981) and Plummer (2003).

Frequency of occurrence and diversity indices of fungi

The physico-chemical data obtained were correlated with the fungal diversity and distribution of fungi. The frequency of occurrence of fungi in the four sampling stations was calculated and represented in the following frequency grouping per sample.

$$\text{Frequency of occurrence} = \frac{\text{Number of sampling stations where the species occurred}}{\text{Total number of sampling stations studied}} \times 100$$

The diversity of fungi in the mangrove samples of

four sampling stations were assessed on the basis of diversity indices.

$$\text{Simpson index } D' = \frac{1}{\sum(Pi)^2}$$

and

$$\text{Shannon index, } H' = - \sum (Pi \ln Pi),$$

Where *Pi* is the Proportion of individuals of that species; *i* contribute to the total (Magurran, 1988).

The Shannon Evenness, *J'*, was expressed by:

$$J' = \frac{H'}{H' \text{ max}}$$

Where *H'* mark is the maximum value of density for the number of species present (Pielou, 1975).

Results and Discussion

The physico-chemical parameters of water and sediment samples in mangrove stations, salinity, alkalinity, sulphate, hardness, total organic matter were 50.12%, 23.0mg, 54.83mg, 24.5mg, 7.15% respectively (Table.1). These parameters were influenced the occurrence of 61 fungi belonging to Zygomycotina (3), Ascomycotina (17), Deuteromycotina (40) and Chytridiomycota (1). Altogether 80 fungi belonging to 42 genera comprising 57 Deuteromycotina, 81 Ascomycotina, 4 Zygomycotina and 1 Chytridiomycota were isolated.

Table 1 Details of physico-chemical parameters of water and sediment in four stations of the East Coast of India

Parameters	Mean	Range
Water samples		
Temperature (°C)	30.5	30-32.1
pH	7.9	7-8.1
Dissolved oxygen (mg/L)	13.6	12.8-14.2
Chemical oxygen demand (mg/L)	14.0	13.9-14.6
Salinity (%)	50.12	48.10-51.2
Alkalinity (mg/L)	23.0	22.1-23.5
Total dissolved solids(mg/L)	3.93	2.25-4.4
Sediment samples		
pH	8.0	7.5-8.2
Salt (NaCl) mg/100g	52.64	51.65-54.65
Alkalinity (mg/g)	2.16	1.09-2.45
Total organic matter (mg/g)	7.15	6.18-7.30

Table 2 Isolation of fungi from Sediment, Water, Natural substrates and their frequency of occurrence (FO).

Name of the Fungi	Sediment	Water	Natural substrates	FO
<i>R. nigricans</i> Ehrenberg	-	-	+	9.09
<i>R. oryzae</i> Went and Gerlings	+	-	-	27.27
<i>Bicrouania maritime</i> (Crouan <i>et</i> Crouan) <i>et</i> Volkm - Kohlm	-	-	+	9.09
<i>Didymella avicenniae</i> Patil <i>et</i> Borse	-	-	+	9.09
<i>Didymosphaeria lignomaris</i> Strongman <i>et</i> Miller	-	-	+	9.09
<i>Gymnoascus littoralis</i> Baranetzky	-	-	+	9.09
<i>Halottia posidoniae</i> Durieu <i>et</i> Montagne	-	-	+	9.09
<i>Leptosphaeria avicenniae</i> Kohlm <i>et</i> Kohlm	-	-	+	9.09
<i>Marinophaera mangrovei</i> Hyde	-	-	+	9.09
<i>Pontogeneia calospora</i> (Patouillard) Kohlm	-	-	+	9.09
<i>Verruculina enalia</i> (Kohlm.) Kohlm. <i>et</i> Volkm - Kohlm	-	-	+	9.09
<i>Emericella nidulans</i> (Eidam) Vuill	+	-	-	9.09
<i>Lophiostoma mangrovei</i> Kohlm <i>et</i> Vittal	-	-	+	9.09
<i>Neurospora crassa</i> Shear and Dodge	+	+	+	27.27
<i>Aspergillus alliaceus</i> Thom & Church	+	-	-	9.09
<i>A. erythrocephalus</i> Berk & Curt	-	+	-	9.09
<i>A. flavipes</i> (Bain & Sart.) Thom & Church	-	+	-	9.09
<i>A. flavus</i> Link	+	+	+	81.81
<i>A. fumigatus</i> Fresenius	+	+	-	45.45
<i>A. glaucus</i> Link	+	+	-	45.45
<i>A. luchuensis</i> Inui	+	-	+	27.27
<i>A. nidulans</i> (Eidam.) Winter	+	-	-	9.09
<i>A. niger</i> Van Tieghem	+	+	+	45.45
<i>A. ochraceus</i> Wilhelm	+	+	+	45.45
<i>A. oryzae</i> (Ahlburg in Korschelt.) Cohn	+	+	+	36.36
<i>A. terreus</i> Thom	+	-	+	45.45
<i>P. citrinum</i> Thom	+	+	+	90.90
<i>P. janthinellum</i> Biourge	+	+	+	72.72
<i>Alternaria tenuis</i> Auct	+	-	-	9.09
<i>Cladosporium britannicum</i> M.B.Ellis	+	+	+	72.72
<i>C. tenuissimum</i> Cooke	+	+	+	81.81
<i>C. phyllachorae</i> M.B.Ellis	-	+	-	9.09
<i>C. stauophorum</i> (Kendrick) M.B.Ellis	+	-	-	9.09
<i>Curvularia lunata</i> (Wakkar.) Boedijn	-	+	-	9.09
<i>C. richardiae</i> Alcorn	+	+	-	36.36
<i>Drechslera indica</i> (Rai, Wadhvani & Tewari) Mouchacca	-	+	-	9.09
<i>Nigrospora sphaerica</i> (Saccardo.) Mason	-	-	+	9.09
<i>Fusarium oxysporum</i> Schlechtendahl	+	+	+	45.45
<i>F. semitectum</i> Berkeley & Ravenel	+	+	+	54.54

+ indicate Positive; - indicate negative

During the study period, a total of 80 fungal species were enumerated from 4 sampling stations by plating and baiting techniques. 43 species of fungi were recovered from sediment samples whereas water samples yielded 40 species and 37 species were isolated from natural substrates (Table.2). When the fungal species diversity was analyzed in relation to different classes, it has been observed that maximum number of species recorded belonged to Hyphomycetes. This was followed by Ascomycetes and Zygomycetes. Among the Hyphomycetes, *Aspergillus* was the common genus represented by 17 species followed by *Alternaria* with 2 species, 5 species with *Penicillium* and *Curvularia* with 3 species. In addition of this *Cladosporium*, *Mucor*, *Rhizopus*, *Fusarium*, *Dreschlera* and *Helminthosporium* were the common genera found in this system.

In mangrove water totally, 40 species of fungi were isolated and enumerated from the water samples by dilution – plating technique. Among the fungi isolated 1 species belonged to Chytridiomycetes; 3 belonged to Zygomycetes; 4 to Ascomycetes and 53 to Deuteromycotina. The above result was discussed with previous reports of Chandralata (1999) and Raghukumar and Raghukumar (1998) also reported adaptation and activity of mangrove ecosystem as facultatives of indwellers or residents. Terrestrial fungi are common in mangrove water and mud (Chowdhery *et al.*, 1982; Garg, 1983).

In this study, 43 fungi were isolated from the mangrove sediment samples. Among these, 1 species belonged to Chytridiomycetes, 3 to Zygomycotina, 2 to Ascomycotina and 26 to Deuteromycotina. As like in the water samples, in sediment samples also the genus *Aspergillus* (12 sp) was also found to be dominant followed by *Cladosporium* (5sp), *Penicillium*(5sp), *Drechslera* (1sp), *Alternaria* (1sp) and *Curvularia* (1sp). Totally, 17 species of fungi were isolated from natural substrates of mangrove plants by baiting technique. In this 4 species belonged to Zygomycotina, 13 to Ascomycotina. A detailed investigation of fungi on mangroves of west coast was made by Patil and Borse (1985), Chinnaraj and Untawale (1992); Chinnaraj (1993). However, vast tracts of mangroves on the east coast remain vitually – unexplored except for the studies of Ravikumar and Vital (1996) and Sarma and Vittal (2001).

The fungal frequency of occurrence in all sampling stations was calculated (in percentage). Accordingly *P. citrinum* showed 90.90% frequency of occurrence followed by *C. tenuissimum* and *A. flavus* (81.81%),

C. britannicum (72.72) and *P. janthnellium* showed lowest occurrence with 9.09% observed in the mangrove eco-systems. The lowest frequency was observed in 49 species. The species richness and diversity of fungi at mangrove stations were determined using Simpson and Shannon indices. Both Simpson and Shannon indices were highest at Thenkaithettu and Ariyankuppam (0.9388 and 2.8947) (Table.3). Species richness and diversity of fungi in all the sampling stations during the study period was in conformity with the diversity studies of Maria and Sridhar (2002).

Table 3 Species richness, diversity and evenness of fungi recovered from all stations of Mangroves.

Sampling stations	Species Recovered	Species richness impson (D')	Diversity indices Shannon (H')	Shannon Evenness (J')
Ariyankuppam (S1)	25	0.9360	2.7852	0.6889
Thenkaithettu (S2)	22	0.8965	2.2846	0.5651
T.R. Pattinam (S3)	16	0.9028	2.4216	0.5558
Muthukuda (S4)	26	0.9233	2.6548	0.6566

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