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Biodiversity of driftwood associated marine fungi from Punnakayal mangroves of Tuticorin district, South east coast of India

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ABSTRACT

Thambraparani River empties in Arabian Sea at Punnakayal area and forms the Punnakayal estuary and it is situated in Tuticorin, South east coast of India. Mangroves are abundant in this area especially *Avicennia sp*. Diversity of marine fungi colonizing the drift wood samples collected from the intertidal regions at different season of the Punnakayal mangrove environment was studied. They are categorized into rare (0-25% frequency), occasional (26-50% frequency), frequent (51-75% frequency) and common (76-100% frequency) species. A total number of 62 species of fungi under 33 genera were recorded from the drift wood samples. They were assigned to Deuteromycetes (46 species), Ascomycetes (14 species), Trichomycetes (1 species) and Basidiomycetes (1 species).

Introduction

Biodiversity in extreme habitats attract great attention among researchers because the study of these systems can increase our understanding of the relationship between organisms and their environment and unraveling the mechanisms of their adaptation to extreme conditions (Oren, 1999). Fungi are one of the important microbial components. Since 1860's, research have been carried out on the fungi of different soil types, such as soils of forest (Domsch *et al.,* 1980; Jones, 1993b; Joshi and Chauhan, 1981) driftwood (Figueira and Barata, 2007), grasslands (Ray and Dwivedi, 1962; Jabbar Miah *et al.*, 1980; Calvo *et al.*, 1984), polar region (Cooke and Fournelle, 1960), desert (Durrell and Shield, 1960), marine and mangrove habitats (Matondkar *et al.*, 1981; Gilbert and Sousa, 2002) and coastal sand from various parts of the world. All these studies revealed that the fungi might reside permanently or temporarily for a period on the substrates. Their number and species composition in the habitat differs from place to place depending upon the physical, chemical and biological factors of the particular habitat.

Mangrove ecosystem is a highly productive one next to coral reefs and provides energy to marine habitats through production and decomposition of plant detritus (Lugo and Snedaker, 1975). Mangrove forests occupy several million hectares of coastal area worldwide and distributed in over 112 countries and territories comprising a total area of about 1,81,000 km^2 in over one fourth of the world coastline (Alongi, 2002). According to forest survey of India (FSI) (State report of forest, 1999), out of 4, 87,100 ha of mangrove wetlands in India nearly 56.7% (2, 75,800 ha) is present along the east coast, and 23.5% (1, 14,700) along the west coast and the remaining 19.8% (96,600 ha) is found in the Andaman and Nicobar islands. Mangroves are dominant along Indian coastline and provide niches and habitats for many marine and estuarine organisms.

Microorganisms play an important ecological role in decomposing organic matter and producing protein-rich detritus that serves as food to fishes especially in detritus-based marine ecosystems like mangroves (Mumby *et al.*, 2004). Although microbes play an important role in the cycling of nutrients in the mangrove ecosystem, very little information is available about the types of microbes associated with decomposing wood. Mangrove forests are the "hot spots" of biodiversity and also for marine fungi (Rani and Paneerselvam, 2009). Mangrove areas are home to a group of fungi called manglicolous fungi. These organisms are vitally important for nutrient cycling in these habitats (Hyde and Lee, 1995) and are able to synthesize all the necessary enzymes to degrade lignin, cellulose and other plant components (Bremer, 1995). Mangrove trees are able to grow at salinities ranging from full sea water to fresh water, thus a different fungal flora can be expected within this salinity gradient (Kohlmeyer, 1969). 54 mangrove trees with 60 associates were listed by Tomlinson (Tomlinson, 1986). The authors (Chinnaraj, 1993; Ravikumar and Vittal, 1996; Borse *et al.*, 2000; Sarma and Vittal, 2000; Sarma and Vittal, 2001; Sarma *et al.*, 2000; Maria and Sridhar, 2004, 2003, 2002; Pawar and Borse, 2004; Raveendran and Manimohan, 2007; Gayatri and Raveendran, 2008; Sridhar, 2009b) have published reports on manglicolous marine fungi from Indian Peninsula.

Fungi are particularly important in the marine microbe as decomposers of dead organic substrates (Kohlmeyer and Kohlmeyer, 1979). The dead organic matter and the associated microorganisms form the base of the food webs of commercially important fishes and crustaceans. The undecomposed leaves and wood are poor in nutrients, and they become nutritious due to the microbial enrichment process during decomposition (Odum, 1971). Microbes in the marine environment form an important link in the biogeochemical cycling and the cycling activities often determine the productivity of any ecosystem. They further clean up the environment from pollution. As they inhabit in the unusual condition, now-a-days scientists look at them for production of novel secondary metabolites. In the marine ecosystem, fungi holds a wide range of habitats, viz., water including sea foam, sediments, plant and animal debris. Although wood is reported to be high in mangrove ecosystems, little is known about its production. Among the plant detritus, intertidal driftwood are one of the important and interesting objects for fungal diversity study, as they are unknown origin of plant species and drift to any part of the coast by wind, wave

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action and water movement. They are exposed to sunlight and atmosphere at a frequent interval due to the tidal variations. Marine fungi have been shown to be essential in the breakdown of leaves and preconditioning of wood for wood boring organisms (Kohlmeyer *et al.,* 1995). Further, the study gives clues on the fungi responsible for the nutrient cycles in the marine environment (Kohlmeyer and Kohlmeyer, 1979).

Therefore the current study aims to understand the diversity of filamentous fungi on the Punnakayal mangrove drift wood samples during different seasons and percentage contribution of the fungal species.

Materials and methods

Study area

Punnakayal estuary is the only estuary of Tuticorin district. The Estuarine area is covering a mangrove area of about 7 sq.km, out of which 3 sq.km is denuded and in 1 sq.km restoration has been attempted. The area surrounding this mangrove support rich fishery and it plays an important role in the livelihood of about 80 fishermen families living in Punnakayal village. *Avicennia marina* (95%) is the dominant species of the mangrove forest and the trees reach a height of 15 feet.

Collection of samples and mycological examination

Small wood pieces of mangrove were collected from the mangrove forest. Collected samples were kept in polythene bags, tied with a string and transported to the laboratory. Some wood piece samples surfaces were scrubbed with the help of a new blade and particles were used for plating technique using Potato dextrose agar. The remaining wood pieces were incubated with 50% sterilized distilled water in order to maintain the moisture condition at room temperature for seven days. After incubation, all the wood samples were examined under dissection microscope for the observation of ascocarps, basidiocarps and conidia. The fungal cultures were then transferred, sub cultured and pure cultures were maintained. The semi permanent slides were stained using lacto phenol cotton blue. The slide was observed and microphotography of individual fungal species was taken using Nikon phase contrast microscope (Nikon, Japan). The morphology and septation were used for the identification of fungal species. The reproductive structures were transferred with a needle to a microscope slide with a drop of water to expose the spores and carefully squeezed under a cover glass. In some cases, asci and sterile elements of the ascocarps such as paraphyses and pseudoparaphyses of the fruit bodies were used for identification of the species.

Identification

The fungi were identified with standard manuals of Marine Mycology - The Higher Fungi (Kohlmeyer and Kohlmeyer, 1979), and the publication (Kohlmeyer and Kohlmeyer, 1992), A manual of *Penicillia* (Raper and Thom, 1949), Manual of *Aspergillus* (Raper and Fennell, 1965), Soil fungi (Dosch *et al.*, 1980), Hypomycetes (Subramanian, 1971) and Dematiaceus hypomycetes (Ellis, 1971;1976).

Presentation of data

Number of species is referred as species diversity. Population is expressed in terms of colony forming unit (CFU) per wood sample with dilution factor. In order to assess the dominance of individual species in each season, percentage contribution was worked out as follows.

% contribution = No. of colonies of fungus in a sample / Total number of colonies of all the species in a sample × 100

Frequency occurrence was calculated as follows in order to identify their existence in the drift wood collected during different seasons.

% frequency = Number of wood samples in which a particular fungus occurred / Total number of wood samples examined × 100

Based on the frequency occurrence, the fungi were grouped as rare (0-25% frequency), occasional (26-50% frequency), frequency (51-75% frequency) and common (76-100% frequency) species.

Results

Fungal diversity

62 fungal species belonging to 33 genera were isolated from drift wood of Punnakayal mangrove (Table. 1). Among the 62 fungal species maximum number of 46 species belonged to the class Deuteromycetes followed by 14 species of Ascomycetes, and single species of Basidiomycetes and Trichomycetes.

Species composition

Among the 33 genera recorded, the species grouped under the genus *Aspergillus* (19 species) were dominant followed by *Alternaria* (3 species), *Penicillium* (3 species), *Lignicola* (3 species), *Cladosporium, Fusarium, Geotrichum*, (2 species each). All other genera were represented by one species each.

Season wise occurrence

Fungal diversity showed variations in different seasons. The highest number of 38 species was recorded in post monsoon season followed by 36 species in monsoon and 27 species in winter season (Table 2).

Frequency class

Based on the frequency of fungi *Verticillium* sp., *Trichoderma* sp., *Penicillium* sp., *Lignicola longirostris*, *Helminthosporium oryzae*, *Altennospora quadricornuta*, *A.niger* and *A. glaucus* were classified as common; *A. conicus, A. fumigatus, A. oryzae, A. terreus, A. sulphures*, *Acrocylindrium oryzae*, *Alternaria alternat*, *Camarosporium* sp., *Curvularia lunata*, *Cytospora rhizosphorae*, *Euroticum chevalieri, Halocyphina villosa*, *Helecoccum japonense*, *Oospore lupuli, Penecillium quabrum* and *Sporotrichum* species as rare species in drift wood (Table 2).

Percentage contribution

The percentage occurrence of all the fungus was calculated from total number of colonies. Totally 258 number of colonies were observed, of that 3.4% of species were *A. niger* and 3.1% species were *A. fumigatus, A. sydowii and Heleococcum japonense.* The species such as *Trichoderma koeninji, Camarosporium* species, *Cytospora rhizophorae, Aigialus* species, *Mucor racemosus*, *Cladosporium* species were observed in a lower percentage.

Discussion

Drift woods are one the important and interesting objects for the study of fungal colonization as their origin is unknown and can be drifted to any part of the coast by wind, wave action and water movements in the breakdown of driftwood and thus in the nutrient cycles of marine habitat. They get exposed to sunlight and atmosphere at frequent intervals due to tidal variations. Ravikumar and Kathiresan (1993) reported higher number of fungi on leaf litter than those on fresh leaves. In the present study also decomposed drift wood taken for the analysis. However, a few quantitative studies are available on fungal association with mangrove litter in the West coast of India (Borse, 1988; Raghukumar *et al.,* 1995) and in East coast (Ravikumar and Vittal, 1996; Sarma and Vittal, 2001). Fungi of mangrove drift wood from east coast especially Punnakayal mangroves remain unexplored. This study provides information regarding the diversity of fungi from east coast of Punnakayal areas they are involved in nutrient regeneration cycles.

Table 1. Isolation of fungi from drift wood of Punnakayal mangrove

S. No	Fungal isolates	Taxonomy
1	*Alterneria alternat*	Deuteromycetes
2	*Alternaria solani*	Deuteromycetes
3	*Alterneria tititicina*	Deuteromycetes
4	*Aspergillus niger*	Deuteromycetes
5	*A. fumigatus*	Deuteromycetes
6	*A. sydowii*	Deuteromycetes
7	*A. versicolor*	Deuteromycetes
8	*A. flavus*	Deuteromycetes
9	*A. flavipes*	Deuteromycetes
10	*A. luchensis*	Deuteromycetes
11	*A. oryzae*	Deuteromycetes
12	*A. ruber*	Deuteromycetes
13	*A.terreus*	Deuteromycetes
14	*A.ustus*	Deuteromycetes
15	*A.smithii*	Deuteromycetes
16	*A.glaucus*	Deuteromycetes
17	*A.quercinus*	Deuteromycetes
18	*A.awamori*	Deuteromycetes
19	*A.terricola*	Deuteromycetes
20	*A.wenti*	Deuteromycetes
21	*A.conicus*	Deuteromycetes
22	*Cladosporium species*	Deuteromycetes
23	*Cladosporium oxysporum*	Deuteromycetes
24	*Curvularia lunata*	Deuteromycetes
25	*Eurotium chevalieri*	Ascomycetes
26	*Fusarium oxysporium*	Deuteromycetes
27	*Geotricum candidum*	Deuteromycetes
28	*Mucor racemosus*	Trichomycetes
29	*Penicillium quabrum*	Deuteromycetes
30	*Penicillium oxalicum*	Deuteromycetes
31	*Penicillium species*	Deuteromycetes
32	*Trichoderma species*	Deuteromycetes
33	*Heleococcum japonense*	Ascomycetes
34	*Oospore lupuli*	Deuteromycetes
35	*Savoryella lignicola*	Ascomucetes
36	*Verculina enalia*	Ascomycetes
37	*Aigialus species*	Ascomycetes
38	*Lignicola laevis*	Ascomycetes
39	*Leptosphaeria peruviana*	Ascomycetes
40	*Lulworthia species*	Ascomycetes
41	*Halocyphina villosa*	Basidiomycetes
42	*Chaetomastia typhicola*	Ascomycetes
43	*Botrytis cinerea*	Deutromycetes
44	*Helicascus kanaloanus*	Ascomycetes
45	*Altennospora quadricornuta*	Deuteromycetes
46	*Rhizophila marina*	Ascomycetes
47	*Cirrenalia tropicalis*	Deuteromycetes
48	*Lignicola longirostris*	Ascomycetes
49	*Halosarpheia marina*	Ascomycetes
50	*Lignicola tropica*	Ascomycetes
51	*Trichocladium linderi*	Deutromycetes
52	*Fusarium moniliformis*	Deutromycetes
53	*Verticillium species*	Deutromycetes
54	*Geotrichum sps*	Deutromycetes
55	*Cytospora rhizophorae*	Deutromycetes
56	*Camarosporium species*	Deutromycetes
57	*Trichoderma koeninji*	Deutromycetes
58	*Helminthosporium oryzae*	Deutromycetes
59	*Aspergillus sulphureus*	Deutromycetes
60	*Tubercularia species*	Deutromycetes
61	*Sporotrichum species*	Deutromycetes
62	*Acrocylindrium oryzae*	Deutromycetes

Table. 2. Marine fungi collected from drift wood during different seasons, together with overall frequency occurrence of each species.

S. No	Fungal isolates	Pre monsoon (April to June)	Monsoon (July- Sep)	Post - mon soon (Oct- Nov)	Winter (Dec to Jan)	% Frequency	Frequency class
1	*Aspergillus awamori*	-	+	+	-	50	O
2	*A.conicus*	+	-	-	-	25	R
3	*A.flavipes*	-	+	+	-	50	O
4	*A.flavus*	+	+	+	-	75	F
5	*A.fumigatus*	-	-	-	+	25	R
6	*A.glaucus*	+	+	+	+	100	C
7	*A.luchensis*	+	-	+	+	75	F
8	*A.oryzae*	-	+	-	-	25	R
9	*A.quercinus*	+	-	+	-	50	O
10	*A.ruber*	-	-	+	+	50	O
11	*A.smithii*	+	-	+	-	50	O
12	*A.sydowii*	-	-	+	+	50	O
13	*A.terreus*	+	-	-	-	25	R
14	*A.terricola*	+	+	+	-	75	F
15	*A.ustus*	+	-	-	+	50	O
16	*A.versicolor*	-	+	+	+	75	F
17	*A.wenti*	-	+	-	+	50	O
18	*A.niger*	+	+	+	+	100	C
19	*A.sulphureus*	+	-	-	-	25	R
20	*Acrocylindrium oryzae*	-	-	+	-	25	R
21	*Aigialus species*	+	+	+	-	75	F
22	*Altennospora quadricornuta*	+	+	+	+	100	C
23	*Alternaria solani*	+	+	-	-	50	O
24	*Alterneria alternat*	-	+	-	-	25	R
25	*Alterneria tititicina*	+	-	-	+	50	O
26	*Botrytis cinerea*	-	+	+	-	50	O
27	*Camarosporium species*	-	+	-	-	25	R
28	*Chaetomastia typhicola*	-	+	-	+	50	O
29	*Cirrenalia tropicalis*	+	+	-	-	50	O
30	*Cladosporium oxysporum*	-	+	-	+	50	O
31	*Cladosporium species*	+	+	+	-	75	F
32	*Curvularia lunata*	-	-	-	+	25	R
33	*Cytospora rhizophorae*	+	-	-	-	25	R
34	*Eurotium chevalieri*	-	-	+	-	25	R
35	*Fusarium moniliformis*	+	+	+	-	75	F
36	*Fusarium oxysporium*	+	+	-	-	50	O
37	*Geotrichum candidum*	+	-	+	+	75	F
38	*Geotrichum sps*	+	-	+	+	75	F
39	*Halocyphina villosa*	-	-	-	+	25	R
40	*Halosarpheia marina*	+	+	-	-	50	O
41	*Heleococcum japonense*	-	-	+	-	25	R
42	*Helicascus kanaloanus*	-	+	+	-	50	O
43	*Helminthosporium oryzae*	+	+	+	+	100	C
44	*Leptosphaeria peruviana*	-	-	+	+	50	O
45	*Lignicola laevis*	+	-	-	+	50	O
46	*Lignicola longirostris*	+	+	+	+	100	C
47	*Lignicola tropica*	+	+	+	-	75	F
48	*Lulworthia species*	+	+	-	-	50	O
49	*Mucor racemosus*	-	+	+	+	75	F
50	*Oospore lupuli*	-	-	+	-	25	R
51	*Penicillium oxalicum*	-	+	+	-	50	O
52	*Penicillium quabrum*	+	-	-	-	25	R
53	*Penicillium species*	+	+	+	+	100	C
54	*Rhizophila marina*	+	+	+	-	75	F
55	*Savoryella lignicola*	+	+	-	-	50	O
56	*Sporotrichum species*	-	-	-	+	25	R
57	*Trichocladium linderi*	+	+	-	-	50	O
58	*Trichoderma koeninji*	+	+	+	-	75	F
59	*Trichoderma species*	+	+	+	+	100	C
60	*Tubercularia species*	+	-	+	-	50	O
61	*Verculina enalia*	+	-	-	+	50	O
62	*Verticillium species*	+	+	+	+	100	C

R - Rare (0 - 25%); O - Occasional (26 - 50%); F- Frequent (51-75%); C- Common (76 -100%)

Table. 3. Total number of colonies and percentage contribution of fungi from Punnakayal mangrove

S. No	Fungal isolates	TNC	% contribution
1	*Alterneria alternat*	7	2.713
2	*Alternaria solani*	5	1.937
3	*Alterneria tititicina*	5	1.937
4	*Aspergillus niger*	9	3.488
5	*A. fumigatus*	8	3.100
6	*A. sydowii*	8	3.100
7	*A.versicolor*	3	1.162
8	*A.flavus*	8	3.100
9	*A.flavipes*	6	2.325
10	*A.luchensis*	7	2.713
11	*A.oryzae*	4	1.550
12	*A.ruber*	3	1.162
13	*A.terreus*	2	0.775
14	*A.ustus*	2	0.775
15	*A.smithii*	5	1.937
16	*A.glaucus*	4	1.550
17	*A.quercinus*	4	1.550
18	*A.awamori*	6	2.325
19	*A.terricola*	7	2.713
20	*A.wenti*	4	1.550
21	*A.conicus*	4	1.550
22	*Cladosporium species*	1	0.387
23	*Cladosporium oxysporum*	3	1.162
24	*Curvularia lunata*	3	1.162
25	*Eurotium chevalieri*	5	1.937
26	*Fusarium oxysporium*	6	2.325
27	*Geotrichum candidum*	6	2.325
28	*Mucor racemosus*	1	0.387
29	*Penicillium quabrum*	4	1.550
30	*Penicillium oxalicum*	3	1.162
31	*Penicillium species*	5	1.937
32	*Trichoderma species*	6	2.325
33	*Heleococcum japonense*	8	3.100
34	*Oospore lupuli*	3	1.162
35	*Savoryella lignicola*	3	1.162
36	*Verculina enalia*	4	1.550
37	*Aigialus species*	1	0.387
38	*Lignicola laevis*	2	0.775
39	*Leptosphaeria peruviana*	3	1.162
40	*Lulworthia species*	5	1.937
41	*Halocyphina villosa*	4	1.550
42	*Chaetomastia typhicola*	6	2.325
43	*Botrytis cinerea*	7	2.713
44	*Helicascus kanaloanus*	4	1.550
45	*Altennospora quadricornuta*	4	1.550
46	*Rhizophila marina*	4	1.550
47	*Cirrenalia tropicalis*	3	1.162
48	*Lignicola longirostris*	5	1.937
49	*Halosarpheia marina*	2	0.775
50	*Lignicola tropica*	3	1.162
51	*Trichocladium linderi*	3	1.162
52	*Fusarium moniliformis*	3	1.162
53	*Verticillium species*	4	1.550
54	*Geotrichum sps*	2	0.775
55	*Cytospora rhizophorae*	1	0.387
56	*Camarosporium species*	1	0.387
57	*Trichoderma koeninji*	1	0.387
58	*Helminthosporium oryzae*	5	1.937
59	*Aspergillus sulphureus*	4	1.550
60	*Tubercularia species*	4	1.550
61	*Sporotrichum species*	3	1.162
62	*Acrocylindrium oryzae*	6	2.325
	Total no. of colonies	258	
	Total no. of species	33	

Biogeographical distribution of marine fungi in different substratum was first attempted by Hughes (1974). Detailed analyses of distribution of marine fungi have been made by Hughes (1986) and Booth and Kenkel (1986). Ravikumar and Purushothaman (1988a), Ravikumar and Vittal (1996), Ragukumar (1973) reported marine fungi on different substratums of Vellar estuary, Pitchvaram estuary and Tamil Nadu coast mangrove habitat respectively. Hughes (1975) stated that studies of intertidal wood gives a better estimate of species diversity and distribution of lignicolous fungi in a certain area than trapping experiments with wood panels. In the present study drift wood samples were collected and examined the fungi which are colonizing in the drift wood samples. The biodiversity of fungal species in drift wood gave knowledge about fungal species involved in nutrient cycling in the particular study area.

In the present investigation totally 62 fungal species belonging to 33 genera encountered including 46 species of Deuteromycetes followed by 14 species of Ascomycetes and each one species of Trichomycetes and Basidiomycetes. Fungal hyphae are commonly found on and in decomposing mangrove leaves, wood and from mangrove communities over a hundred species of fungi were identified by many researches. Hyde (1990) listed 120 species from 29 mangrove forests around the world. These included 87 ascomycetes, 31 deuteromycetes and 2 basidiomycetes. Ravikumar and Vittal (1996) reported 48 fungal species were found in decomposing Rhizophora debris of Pichavaram, South India. Jones and Alias (1997) reported two hundred higher marine fungi form fifty five mangroves and their associates. Sridhar (2009a) reported 165 marine fungi encompassing of 111 ascomycetes, 1 basidiomycete and 53 mitosporic fungi form Indian mangroves. Most of the studies involving fungi are of a descriptive nature designed for taxonomic and inventory interests.

In the present study abundance of fungi belonging to Deuteromycetes were high followed by Ascomycetes, Trichomycetes and Basidiomycetes. The abundance of the group of fungi on marine substrates has been reported by Hyde and Jones (1988) and Immaculate *et al.,* (2012). Rani and Paneerselvam (2009) reported among the total isolation of 16 genera of fungi, 14 genera were belonged to Ascomycotina, one of Basidiomycotina and 3 genera of Deuteromycotina. Although the above wide range of fungi belonged to three groups were recorded and among that ascomycotina were the most prevalent group of fungi. Maria and Sridhar (2002) reported 78 species of fungi belonging to 45 genera comprising 13 ascomycetes, one basidiomycete and 31 deuteromycetes were recorded from the dead woods of mangroves in different parts of India. But Deuteromycetes was the dominant genera isolated from mangrove environment from many parts of Tamil Nadu, covering Kanniyakumari, Gulf of Mannar (Nadimuthu, 1998), Pichavaram (Venkatesan, 1981) and Madras coast (Subramanian and Ragukumar, 1974), Muthupet mangrove (Rani and Paneerselvam, 2009; Immaculate *et al.,* 2012). Dominant occurrence of Deuteromycetes as facultative marine forms was already reported by these workers, coinciding with the present study.

Marine microbes represent a potential source for commercially important bioactive compounds and their bioremediation capabilities are also remarkable. They also play a crucial role in decomposition of organic matter and cycling of nutrients. Among the 62 species recorded in the present investigation, the genus *Aspergillus*, *Alternaria*, *Lignicola* and *Penicillium* showed broad spectrum range, represented by 19 and 3 species respectively. Dominant occurrence of *Aspergillus* was reported from various marine soils. Evidently Madhanraj *et al.,* (2010) reported that *Aspergillus* was dominant genera among the 24 fungal species isolated from entire Tamil Nadu coast. Saravanan (2002) also reported *Aspergillus* and *Penicillia* were predominant genera from south East Coast of India. Dominance of the genus *Aspergillus* in the present study sites may be due to their greater rate of spore production, dispersal and partly due to their resistance to over extreme environmental conditions (Thennarasu *et al.*, 2011). Alias *et al.*, (1995) reported high percentage occurrence of *Lignicola laevis, Halosarpheia marina, Verruculina enalia* species from randomly collected mangrove wood samples from Malaysian mangrove play an important role in wood degradation. In the present study 50% occurrence of all those species observed in the study area. The field of marine mycology is necessary to investigate diversity of fungi in the marine environment before we can understand their ecological significance and their distinct characters.

The percentage occurrence as an expression of the frequency of collections of fungi gives an indication of the more common fungi within the mangrove ecosystems (Alias *et al.,* 1995). The present study also deals with the pattern of distribution of different species of obligate marine fungi. The pattern of distribution has been categorized into common, frequent, occasional and rare. The common occurrence of *A. terreus* and *A. niger* was reported in the sites from Madras coast by Subramanian and Raghukumar (1974). In the present study *A. terreus* found as rare species but *A. niger* found as commonly available species in drift wood during all the seasons. Prabhakaran *et al.,* (1987) reported thirty one fungal isolates were recorded from soil and 27 species from decaying mangroves and seven species from floating plants were reported with the dominance of *Aspergillus* followed by *Penicillium, Fusarium* and *Trichoderma* in Mangalvan mangrove ecosystem. Venkateswara sarma *et al.,* (2001) reported seventy three species of fungi from Godavari and 67 species from Krishna estuaries of India were collected from the decaying samples of *Rhizophora* and *Avicennia* with dominant occurrence of *A.niger.* Sivakumar and Kathiresan (1990) reported 10 species of fungi, on the surface of mangrove leaves, with the dominance of *Alternaria alternata* and *Rhizopus ingricam* followed by *Aspergillus* and *Penicillium* species. In the present study *Alternaria* species was not observed in all the season in drift wood, occurrence were occasional and rarely available. The fungal species *Rhizophila marina* were occurred frequently. Sixty seven fungal species were recorded from the intertidal wood samples with the dominance of *Lulworthia* species and forty eight fungal species were identified from dead parts of *Rhizophora mucronata* prop roots (Poonyth *et al.*, 2001). In the present study *Lulworthia* species were observed from drift wood samples in the season of pre monsoon and monsoon season were recorded as an occasionally observed species.

Ragukumar and Bhat (1994) pointed out that no method is available for the study of entire mycoflora assemblage of any of the habitat/substratum as different fungal groups occupy different niches and therefore several methods have to be adopted to obtain the wholes picture of the fungal diversity. Accordingly present investigation was carried out by Plating method and direct examination method. Both the methods yielded distinct group of fungal population namely facultative marine fungi and obligate marine fungi, respectively. The identification of these fungi was confirmed with the help of Kohlmeyer and Kohlmeyer (1979). There is no previous record in the drift wood associated species from Punnakayal mangrove.

Therefore this is new information about the diversity of fungi in Punnakayal mangrove. Substrate availability and climate change are the delimiting factors for the geographical distribution of fungi (Bobout *et al.,* 1987; Ananda *et al.,* 1998), and it has been rightly suggested that examination of more substratum is needed to understand the complete biodiversity status of marine fungi of India. Ragukumar (1996) pointed out that understanding of various niches occupied by marine fungi should be given newer thrust in the areas of Indian mycological research. In this context, the present investigation is a new record on the distributional pattern of marine fungi.

Conclusion

Mangrove ecosystems provide shelter and nurturing sites for many marine microorganisms. Fungal colonization of mangrove and intertidal woody litter was assesses by plating and damp incubation techniques. Plating technique usually results in the isolation of terrestrial fungi, while using the damp incubation technique, besides terrestrial fungi, marine fungi can also recovered. Hence it could be concluded that there is no uniformity in the diversity of marine fungi and their distribution in different seasons. Extent of salinity, kind of substrates, and position of intertidal region, nature of floor, pH and oceanic region affect the occurrence and diversity of marine fungi in the mangrove ecosystem. Due to the presence of rich source of nutrients mangroves are called the homeland of microbes. These surveys strengthen the mycogeographic and mycodiversity studies. In addition this information helps to monitor the status of marine and marine influenced ecosystems. Extensive exploration, identification, isolation and screening are suggested in search of new leads for microbial drugs and enzymes.

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