

FUNGI ISOLATED FROM THE EEZ OF INDIAN COAST

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ABSTRACT

Seventy eight water samples from surface to 1000 m were collected at 15 stations during FORV *Sagar Sampada* Cruise No. 24. From these, 208 yeast isolates were obtained belonging to the genera *Candida*, *Rhodotorula*, *Sporobolomyces*, *Sterigmatomyces*, *Trichosporon*, *Cryptococcus*, *Saccharomyces* and *Debaryomyces*. *Candida* was the dominant genus followed by *Rhodotorula*.

Seventeen yeast isolates were obtained from the benthic sediment samples and in association with euphausiids from eight stations during FORV *Sagar Sampada* Cruise No. 35. They belonged to the genera *Candida*, *Rhodotorula*, *Trichosporon* and *Debaryomyces*. Filamentous fungi isolated during the cruise belonged to the genera *Aspergillus*, *Penicillium*, *Cladosporium*, *Fusarium* and *Alternaria*. Here the yeast *Rhodotorula* was dominant and *Aspergillus* amongst filamentous fungi. *C. tropicalis* was found commonly associated with euphausiids.

INTRODUCTION

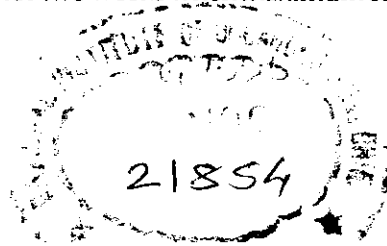
Occurrence of yeasts in the sea and open ocean has been reported by several workers (Bhat and Kachwalla, 1955; Fell and van Uden, 1963; Kriss *et al.*, 1967). Bhat and Kachwalla (1955) were the first to isolate yeasts from Indian waters. Fell (1967) reported yeasts from Indian ocean. Similarly there have been a few reports on the filamentous fungi from the sea and open ocean (Johnson and Sparrow, 1961; Roth *et al.*, 1964; Willingham and Buck, 1965; Cvetkovic' and Ristanovic', 1980). Fell (1967) reported the occurrence of filamentous fungi while studying the distribution of yeasts in the Indian Ocean. During the last decade too, there had been sporadic reports of yeasts and filamentous fungi from sea water and sediments (Paula *et al.*, 1983; Bruni *et al.*, 1983; Fedorak *et al.*, 1984). There had been reports of yeasts isolated from amphipods (Roth *et al.*, 1962), from copepods (Seki and Fulton, 1969), from shrimps (Phaff *et al.*, 1952) and in association with shrimp (Pagnocca *et al.*, 1989). Till now no systematic study of the fungal flora of the EEZ of the Indian coast has been taken up.

This paper comprises of the results of the two cruises of FORV *Sagar Sampada*, one in the EEZ of the west coast of India in the Arabian Sea (Cruise No.24 in November, 1986) and the other in the EEZ along the east coast of India in the Bay of Bengal in September, 1987. During these two cruises we had tried to investigate the different aspects of marine mycology.

Fungal flora, both filamentous fungi (Prabhakaran and Ranu Gupta - in press) and the yeasts were isolated from the water samples collected from different depths of the water column from 15 stations during Cruise No. 24. From the benthic sediment samples too, both the fungal flora were isolated from eight stations during FORV *Sagar Sampada* Cruise No. 35. Yeasts associated with the zooplankton (euphausiids) were also isolated in the latter cruise.

MATERIALS AND METHODS

The sampling stations of Cruise No. 24 is given in Fig. 1. The water samples were collected from 15 stations at different depths from 0 to 1000 m by the Rosette sampler available onboard the ship. The Rosette bottles were cleaned and rinsed with alcohol (95%) before every operation. Hydrographic parameters such as temperature, salinity, dissolved oxygen and pH of the water were recorded simultaneously. Processing of the samples was started immediately after all the collections were over at each station. 500 ml of each sample was filtered through a millipore filter membrane with 0.45 μm porosity. After filtration, each membrane was placed in a petri plate on nutrient medium containing antibiotic mixture to prevent bacterial growth (van Uden and Fell, 1968). The plates were then incubated at $25 \pm 1^\circ\text{C}$ for the samples collected down to 100m depth and $10 \pm 1^\circ\text{C}$ for the samples collected below that depth (Jones, 1976) for two weeks when maximum colonies



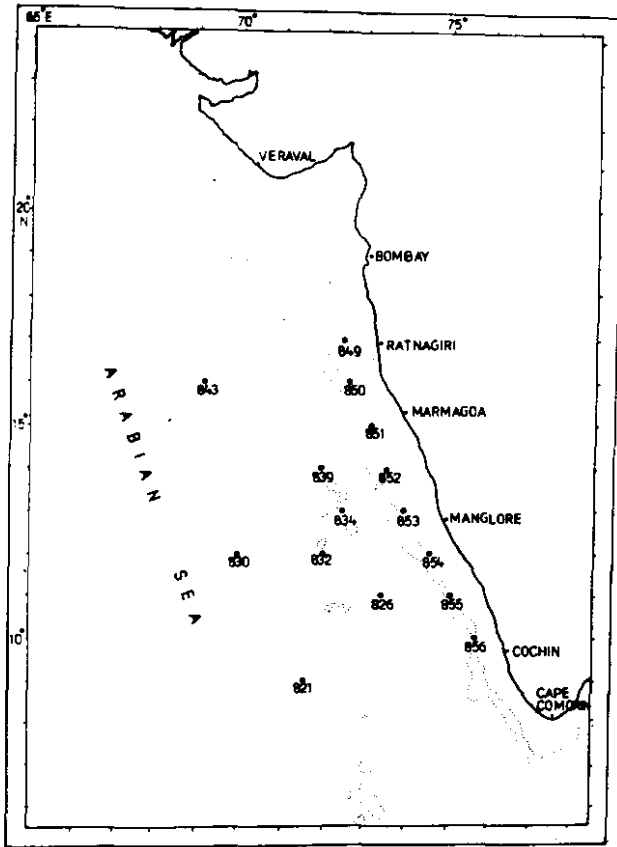


Fig. 1. Map showing location of sampling stations (FORV *Sagar Sampada* cruise No. 24).

showed up. The colony counts were taken through a colony counter.

The track of FORV *Sagar Sampada* cruise No. 35 is given in Fig. 2, showing the sampling stations near the coast from where the benthic sediment samples were collected and also the euphausiid samples from the regular zooplankton hauls. The depth ranged from 32 to 57 m. As the deep sea grab was not available onboard, coastal stations with lesser depths were chosen for sediment collection.

A Van Veen grab was used to collect the sediment samples. The grab was thoroughly cleaned and then wiped with cotton wool soaked in alcohol (95%) before each collection. After every collection the whole lump of the sediment was immediately taken up in a pre sterilized polythene bag. The samples were taken out aseptically inside a sterile chamber from the centre of the lump to avoid any chance of external contamination. One gram of this sediment sample was shaken with 100 ml of sterilized sea water and allowed to stand for 10 minutes to let the particles to settle down. The supernatant was then filtered through 0.45 μ m porosity cellulose acetate

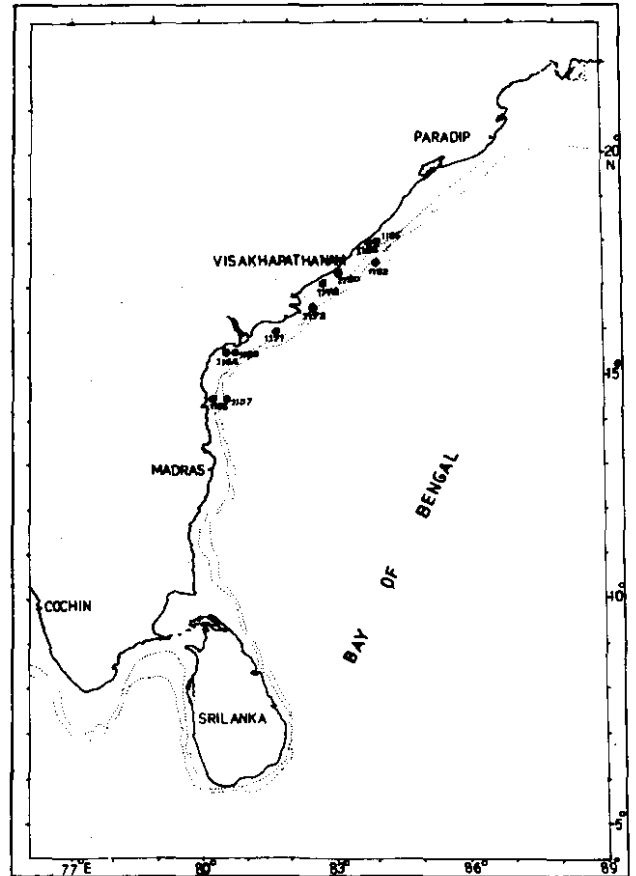


Fig. 2. Map showing location of sampling stations (FORV *Sagar Sampada* cruise No. 35).

membrane filter which was placed in a petri plate with nutrient medium containing antibiotic mixture (Van Uden and Fell, 1968). Medium used for the isolation of filamentous fungi was GY-Agar (Johnson and Sparrow, 1961) with 0.01% chloramphenicol to avoid bacterial growth. Triplicate samples were taken from each collection and each membrane was placed in one plate for the yeast isolation and similar process was carried out for the isolation of filamentous fungi. For each set, blank plates were put in triplicate as controls. The plates were incubated at $25 \pm 1^\circ\text{C}$ for a week for the yeast and for 3 to 4 days for the filamentous fungi. The colony counts were taken as before.

For each of the eight stations five samples of healthy looking euphausiids were taken from the regular hauls and washed well with sterilized sea water to remove the loosely adhering micro-organisms from them. Then each sample was aseptically planted on nutrient medium with antibiotic mixture (van Uden and Fell, 1968), in petri plates and incu-

bated at $25 \pm 1^\circ\text{C}$ for a week. The growth appearing out from the euphausiids on the medium was isolated and identified.

The identification of yeasts was carried out on the basis of detailed cultural, morphological, physiological and biochemical characteristics (Kreger van-Rij, 1984). The identification of filamentous fungi was carried out according to the standard mycological books.

RESULTS AND DISCUSSION

Out of the 78 water samples collected, 71 were positive for the presence of yeasts. Table 1 gives the list of yeast species isolated. Table 2 gives the hydrographical parameters and the species of yeasts isolated from different samples at each of the 15 stations. Yeast concentration ranged from 0 to 260 colony forming units (cfu) per litre.

Yeast population was denser down to 100 m depth after which the density decreased. A total of 24 species belonging to eight genera were isolated (Table 1) of which 16 species occurred infrequently. *Candida membranaefaciens* was the dominant yeast species followed by *Rhodotorula rubra*. Bhat and Kachwalla (1955) reported *C. tropicalis* as the most common species of marine yeast from Bombay coastal waters, but for Fell (1967) *C. atmospherica* and *R. rubra* were the ubiquitous species of yeasts in the Indian Ocean.

Most of the yeast species were isolated down to 100 m depth. Exceptions were *R. graminis*, *Cryptococcus* sp. and *Candida* sp. from 500 m depth at different stations and an isolate of *Candida* sp. even from 1000 m depth.

Of all the yeasts isolated *Sterigmatomyces indicus* was the only obligate marine yeast, while the others were facultatively marine yeasts (Kohlmeyer and Kohlmeyer, 1979). Amongst the eight genera isolated *Debaryomyces* and *Saccharomyces* were the two ascosporogenous ones while all the others asporogenous.

It is obvious from Table 2 that dissolved oxygen and temperature of the collection site had direct influence on the incidence of the yeast species whereas pH and salinity had apparently no effect.

C. albicans, *C. parapsilosis*, *C. atmospherica* and *St. indicus* were found in the temperature range of 20°C to 28°C with high dissolved oxygen. Exception was at st. 834 where *C. albicans* was isolated from

TABLE 1. Species of yeasts isolated from the EEZ of west coast of India

Species
<i>Candida albicans</i> (Robin) Berkhout
<i>C. atmospherica</i> Santa Maria
<i>C. glabrata</i> (Anderson) Meyer et Yarrow
<i>C. guilliermondii</i> (Castellani) Langeron et Guerra
<i>C. membranaefaciens</i> (Lodder et Kreger van-Rij) Wickerham et Burton
<i>C. parapsilosis</i> (Ashford) Langeron et Talice
<i>C. polymorpha</i> Ohara et Nonomura ex Meyer et Ahearn
<i>C. tropicalis</i> (Castellani) Berkhout
<i>C. Vvni</i> (Desmazieres ex Lodder) Van Uden et Buckley
<i>Candida</i> sp.
<i>Cryptococcus laurentii</i> (Kufferath) Skinner
<i>Cryptococcus</i> sp.
<i>Debaryomyces hansenii</i> (Zopf) Lodderet Kreger-Van Rij
<i>Rhodotorula aurantiaca</i> (Saito) Lodder
<i>R. glutinis</i> (Fresenius) Harrison
<i>R. graminis</i> (Di Menna)
<i>R. minuta</i> (Saito) Harrison
<i>R. rubra</i> (Demme) Lodder
<i>Rhodotorulas</i> sp.
<i>Saccharomyces cerevisiae</i> Meyen Ex hansen
<i>Saccharomyces</i> sp.
<i>Sporobolomyces</i> sp.
<i>Sterigmatomyces indicus</i> Fell
<i>Trichosporon</i> sp.

low dissolved oxygen area. Above 24°C and with high oxygen areas yeast species isolated were *C. glabrata*, *C. polymorpha*, *C. tropicalis*, *R. aurantiaca* and *R. minuta*. The versatile yeast species tolerating wide temperature and dissolved oxygen range were *C. guilliermondii*, *C. membranaefaciens*, *C. vini*, *Candida* sp., *Cr. laurentii*, *Cryptococcus* sp., *D. hansenii*, *R. glutinis*, *R. graminis*, *R. rubra*, *Rhodotorula* sp. *S. cerevisiae* and *Trichosporon* sp.

Table 3 gives the details of the positions of the stations for the collection of sediment samples and the filamentous fungi isolated during FORV *Sagar Sampada* Cruise No. 35. Table 4 gives the details of the yeast species isolated from the benthic sediment samples during the same cruise. Table 5 gives the details of the yeast species found associated with euphausiids from five out of eight stations. Out of the 40 samples of healthy euphausiids screened, only five samples from five different stations showed positive association with yeast.

In our investigation we find that the yeast density was restricted to the euphotic zone and very few yeast counts were obtained from 500 and 1000m depth of the water column. Fell (1967) too observed that increased density of yeast population was related to the productivity of the region in particular, corresponded with the concentration of the inverte-

TABLE 2. Species of yeasts isolated from different water samples in the EEZ of west coast of India. (FORV Sagar Sampada Cruise No. 24, 16.11.1986 - 4.12.1986)

Station No.	Position	depth (m)	Temp. (°C)	Salinity (‰)	Oxygen (ml/l)	pH	Total No. of Cfu/l	Species isolated
1	2	3	4	5	6	7	8	9
821	09° 00'N	0	27.00	35.1	4.23	8.26	8	<i>C. albicans</i> &
	71° 30'E	10	23.92	35.6	4.15	8.27	18	<i>C. membranaefaciens</i>
		50	20.95	35.4	3.15	8.14	18	<i>C. membranaefaciens</i> & <i>C. vini</i>
		100	15.98	35.7	0.54	7.67	6	<i>Cryptococcus</i> sp., <i>R. minuta</i> & <i>Rhodotorula</i> sp.
		500	10.05	35.5	0.99	7.57	4	<i>C. quilliermondii</i> & <i>S. cerevisiae</i>
1000	9.07	35.4	1.23	7.62	0	<i>Candida</i> sp.		
826	11° 00'N	0	23.50	34.9	4.92	8.26	0	-
	73° 30'E	10	23.10	35.1	4.88	8.29	18	<i>C. quilliermondii</i> & <i>St. indicus</i>
		50	22.20	35.0	0.38	8.21	28	<i>C. membranaefaciens</i> & <i>Cryptococcus</i> sp.
		100	20.50	35.2	0.26	7.79	30	<i>C. membranaefaciens</i> , <i>Candida</i> sp. <i>Cryptococcus</i> sp. & <i>R. rubra</i>
		500	13.50	34.9	0.38	7.59	2	<i>R. graminis</i>
1000	8.50	34.8	0.61	7.58	0	-		
830	11° 59' N	0	27.90	35.8	4.81	8.25	0	-
	70° 03' E	10	22.90	36.0	4.61	8.29	158	<i>Cr. laurentii</i> , <i>D. hansenii</i> , <i>R. glutinis</i> & <i>R. rubra</i>
		50	19.50	35.4	0.45	7.85	16	<i>Candida</i> sp. & <i>Trichosporon</i> sp.
		100	16.93	35.8	0.29	7.72	2	<i>Candida</i> sp.
		500	13.75	34.9	0.38	7.61	6	<i>Candida</i> sp. & <i>Cryptococcus</i> sp.
1000	9.74	34.8	0.62	7.59	4	<i>Candida</i> sp.		
832	12° 00'N	0	28.00	34.9	4.91	8.27	58	<i>C. membranaefaciens</i> , <i>Cr. laurentii</i> & <i>D. hansenii</i>
	71° 58'E	10	24.62	35.8	4.84	8.26	128	<i>C. qlabrata</i> , <i>Candida</i> sp., <i>Cryptococcus</i> sp. & <i>S. cerevisiae</i>

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Table 2 contd.

1	2	3	4	5	6	7	8	9
		50	21.15	35.6	0.85	7.92	86	<i>D. hansenii</i> , <i>R. graminis</i> & <i>R. rubra</i> .
		100	19.05	34.9	0.23	7.73	86	<i>C. quilliermondii</i> , <i>C. membranaefaciens</i> & <i>Rhodotorula</i> sp.
		500	14.35	34.8	0.30	7.51	6	<i>Candida</i> sp.
834	13° 00' N	0	28.30	35.2	4.81	8.23	136	<i>C. membranaefaciens</i> , <i>Cr. laurentii</i> , <i>D. hansenii</i> & <i>St. indicus</i>
	72° 30' E	10	26.35	35.3	4.54	8.21	160	<i>C. tropicalis</i> , <i>D. hansenii</i> , <i>R. graminis</i> , <i>R. rubra</i> , <i>Sporobolomyces</i> sp. & <i>St. indicus</i>
		20	24.95	34.9	3.46	8.20	60	<i>Cr. laurentii</i> , <i>D. hansenii</i> & <i>R. minuta</i>
		30	22.75	34.8	1.92	8.10	36	<i>C. albicans</i> & <i>St. indicus</i>
		40	20.70	35.1	1.07	8.10	80	<i>Cr. laurentii</i> , <i>R. minuta</i> & <i>R. rubra</i>
839	14° 00' N	0	27.30	35.0	5.08	8.27	81	<i>C. membranaefaciens</i> , <i>R. glutinis</i> & <i>Rhodotorula</i> sp.
	71° 57' E	10	26.93	34.8	4.82	8.26	38	<i>C. polymorpha</i> , <i>D. hansenii</i> , <i>R. minuta</i> & <i>R. rubra</i>
		50	20.35	35.0	0.84	7.98	40	<i>C. membranaefaciens</i> , <i>R. glutinis</i> , <i>R. graminis</i> & <i>R. rubra</i>
		100	17.36	35.2	0.46	7.73	44	<i>C. membranaefaciens</i> , <i>Candida</i> sp. & <i>Saccharomyces</i> sp.
		500	11.57	34.9	0.23	7.49	0	-
843	15° 45' N	0	26.10	35.3	5.11	8.23	108	<i>C. atmospherica</i> , <i>R. rubra</i> & <i>St. indicus</i>
	69° 14' E	10	26.52	35.6	4.92	8.22	38	<i>R. graminis</i> and <i>R. minuta</i>
		50	23.35	35.6	4.54	8.19	32	<i>C. atmospherica</i> , <i>Cryptococcus</i> sp. <i>R. rubra</i> & <i>St. indicus</i>
		100	21.23	35.4	1.46	7.69	42	<i>C. membranaefaciens</i> , <i>C. vini</i> & <i>Candida</i> sp.
		500	11.98	35.1	0.23	7.48	0	-
849	17° 00' N	0	27.30	34.6	5.03	8.31	118	<i>C. albicans</i> , <i>C. tropicalis</i> & <i>R. rubra</i>
	72° 31' E	10	26.99	34.5	4.92	8.30	198	<i>C. albicans</i> , <i>C. troicapolis</i> , <i>D. hansenii</i> & <i>R. rubra</i>

Table 2 Contd.

1	2	3	4	5	6	7	8	9
		20	26.93	34.6	4.85	8.19	134	<i>C. membranaefaciens</i> , <i>C. parapsilosis</i> , <i>C. vini</i> <i>Cryptococcus</i> sp., <i>D. hansenii</i> & <i>R. minuta</i>
		30	27.05	34.3	4.85	8.08	82	<i>C. membranaefaciens</i> , <i>R. minuta</i> & <i>R. rubra</i>
		70	20.74	34.2	4.69	7.99	30	<i>C. albicans</i> & <i>Candida</i> sp.
	16° 00'N	0	27.00	35.3	5.30	8.22	228	<i>C. membranaefaciens</i> , <i>C. tropicalis</i> , <i>D. hansenii</i> & <i>R. rubra</i>
	72° 48' E	10	27.02	35.3	4.99	8.20	260	<i>C. membranaefaciens</i> , <i>C. tropicalis</i> , <i>D. hansenii</i> & <i>R. rubra</i>
		30	21.96	35.3	4.46	8.10	90	<i>C. parapsilosis</i> , <i>Candida</i> sp. & <i>R. rubra</i>
		75	19.96	35.1	0.46	8.08	28	<i>C. quilliermondii</i> , <i>Cryptococcus</i> sp. & <i>R. glutinis</i>
		100	19.87	34.8	0.31	7.89	38	<i>C. vini</i> & <i>R. rubra</i>
	15° 00'N	0	26.80	35.2	5.12	8.24	98	<i>C. albicans</i> , <i>C. membranaefaciens</i> , <i>C. tropicalis</i> & <i>R. minuta</i>
	73° 15' E	10	27.08	35.1	5.08	8.19	84	<i>C. albicans</i> , <i>C. membranaefaciens</i> , <i>C. tropicalis</i> & <i>R. minuta</i>
		30	26.24	35.2	5.07	8.15	56	<i>C. tropicalis</i> & <i>Cryptococcus</i> sp.
		75	20.95	35.9	0.99	8.11	34	<i>C. quilliermondii</i> , <i>C. membranaefaciens</i> & <i>R. rubra</i>
		100	19.85	35.9	0.77	7.91	16	<i>C. membranaefaciens</i>
852	14° 00'N	0	27.42	35.1	4.98	8.20	140	<i>C. albicans</i> , <i>R. rubra</i> & <i>Trichosporon</i> sp.
	73° 34' E	10	27.35	35.1	4.92	8.16	96	<i>C. albicans</i> , <i>R. rubra</i> & <i>Sporobolomyces</i> sp.
		30	25.88	35.6	4.46	8.12	84	<i>C. vini</i> , <i>D. hansenii</i> & <i>R. glutinis</i>
		50	21.90	35.8	1.23	8.09	24	<i>Cryptococcus</i> sp. & <i>S. cerevisiae</i>
		75	22.01	35.8	1.07	8.02	26	<i>C. membranaefaciens</i> & <i>Candida</i> sp.
853	13° 00'N	0	26.10	35.1	5.10	8.22	60	<i>Cryptococcus</i> sp., <i>D. hansenii</i> <i>Rhodotorula</i> sp. & <i>Saccharomyces</i> sp.

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Table 2 Contd.

1	2	3	4	5	6	7	8	9
	74° 00' E	10	27.39	34.9	4.92	8.21	62	<i>Cryptococcus</i> sp., <i>D. hansenii</i> , & <i>S. cerevisiae</i>
		30	25.08	34.9	4.69	8.16	44	<i>C. membranaefaciens</i> , <i>Cryptococcus</i> sp. & <i>R. rubra</i>
		75	24.50	35.1	2.99	8.07	50	<i>C. membranaefaciens</i> & <i>Cryptococcus</i> sp.
		90	23.79	35.1	2.92	8.02	24	<i>Candida</i> sp. & <i>Cryptococcus</i> sp.
854	12°00N	0	26.92	35.1	5.34	8.26	98	<i>C. tropicalis</i> , <i>Cryptococcus</i> sp., <i>R. minuta</i> & <i>Saccharomyces</i> sp.
	74°36'E	10	27.43	35.1	4.92	8.19	74	<i>C. parapsilosis</i> , <i>C. tropicalis</i> <i>R. minuta</i> & <i>R. rubra</i>
		30	26.20	34.8	4.61	8.15	84	<i>C. membranaefaciens</i> , <i>Candida</i> sp. & <i>R. minuta</i>
		50	25.34	35.2	4.54	8.06	48	<i>Candida</i> sp., <i>Cryptococcus</i> sp. & <i>Sporobolomyces</i> sp.
		100	22.27	35.1	2.07	7.96	0	-
855	11°00N	0	27.35	34.9	5.08	8.31	56	<i>C. albicans</i> , <i>C. parapsilosis</i> , <i>R. rubra</i> & <i>Trichosporan</i> sp.
	75°09'E	10	27.83	34.8	4.85	8.27	144	<i>C. albicans</i> , <i>C. guilliermondii</i> , <i>C. parapsilosis</i> , <i>C. tropicalis</i> , & <i>R. rubra</i>
		30	25.82	35.0	4.23	8.14	140	<i>C. membranaefaciens</i> , <i>C. vini</i> <i>Cryptococcus</i> sp., <i>R. rubra</i> & <i>Saccharomyces</i> sp.,
		75	23.95	35.3	3.99	8.06	80	<i>Candida</i> sp. & <i>R. rubra</i>
		100	22.90	35.3	3.76	7.98	20	<i>R. graminis</i>
856	10°00'N	0	26.63	35.1	5.23	8.28	38	<i>C. membranaefaciens</i> , <i>C. tropicalis</i> & <i>R. rubra</i>
	75°40'E	10	26.92	35.0	4.69	8.23	108	<i>C. membranaefaciens</i> , <i>C. tropicalis</i> , <i>D. hansenii</i> , <i>R. aurantiaca</i> & <i>R. rubra</i>
		30	27.26	34.9	4.08	8.19	100	<i>C. membranaefaciens</i> , <i>Crypto-</i> <i>coccus</i> sp. & <i>R. rubra</i>
		75	26.66	34.8	3.69	8.05	70	<i>C. membranaefaciens</i> & <i>Rhodotorula</i> sp.
		100	25.34	35.1	3.53	7.99	32	<i>C. membranaefaciens</i> & <i>Candida</i> sp.

TABLE 3. Species of filamentous fungi isolated from different sediment samples in the EEZ of east coast of India (FORV Sagar Sampada Cruise No. 35)

Station No.	Position	depth (m)	Total No. of Cfu/g	Species isolated
1156	14° 30' N 80° 18' E	32	10	<i>Penicillium</i> Sp., <i>Fusarium</i> sp. and <i>Aspergillus flavus</i>
1164	15° 33' N 80° 40' E	50	8	<i>Aspergillus fumigatus</i> and <i>Cladosporium</i> sp.
1171	16° 00' N 81° 28' E Near the st. 16° 05' N 81° 30' E	160 40	13	<i>Aspergillus niger</i> , <i>Penicillium chrysogenum</i> , <i>Penicillium</i> sp. and <i>Fusarium</i> sp.
1172	16° 31' N 82° 25' E	34	34	<i>Aspergillus niger</i> , <i>Penicillium</i> sp., <i>Fusarium</i> sp., <i>Cladosporium</i> sp. <i>C. herbarum</i> and <i>Alternaria</i> sp.
1179	17° 15' N 82° 05' E	46	7	<i>Aspergillus niger</i> and <i>Cladosporium</i> sp.
1180	17° 25' N 83° 00' E	51	8	<i>Aspergillus fumigatus</i> and <i>Cladosporium</i> sp.
1185	18° 03' N 84° 04' E	57	9	<i>Penicillium</i> sp. and <i>Cladosporium</i> sp.
1186	18° 01' N 83° 54' E	40	22	<i>Aspergillus niger</i> , <i>Aspergillus flavus</i> , <i>Penicillium</i> sp. and <i>Fusarium</i> sp.

brates. Majority of yeasts in ocean are probably saprophytes, for their growth they depend on the available organics after the death of various marine organisms (Fell, 1976). In turn they may be included in the diet of invertebrates as a supplementary source of proteins and vitamins. Our observation of the presence of denser population of yeast in the upper layers (euphotic zone) corroborates Fell's observations.

In view of the above and as is obvious from our results of the cruise more detailed study of the EEZ of India is essential to give a better understanding of the yeast population in relation to their linkage to the productivity of the region and their role in the food chain of the ecosystem.

When we compare the population of yeast and filamentous fungi in the benthic sediment, we find that the filamentous fungi were more in number and variety than the yeasts, but it was reverse in water samples. As deep sea grab was not available on-board we took the sediment samples from the coastal stations. It is obvious that most of the filamentous fungi isolated were from terrigenous origin highly adapted to diverse ecological conditions.

Out of the five positive samples of euphausiid, two showed association with *C. tropicalis*, one with *R. lactosa*, another one with *Trichosporon* sp. One sample showed association with both the yeasts (*R. lactosa* and *C. tropicalis*). The relation between the yeast species and the euphausiid has to be established.

TABLE 4. Species of yeasts isolated from different sediment samples in the EEZ of east coast of India (FORV Sagar Sampada Cruise No. 35)

Station No.	Position	depth (m)	Total No. of Cfu/g	Species isolated
1156	14° 30' N 80° 18' E	32	18	<i>Rhodotorula graminis</i>
1164	15° 33' N 80° 40' E	50	9	<i>Debaryomyces hansenii</i> & <i>Rhodotorula minuta</i>
Near the st.1771	16° 05' N 81° 30' E	40	19	<i>Rhodotorula minuta</i>
1172	16° 31' N 82° 25' E	34	-	-
1179	17° 15' N 82° 05' E	46	12	<i>Rhodotorula rubra</i>
1180	17° 25' N 83° 00' E	51	6	<i>Rhodotorula minuta</i> & <i>Rhodotorula graminis</i>
1185	18° 03' N 84° 04' E	57	8	<i>Rhodotorula minuta</i> , <i>Rhodotural rubra</i> & <i>Candida tropicalis</i>
1186	18° 01' N 83° 54' E	40	16	<i>Candida tropicalis</i>

TABLE 5. Species of yeasts isolated in association with euphausiids during FORV Sagar Sampada Cruise No. 35

Station No.	Position	Species isolated
1156	14° 30' N 80° 18' E	<i>Candida tropicalis</i>
1157	14° 30' N 80° 28' E	<i>Candida tropicalis</i>
1165	15° 30' N 80° 46' E	<i>Rhodotorula lactosa</i> & <i>Candida tropicalis</i>
1179	17° 15' N 82° 05' E	<i>Trichosporon</i> sp.
1182	17° 30' N 84° 00' E	<i>Rhodotorula lactosa</i>

Healthy samples were chosen, so that there is less chance of the saprophytic role of the yeasts isolated. As suggested by Pagnocca *et al.* (1989) in the case of shrimp, it could be from the intestinal flora where they are favourably lodged.

During these two cruises we had tried to explore different avenues of marine mycology in the EEZ of Indian coast and the results indicate that a detailed systematic study is needed in this less studied field of biological oceanography.

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