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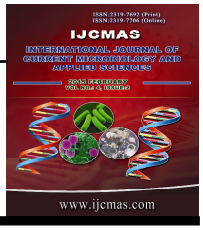

Original Research Article

A Study on the Diversity of Marine Fungi along the South East Coast of Tamilnadu – A Statistical Analysis

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A B S T R A C T

In the present study investigated the mycodiversity of the four spots [Adirampattinam (SS1), Mallipattinam (SS2), Rajamadam (SS3) and Memesal (SS4)] along the south east coast of Tamilnadu. The marine sediments were collected by hand-pushing plastic core tubes. The sediments were processed carefully and subjected to microbiological analysis. The study revealed that the season greatly influence the mycodiversity. The microbiological analysis results were subjected to statistical analysis; it includes correlation analysis, Shannon diversity indices and ANOVA analysis. Statistical approach revealed that the distribution of fungi not only influenced by season but also by sampling spots. Thus we conclude through this research that among the four sampling spots, Adirampattinam was found as the spot for maximum mycodiversity and therefore this spot could be considered as spot for the isolation of potential fungi.

Keywords

Mycodiversity, Marine sediment, Hand-pushing plastic core tubes, Correlation, Shannon diversity, ANOVA

Introduction

In terms of sheer volume, the marine environment represents a major portion of the biosphere and contains 97% of the earth water. Much of this is in the deep sea at a depth greater than 1,000 meters, representing 75% of the oceans volume. The ocean has been called a "high pressure refrigerator", with most of the volume below 100 meters at a constant 3^{o}C temperature. The ocean at its greatest depth is slightly more than 11,000 meters deep or equivalent to almost 29 empire state buildings (each 1,250 feet or 381 meters in height) stacked on top on one another. The pressure in the marine environment increases approximately 1atm / 10 meters in depth and pressure are in the vicinity of 1,000 atm at the greatest ocean depths (Jones and Hyde, -1988).

Many marine invertebrates produce natural compounds that affect the growth,

metabolism, reproduction, and survival of other types of organism. Hence, they are considered to be bioactive. These include potentially effective therapeutic agents with antiviral, antibacterial and antitumor properties produced by invertebrates from the classes Porifera, Nidaria, Mollusca, Echinodermata, Bryozoa and Urochordata. Close relations between marine invertebrate species and microorganisms, including symbiotic associations and interactions during larval settlement, have been characterized and this provides insights to the regulation of host symbiotic microbial community interactions. Many of the compounds isolated from marine organisms, such as sponges, may be produced by associated microbes. Previous studies have also suggested that some bioactive compounds isolated from marine organisms have been shown to exhibit anticancer, antimicrobial, antifungal or anti-inflammatory and other pharmacological activities (Natori *et al.,* 1994.).

Marine fungi comprise of an estimated 1500 species, excluding these that from lichens. This number is low compared to the number of described and estimated terrestrial fungi cover 250,000. So far, less than 500 filamentous higher marine fungi have been described and only 79 are associated with algae as parasites or symbiosis and 18 with animal hosts. A number of interesting compounds, such as cytoglobosins and halovirs had been isolated from marine fungi. Hence we consider that there are numerous marine fungi containing further remarkable structures as well as bioactive compounds (Kohlmeyer and Volkmann–Kohlmeyer, 2003).

Recently among the marine microorganisms, marine derived fungi have been recognized as one of the last barely tapped resources for new biologically active secondary metabolites including antitumor, antibacterial, antifungal, antiviral and enzyme inhibitors compounds. Overall research on marine derived fungi has led to discovery of some 272 new natural products until 2002 and another's 240 new structures from 2002 until 2004, this providing evidence that marine derived fungi have a potential to be a rich source of pharmaceutical leads.

Microorganisms adapted to life in an extreme environment. Most of them are able to deal with moderate concentrations of salts dissolved in water surrounding them obviously all marine organisms can entire, and very often require the salacity of the ocean, which is remarkably constant around the world and is close to 3.5% of total salts (El-Kady, 1986). These are two major types of biologically important environments in which the salt factor will interact with microbial populations, soil and water which account for 70% of the earth's surface. In the oceans, fungi live as saprophytes, parasites and symbionts on various matrices such as sea, sand, logs, water, soil bubbles as well as algal and other marine organisms. Microbial infections of the skin and underlying tissues are among the most frequent conditions encountered in acute ambulatory care. Marine fungi have proved to be a rich source of new biologically natural products (Mansuma *et al.*, 2001.).

Fungi were among the first microorganisms to be investigates scientifically, making mycology, the study of fungi, one of the first microbiological sciences. They are all eukaryotic, non photosynthetic organisms, usually enclosed by cell walls that are composed of chitin, a polysaccharides of N-acetylglucosamine subunits (unlike plant cells, which have cells wall of cellulose, a polysaccharide composed of glucose subunits) many fungi are familiar to all of us

molds that grow on bread, fruit, and cheese; mildew in damp textiles; yeast used in baking and brewing; mushrooms and toadstools. Some fungi produce antibiotics that we used therapeutically, against many bacterial infections. Among the fungi are organisms that extract a wide range of degradation enzymes that attack visually any organic material. Such degradative activities make fungi essential participants in recycling natural wastes in our environment, decomposes in the biogeochemical cycle.

Marine fungi have proved to be a rich source of new biologically natural products. Because of their particular living conditions, salinity, nutrition, higher pressure, temperature variations, competition with bacteria, viruses and other fungi, they may have developed specific secondary metabolic pathways compared with terrestrial fungi (Liberra and Lindequist, 1995).

Hence an attempt has been made to isolate marine derived fungi and assess their diversity through statistical approach.

Materials and Methods

Collection of samples

The sediment samples were collected randomly four times in a month in morning, afternoon and evening session from four different sampling stations namely Adirampattinam(SS1), Rajamadam (SS2), Mallipattinam (SS3) and Memesal (SS4). The samples were collected from different locations seasonally for a period of January, April, July and October 2009. Dividing a calendar year into four seasons viz., Postmonsoon (January – March), Summer (April – June), Premonsoon (July – September) and Monsoon (October – December), based on the north east monsoon, which is prevailing in the study area. Sediment samples were collected by hand-pushing plastic core tubes (7 cm diameter) as far as possible into the sediment. The sediment cores retrieved in the field were sliced on arrival at the lab at 1-cm depth intervals for the first 15 cm, 2-cm depth intervals from 15–25 cm, and then every 5 cm for the deeper sections of the cores. The sediments were kept cool in icebox during the transportation to the laboratory according to Al-Shiwafi *et al.* (2005) and Jung *et al.* (2005). They were then ground manually to a fine powder in an alumina mortar; it is passed through a 2-mm mesh screen and stored in polyethylene bags based on method used by for further physico-chemical analysis.

Analysis of diversity indices and ANOVA

Diversity indices like the species richness, species diversity, dominance index of the sampling spots were assessed were assessed by PRIMER v5 and SPSS V16.

Analysis of Mycoflora

Dilution plating technique described by (Warcup, 1950) was used to isolate the fungi from soils. After incubation, Sediment samples were diluted (1:1,000, 1:10,000 and 1:100,000) in sterilized sea water followed by 200 µL inoculation in Petri dishes containing PDA culture medium. The inoculated plates were incubated in a dust free cupboard at the room temperature (26±2°C) for 7 days.

After the incubation the development of fungal colonies were observed. The fungal cultures were then transferred; subcultured and pure cultures were maintained. The semi-permanent slides were prepared using lacto phenol cotton blue staining method (Dring, 1976).

Identification

The slides were observed under microscope (400X) and identified with the help of keys given by (Barghoorn and Linder, 1944; Johnson and Sparrow, 1961; Barnett and Hunter, 1972; Anisworth *et al.,* 1973a; Anisworth *et al.,* 1973b; Kohlmeyer and Kohlmeyer, 1979; Kohlmeyer and Kohlmeyer, 1991) and following the taxonomic arrangement proposed in the 6th edition of Ainsworth and Bisby's Dictionary of the Fungi (Anisworth, 1971.).

Results and Discussion

Analysis of Mycoflora

Totally 58 species of fungi (Table: 1) were isolated during the course period of research. Among the isolated species, Ascomycota encounter 48 species followed by Mitosporic fungi 5 species, Mucoromycotina and Anamorphic fungi each 2 species and Hyphomycetes 1 species, respectively (Table 2). Study on diversity índices analysis revealed among the four sampling spots, SS1 Adirampattinam showed high species diversity and species richness during the monsoon season and least was observed in SS4 Memesal. The study also led to the conclusion that human interference might be one of the reasons for non-uniformity of mycodiversity along the coastal ecosystem.

Analysis of Variance

Analysis of Variance (ANOVA) was carried out for fungi population in all the seasons of all the sampling stations. In Memesal, maximum fugal diversity was observed during the Premonsoon 2.07 ± 1.66 and least was observed during Postmonsoon 1.499 ± 1.33.

Analysis of Variance (ANOVA) was carried out for fungi population in all the seasons of all the sampling stations. In Adirampattinam, maximum fugal diversity was observed during the monsoon 2.09 ± 2.01 and least was observed during Postmonsoon 1.156 ± 0.944.

Analysis of Variance (ANOVA) was carried out for fungi population in all the seasons of all the sampling stations. In Mallipattinam, maximum fugal diversity was observed during the monsoon 2.33 ± 2.14 and least was observed during Postmonsoon 1.736 ± 1.59.

Analysis of Variance (ANOVA) was carried out for fungi population in all the seasons of all the sampling stations. In Rajamadam, maximum fugal diversity was observed during the Summer 2.12 ± 1.65 and least was observed during Postmonsoon 1.345 ± 1.56.

In Mallipattinam, post monsoon season was found to show maximum fungal diversity. In the station Rajamadam, summer season maximum fungal diversity, In Memesal, premonsoon season was found to show maximum fungal diversity and In Adirampattinam, monsoon season was found to show maximum fungal diversity. All the results were 3 replicates and the significant was at 5% level (Table 3; Fig. 1)

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Among 58 species isolated, only 10 (Table: 4) species were found to be common to all stations on all seasons. The physico-chemical parameters recorded during the present study was not adversely affected the distribution of fungi in the marine sediment. pH and organic carbon (Table: 5) are the major factors affecting the diversity of marine fungi.

The species richness and diversity of fungi at four sampling stations were determined using Shannon, Dominance index, Species richness and Eveness indices. The Shannon index was found to be maximum at SS1 (3.2196) and minimum at SS4 (2.5685). The Dominance index was found to be maximum at SS1 (0.0772) and minimum at SS4 (0.0792) during monsoon season. The Species richness was highest at SS1 and least at SS4 (6.1339 and 3.9172) and the evenness index was highest at SS1 (0.9162) and least at SS4 (0.9022) (Table 6).

Among 58 species of fungi isolated, the Adirampattinam (SS1) was represented by 35 species followed by Rajamadam (SS2) and Mallipattinam (SS3) each by 29 species and Memesal (SS4) by 27 species. From these, it was evident that maximum fungi diversity was in Adirampattinam (SS1) and minimum in Memesal (SS4) (Table 2). Distribution of filamentous fungi in the present study has shown a higher diversity. Of the 58 isolates belonged to 37 genera comprising 48% Ascomycota, 2% Mucoromycotina, 2% Anamorphic fungi, 1% Hyphomycetes and 5% Mitosporic fungi (Table 2).However, the present study matches the findings of several investigators who found Ascomycetes fungi as the major contributor to the filamentous higher marine fungi (Kohlmeyer and Kohlmeyer, 1979; Hyde *et al.*, 2000; Sridhar and Prasannarai, 2001).

The mycodiversity recorded in the present study (number of species) was narrow. The minimum of 1 species (Table: 1) were recorded in the marine sediment collected during post monsoon, summer, Premonsoon and monsoon season in 2009. The maximum of 15 species (Table: 1) and 14 species (Table: 1) were recorded in the marine sediment collected during Premonsoon and monsoon season in 2009.Among four station The genus *Aspergillus* was constituted by the maximum of 14 species (Table: 1) followed by the genus *Penicillium* was 5 species.

As in the present study the trend of species composition with bulk number of *Aspergillus* species are reported from mangrove sediments of Cochin (Kerala) by Prabhakaran and Gupta (1990) coastal and Brackish sediments by Subramanian and Raghu-Kumar (1974) and sand dune of Tamil Nadu coast by Madhanraj *et al.* (2010). This could be inferred as that the fungal species isolated are bulk from the genus *Aspergillus* which are highly adapted to the varying soil characteristics observed in the study areas. Evidently, the tolerance and adaptive mechanism of *Aspergillus* to varying marine environmental characteristics are reported by Pawar and Thirumalachar, (1966), Subramanian and Raghu-Kumar (1974) and Nadimuthu (1998).

Among 58 species isolated, only 10 (Table: 4) species were found to be common to all stations on all seasons. The physico-chemical parameters recorded during the present study was not adversely affected the distribution of fungi in the marine sediment. pH and organic carbon (Table: 5) are the major factors affecting the diversity of marine fungi as is well illustrated by the data of Booth and Kenkel, (1986). The ocean of the world is varied greatly in intertidal amplitude and salinity of the waters, all eatures that can dramatically affect fungal biodiversity. Species richness and diversity of fungi in all the four sampling stations during the four seasons is in conformity with the studies of Maria and Sridhar (2002).

Ecological studies of marine fungi have mainly focused on those sporulating on the incubated substratum. This may lead to an

underestimated diversity, because the fungi are present only as mycelium and sporulation may be inhibited by the presence of other fungi (Tan *et al.,* 1995.).The needs for the diversity and development of new classes of antimicrobial compounds are increasing, due to trends in antibiotic resistance among different strains of fungi and other microorganism. Which are causing serious problems in the containment of infectious diseases (Bhadury *et al.,* 2006). Improvement of microbial strains for over-production of industrial products has been the hallmark of all commercial fermentation process (Parekh *et al.,* 2000) especially for marine fungi and mangrove fungi, from which the bioactive compounds isolated, are often available in minute amounts only.

According to Atalla, *et al.* (2011), reported that the marine algal associated *Penicillium brevicompactum* produced 11 clear bioactive compounds and all the compounds were found to have antibacterial and antifungal activity. There are plethora of compounds are being extracted from marine microbial flora and fauna, to highlight this, Ira Bhatnagar and Se-Kwon Kim (2010), wrote a review on the excellence of marine microbial bioactive compounds.

Petit *et al.* (2004) found that a marine strain of *Penicillium waksmanii* produce griseofulvin. Filamentous fungi, the principle commercial sources of xylanolytic enzymes, have many industrial uses, such as in paper manufacturing, animal feed, bread-making, juice and wine industries and xylitol production (Raghukumar *et al.,* 2004; Polizeli *et al.,* 2005).

In the present study, it seemed that the field of marine mycology is necessary to investigate diversity of fungi in the marine ecosystem before we can understand their ecological significance and their distinct characters. The mycoflora of the oceans has not been studied in enough detail to identify marine-isolated fungi as specific halophiles, salt-adapted species, or non-marine fungi capable of survival in sea water. Large numbers of fungi have been isolated from the sea (Johnson and Sparrow, 1961).

However, these are only a few of the factors that have an effect on the occurrence and distribution of marine fungi. Others include dissolved organic nutrients, hydrogen ion concentration, osmotic effects, oxygen availability, pollutants, abundance of propagules in the water, ability to impact on to and attach to suitable substrata, hydrostatic pressure, substrate specificity, temperature and tidal amplitude and perhaps even light (Booth and Kenkel, 1986).

Lack of coastal vegetation, higher amount of human activities and also oil pillage from the motorized vessels used for fishing activities as well as washout from the catamaran might be the possible reason for the lower species richness and diversity of these above stations with the noted abiotic factors existing in the coastal environment. The presence in soil of micro-organisms capable of killing non indigenous fungi by lysing their cell walls is well documented (Mitchell and Alexander, 1963).

ANOVA analysis revealed that there is significant difference exist between distributions of fungus with sampling stations on all seasons. The study gives the CD value 1.856 which was found to be lower than the observations made by Prasannarai and Sridhar (2003). The present study correlates with the findings of Prasannarai and Sridhar (2003) in the aspect that the distribution of fungi is high in case of number of colonies obtained from sediment samples during the monsoon season.

Table.1 Season wise distribution of marine derived fungi along the South East Coast

S.NO	NAME OF THE FUNGI	SS1				SS2				SS3				SS4			
		PM	SUM	PRM	MON	PM	SUM	PRM	MON	PM	SUM	PRM	MON	PM	SUM	PRM	MON
1.	*Acremonium sp*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2.	*Penicillium luteum*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
3.	*Aspergillus awamori*	+	+	+	+	+	+	+	+	+	-	+	+	+	-	-	+
4.	*Aspergillus sulphureus*	+	+	+	+	-	-	-	-	+	-	+	+	-	-	-	-
5.	*Aspergillus flavus*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6.	*Aspergillus sydowii*	+	+	+	+	-	-	-	-	+	+	+	+	-	-	-	-
7.	*Aspergillus niger*	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-
8.	*Rhizopus nigricans*	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-
9.	*Geotrichum candidum*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
10.	*Penicillium granulatum*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
11.	*Aspergillus nidulans*	+	+	+	+	+	+	+	+	-	-	-	-	+	+	+	+
12.	*Penicillium expansum*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
13.	*Aspergillus fumigatus*	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
14.	*Absidia glauca*	+	+	+	+	-	-	-	-	+	+	+	+	-	-	-	-
15.	*Massarina japonica*	+	-	+	+	-	-	+	+	-	-	-	-	-	-	-	-

16.	*Alternaria tenuis*	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
17.	*Aspergillus terreus*	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-
18.	*Acrophilophora fusipspra*	-	-	-	-	+	-	-	-	+	-	+	+	-	+	+	+
19.	*Trichocladium acrasporum*	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
20.	*Aspergillus glaucus*	-	-	-	-	-	-	-	-	+	+	+	+	-	-	-	-
21.	*Aspergillus granulosus*	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
22.	*Aspergillus ustus*	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	-
23.	*Aspergillus versicolor*	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	-
24.	*Aspergillus clavatus*	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-
25.	*Aureobasidium pullulans*	-	-	-	-	+	+	+	+	-	-	-	-	+	+	+	+
26.	*Alternaria geophila*	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-
27.	*Chaetomium spp*	-	-	-	-	-	-	-	-	+	-	+	+	+	-	+	+
28.	*Chrysosporium Spp*	-	-	-	-	+	+	-	+	-	-	-	-	-	+	+	+
29.	*Cladosporium spp*	+	+	+	+	-	-	-	+	+	+	-	+	+	+	+	+
30.	*Verticillium spp.*	+	+	+	+	+	+	-	+	-	-	-	-	-	-	-	-
31.	*Cunninghamella spp.*	+	-	+	+	-	-	-	-	-	-	-	-	+	+	+	+
32.	*Curvularia spp*	-	-	-	-	-	-	-	-	+	-	+	+	+	-	+	+

33.	*Verticillium serrae*	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
34.	*Aspergillus oryzae*	-	-	-	-	-	-	-	-	+	+	+	+	-	-	-	-
35.	*Phoma glomerata*	-	-	-	-	-	-	+	+	+	-	+	+	-	-	-	-
36.	*Penicillium notatum*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
37.	*Penicillium chrysogenum*	+	+	+	+	+	+	+	+	-	+	+	+	-	-	-	-
38.	*Trichoderma spp*	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
39.	*Alternaria alternate*	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
40.	*Varicosporina ramulosa*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
41.	*Clavatospora bulbosa*	-	-	+	+	-	-	-	-	-	-	+	+	-	-	-	-
42.	*Ascochyta sp*	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+
43.	*Cumulospora marina*	+	+	+	+	-	-	+	-	-	-	-	-	-	-	-	-
44.	*Dendryphiella salina*	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-
45.	*Periconia prolific*	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-
46.	*Verruculina enalia*	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-
47.	*Salsuginea ramicola*	-	-	-	+	-	-	-	-	-	+	+	+	+	-	-	+
48.	*Savoryella paucispora*	-	-	-	-	-	-	-	-	+	+	+	+	-	+	-	-
49.	*Savoryella*	+	-	-	+	-	-	-	-	+	+	+	+	-	+	-	+

	lignicola																
50.	*Pleospora pelagic*	-	-	-	-	-	-	-	+	+	-	+	+	-	-	-	-
51.	*Marinosphaera mangrovei*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
52.	*Lignincola tropica*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
53.	*Leptosphaeria australiensis*	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+
54.	*Halosarpheia ratnagiriensis*	-	-	-	-	+	-	+	+	-	-	-	-	-	-	-	-
55.	*Aniptodera chesapeakensis*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	+
56.	*Algialus grandis*	-	-	-	-	+	-	-	-	-	-	-	-	+	+	+	+
57.	*Massarina bipolaris*	-	+	+	+	-	-	-	-	-	-	-	-	+	+	-	+
58.	*Halorosellinia oceanicum*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+

PM – postmonsoon, SUM – summer, PRM – premonsoon and MON – monsoon
SS1 – AdirampattinaM, SS2 – Rajamadam, SS3 – Mallipattinam and SS4 – Memesal.

Table.2 List of taxonomic group of fungi and its individual contribution

S.NO	Taxonomical group of fungi	Individual contribution
1	Ascomycota	48
2	Mucoromycotina	2
3	Mitosporic fungi	5
4	Anamorphic fungi	2
5	Hyphomycetes	1

Table.3 Comparison between distributions of fungi with all stations

Area	**Post monsoon**	**Summer**	**Pre monsoon**	**Mon soon**
MEMESAL	1.499 ± 1.33	1.915 ± 1.49	**2.07 ± 1.66***	2.015 ±1.92
ADIRAMPATTINAM	1.156 ± 0.944	1.81 ± 1.55	1.851 ± 1.73	2.09 ± 2.01
MALLIPATTINAM	**1.736 ± 1.59***	2.096 ± 1.62	1.85 ± 1.76	**2.33 ± 2.14***
RAJAMADAM	1.345 ± 1.56	**2.12 ± 1.65***	1.77 ± 1.75	1.720 ± 1.96
CD (P<0.05)	**1.856**			

Values are mean ± SD

Fig.1 Comparison between distributions of fungal species with all stations

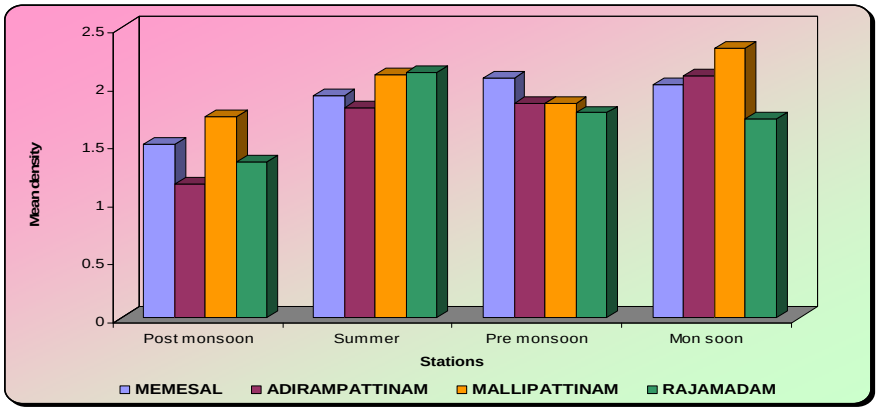

Table.4 List of fungi recorded from all stations

S.NO	NAME OF THE FUNGI
1	*Penicillium expansum*
2	*Geotrichum candidum*
3	*Aspergillus flavus*
4	*Penicillium granulatum*
5	*Penicillium leuteum*
6	*Acremonium Spp*
7	*Aspergillus niger*
8	*Aspergillus sydowii*
9	*Cladosporium Spp*
10	*Chrysosporium Spp*

Table.5 Physico chemical parameter of the marine sediment

S.NO	NAME OF THE PHYSICOCHEMICAL PARAMETER	NAME OF THE STATION AND SEASON															
		ADIRAMPATTINAM				RAJAMADAM				MALLIPATTINAM				MEMESAL			
		JAN 2009	APR 2009	JUL 2009	OCT 2009	JAN 2009	APR 2009	JUL 2009	OCT 2009	JAN 2009	APR 2009	JUL 2009	OCT 2009	JAN 2009	APR 2009	JUL 2009	OCT 2009
1	pH	7.41	7.69	7.12	7.56	7.51	7.77	7.32	7.69	7.49	7.54	7.39	7.26	7.30	7.27	7.41	7.34
2	Electrical conductivity (dsm^{1})	0.41	0.58	0.42	0.56	0.52	0.35	0.30	0.29	0.54	0.32	0.32	0.36	0.32	0.42	0.29	0.42
3	Organic carbon (%)	0.26	0.28	0.22	0.27	0.20	0.22	0.16	0.19	0.18	0.18	0.23	0.17	0.22	0.17	0.19	0.20
4	Organic matter (%)	0.52	0.52	0.34	0.54	0.50	0.48	0.39	0.38	0.38	0.40	0.25	0.38	0.40	0.38	0.29	0.36
5	Cat ion exchange capacity (C. mole $proton^{+}$ / kg)	12.33	11.30	11.10	12.30	14.15	13.40	13.11	14.50	13.06	14.50	12.15	11.40	11.25	12.40	11.39	12.10

Table.6 Analysis of biodiversity indices of marine derived fungi

Name of the Sampling Station	POSTMONSOON				SUMMER				PRE MONSOON				MONSOON				ALL SEASONS POOLED TOGETHER			
	SHANNON INDEX	DOMINANCE INDEX	SPECIES RICHNESS	EVENNESS INDEX	SHANNON INDEX	DOMINANCE	SPECIES RICHNESS	EVENNESS INDEX	SHANNON INDEX	DOMINANCE	SPECIES RICHNESS	EVENNESS INDEX	SHANNON INDEX	DOMINANCE	SPECIES RICHNESS	EVENNESS INDEX	SHANNON INDEX	DOMINANCE	SPECIES RICHNESS	EVENNESS INDEX
ADIRAMPATTINAM	3.0326	.0566	5.3135	.9101	2.7397	.0772	4.3864	.8863	3.1462	.0509	5.6894	.9162	3.2196	.0467	6.1339	.9130	3.1387	.0529	5.1980	.8828
RAJAMADAM	2.5584	.0934	3.9618	.8540	2.1715	.1330	2.9035	.8228	2.2990	.1163	2.9727	.8489	2.6388	.0922	4.9707	.8198	2.5043	.1045	4.5916	.7437
MALLIPATTINAM	2.9025	.0645	4.7526	.9017	2.4718	.1014	3.6915	.8552	2.8867	.0695	5.1890	.8758	2.9408	.0670	5.5589	.8734	2.9272	.0691	4.4248	.8693
MEMESAL	2.6711	.0874	4.2224	.8917	2.6564	.0859	4.2963	.9022	2.5685	.0946	3.9172	.8723	2.8191	.0792	5.5026	.8652	2.7879	.0821	4.4406	.8459

The present study correlates with the report of Sundari *et al.* (1996), that the woody substrata accumulated on the tropical beaches undergo severe desiccation, which might influence the fungal assemblage and diversity. Intertidal sediment samples exposed for a considerable duration to physico-chemical changes in each season since they were sampled about two months after the initiation of each season. Increase in percent colonization of fungi and total number of fungi was seen in August samples. Similar result was given by Prasannarai and Sridhar (2003) from woody substrates. Possibly the environmental factors at intertidal habitats of south east coast of Tamilnadu during the monsoon might be favorable for the growth of fungi. The lowest as well as narrow range of temperature (25º–30ºC) recorded during monsoon season must be ideal for fungal colonization and growth on sediments. In addition, sediment on beaches gets wet continuously during monsoon period.

The present investigation also correlates with Sundari *et al.* (1996) and Aleem (1980). In summary, the assemblage and frequency of occurrence and diversity of marine fungi were highest on sediment sampled during monsoon period in south east coast of Tamilnadu. In addition to many factors which influence the occurrence and function of marine fungi on intertidal sediments, our study indicated that the activity of marine fungi also dependent on the period of sampling.

In conclusion, in the present investigation a number of factors that can affect the diversity of fungi in the marine environment. No single factor can account for the diversity we observe, the marine environment being a complex ecosystem with great variation in many parameters from ocean to ocean, from mangrove to mangrove and from shore to shore and sometimes over a narrow range. Therefore it could be concluded that there is no uniformity in the diversity of marine fungi and their distribution pattern in different geographical regions.

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