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AEROMYCOLOGICAL STUDIES OF INDOOR ENVIRONMENT OF RAMDEOBABA SOLVENT, BRAMHAPURI DIST.CHANDRAPUR (MAHARASHTRA) INDIA

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ABSTRACT

The aim of this study was to determine the fungal spore concentration in indoor environment of Ramdeobaba solvent, Bramhapuri dist. Chandrapur (Maharashtra) India and identification of dominant genera. Indoor environment having organic substrate contains more concentration of fungal propagules as compared to outdoor environment. This fungal concentration varies by meteorological parameters like temperature and humidity. In the present study air samples were collected from February 2023 to January 2024 by petriplate method and Hi air sampler method. The dominant genera of fungi found in Ramdeobaba Solvent were *Rhizopus, Mucor, Alternaria, Aspergillus, Penicillium, Chaetomium, Cladosporium, Curvularia and Fusarium*. Maximum fungal spore concentration was found in month of August at preparation section while minimum concentration was in month May at refinery section. Comparatively the fungal spore concentration varied according to meteorological condition of every month and availability of substrate at indoor places.

INTRODUCTION

Aeromycology is the branch of aerobiology that studies the dispersion of spores and other fungal elements in indoor and outdoor air, the changes in their concentrations, and the factors that affect those changes(Kasprzyk I. 2008).Fungi are heterotrophic eukaryotes that are usually filamentous, devoid of chlorophyll and with chitinous cell wall .Aeromycoflora refers to airborne fungal contributors of the environment (Ghosh et. al., 2014),(Wakade et. al., 2018).Fungal spores are small and buoyant thus having easy access to indoor environment of various packed buildings(Raveesha 2015). Such various areas contaminated by fungi and their spores are also emitted into outdoor air. The air borne fungal spores impacts to the biotic as well as abiotic substances present in perticular environment. Most of the fungi are saprophytic in nature that grows on dead organic material called as substrate. The places wherever substrate is present,the fungal spore starts to germinate and complete their life cycle.Fungal spores are one of the most important contaminants in the edible oil industries, dairy industries, rice mills, saw mills, poha mills, libraries, ware houses and residential schools - Hostels and other indoor places(Kalbende et.al.,2012). The raw materials, oil products and byproducts in edible oil industry are the good substrates on which fungal growth takes place.To assess the presence of the fungal aeromycoflora and their role in allergic reactions in college and university libraries studies were carried out by different researchers (Kukreja SG.2007). Fungal density in the air varies in accordance with geographical region and season. Besides climatic parameters such as wind, humidity, temperature, precipitation, altitude and flora combination may also affect the type and amount of fungi in the air. Some fungi like *Alternaria*, *Aspergil*us, *Cladosporium* and *Penicillium* are generally considered to be important causes of allergic diseases. *Cladosporium* and *Alternaria* exist more commonly in the atmosphere in period of warm air while *Aspergillus* and *Penicillium* exist more intensively in cool periods. (Reddy et.al.2015).The concentration of fungal spore varies according to season and different environment of indoor places (Seema Verma et. al.,2013). So many aeromycological studies have been performed in different indoor places till now like, Adhikari et.al.(2004),Barui and Chanda (2000), Chakraborty et.al.(2000), Jadav and Lall(2011), Karak and et.al.(2017), Karmarkar et.al.(2020).

Ramdeobaba solvent is the oil industry in Bramhapuri of Maharashtra state that produces edible oil from rice bran collected from surrounding rice mills. There are Three major sections in this industry. 1.preparation section where raw material is stored and prepared before extraction of edible oil.2.Refinary section where extracted oil is refined.3.packing section where, final product is packed.

The objectives of this study were to determine indoor aeromycoflora of oil industry, identification of dominant genera and Effect of meteorological parameters on fungal growth and seasonal variation of fungal spore concentration in Ramdeobaba

solvent.. The study of monthly and seasonal fluctuation pattern of airborne fungi is very helpful to understand proper diagnosis and treatment related to health problems (Oliveira et. al.2009)

Material and methods

Study Area

The present study was performed in Ramdeobaba solvent, Bramhapuri dist. Chandrapur (Maharashtra) India located at latitude 20.607068˚ and longitude 79.869759˚ established in 2010.

Air Sampling

During the study air sampling was done fortnightly of every month by two methods,

i) **Petriplate method**- Gravity or depositional sampling is a non-quantitative collection method in which an agar medium is exposed to the environment and airborne organisms are collected primarily by gravity. This sampling method is often used because it is inexpensive and easily performed. Czapeks Dox Agar culture media was prepared before 8th and 23rd day of every month in packed petriplates and then brought to Ramdeobaba solvent to collect the air samples from the indoor environment of three sections. In petriplate method,petriplates were exposed for 8- 10 min to settle the fungal spores in petriplate after that sealed these petriplates and brought to laboratory for incubation at room temperature for 4-6 days and observed the growth of fungal colonies.(Julius Richard Petri 1880)

ii) **Hi media air sampler-**

The Hi air sampler operates on the impaction principle. The air under examination is sucked by the impeller in a ' Tornado – like ' Spiralling conical form and the particles contained in it are centrifugally impacted against the inward facing peripheral agar medium strip as the spiralling return air escapes around the outer surface of the tornado

Air samples was collected by Hi media air sampler by using Rose Bengal Strips(Smith and Dawson 1944) . After going to sites Rose Bengal strip loaded in air sampler and collected the air sample for five minutes from three sections of the oil industry . After that rose Bengal strip removed from air sampler , sealed and brought to laboratory for incubation at room temperature and observed the growth of fungal colonies.

The fungal colonies per unit volume of the air were then calculated as under

$$CFUs/m^3 = \frac{colonies\ on\ Agar\ strip \times 25}{Sampling\ time\ in\ minutes}$$

RESULTS AND DISCUSSION

Petripalte exposure method is the oldest and inexpensive method for collection and identification of air borne fungal spores(Sudharsanam S. et.al. 2008)Throughout the year total fungal spore concentration in Ramdeobaba solvent by exposer petriplate method and Hi media air sampler method were found 1457 and 10645 CFUs/m³ respectively. The no of colonies captured by exposer petriplate method in preparation section were 543 while in refinery section were 431 and in packing section were 492 respectively. Whereas the total no of CFUs/m³ trapped by Hi media air sampler method in preparatory section were 3690 while in refinery section were 3335 and in packing section were 3520 respectively. From the above study maximum fungal spore concentration by exposer petriplate method was found in month of August 12.14% followed by September 11.39%,February 9.33% ,October 8.92% ,March 8.71%, November 8.44% ,January and April 7.82% ,December 7.75% , and May5.07%. Also by Hi air sampler method the maximum fungal spore concentration was found in month of August 11.31% followed by September 10.09%, January 9.20%, July 9.11% , October 9.11% , November 8.45% , February 8.26%, March 7.97%, April 6.76% , May and June 5.30%. From the above data fungal spore concentration was highest in month of August having while lowest concentration was found in month of May . The meteorological parameters directly affect fungal growth, sporulation and dispersal (Kaur 2021).

In the present study aeromycospora showed seasonal variation by exposer petriplate method . The Rainy season have highest fungal spore concentration 36.10% , followed by winter season 32.94% while summer season have low concentration 30.95%. Also by Hi air sampler method , the rainy season have highest concentration 36.2% followed by winter season 34.89% while summer season have low concentration 28.13%. This result was similar to previous study performed by karamkar et.al(2020), Kaur et.al.(2019).AlsoMaximum fungal spore concentration were recorded during rainy season because of favorable climate such as high rain fall with increasing humidity and moderate temperature which is good for growth and development of fungi. And high temperature with decreasing humidity (dry condition) arrests the growth and development of fungi. The correlation between fungal spore concentration and metrological parameter was reported (Tilak and Pande 1997). Airborne fungal spores are ubiquitous in nature and found in almost all seasons but their diversity and concentration fluctuates with respect to the environmental conditions of particular area (Verma et al., 2013). On the basis of availability of substrate, the fungal spore concentration varied section to section . Maximum concentration was found in preparation section where rice bran is stored and processed that enhanced the favorable condition for fungal growth. Mean concentration was found in packing section where final product packed . Minimum concentration was found in refinery section where high temperature was regulated to maintain the viscosity of edible oil that impacts on fungal growth. From the above study fungal spore concentrationwere found in ,1.Preparation section , found by exposer petriplate method and Hi air sampler method were 543 and 3690 CFUs/m³respectively.

2. Refinery section ,found by exposer petriplate method and Hi air sampler method were 431 and 3335 CFUs/m³ respectively.

3. Packing section ,found by exposer petriplate method and Hi air sampler method 492 and 3520 CFUs/m³ respectively.

Airborne microbial quantity and quality vary with time of day, year, and location. The aeromycological survey of indoor environment was carried out at different sites of Christanand hospital Bramhapuri and observed that the total fungal spore concentration and fungal type are vary in all the four sites of Hospital. The number of fungal spores is maximum in O.P.D. followed by general ward, Pathology laboratory and minimum in Operation theater (S.M.Waghare et. al.)

During the investigation the dominant genera of fungi found in different three sections of Ramdeobaba Solvent were *Rhizopus, Mucor, Alternaria, Aspergillus, Penicillium, Chaetomium, Cladosporium, Curvularia and Fusarium.*The result of present investigation is aligned with previous researches.The most dominant fungal spores were recorded *Aspergillus Sp., Penicillium Sp. Sterile mycelia, Alternaria Sp., Mucor, Curvularia, Fusarium , Rhizopus, Torula and Trichothecium. Aspergillus Sp., Penicillium Sp. Sterile mycelia, Alternaria Sp*. Are commonly observed in all four sites of Christanand hospital Bramhapuri(S.M.Waghare et. al.) The variable fungal airomycospora , may remain in the same environment or carried to a long distance particularly by wind, depositing on healthy flora can caused many plant diseases, hence the knowledge of their periodicity is of great concern in terms of predicting the plant epidemics (Chelak and Sharma, 2012).

Table 1

Regional (Chandrapur district)Meteorological data of 2023-24

Month	temperature(˚C)			Average Precipitation (mm)	Relative Humidity (%)		
	Min.	Max.	Average		Min.	Max.	Average

February 2023	17.1	36.6	26.0	00	18.6	94.1	46.2
March 2023	22.1	40.9	30.8	22.78	15.1	84.8	37.1
April 2023	26.6	43.7	33.6	44.41	17.3	70.4	39.5
May 2023	29.4	44.9	36.6	74.4	17.0	68.5	36.5
June 2023	24.7	40.9	31.3	88.47	28.2	95.4	62.7
July 2023	23.5	33.7	27.4	579.73	46.4	98.4	80.9
August 2023	23.0	33.9	27.0	207.82	49.5	99.0	81.4
September 2023	23.8	33.4	27.9	302.7	49.0	98.3	76.3
October 2023	20.9	33.4	27.9	06.06	33.9	89.3	64.1
November 2023	18.1	33.0	25.6	8.22	30.3	83.1	56.0
December 2023	11.9	29.6	21.5	5	31.6	97.0	63.4
January 2024	15.1	31.7	22.4	0.95	23.7	74.1	46.8
Annual				**1339.91**			

Table 2

Exposer petriplate method

Fungal spore concentration Observed from February 2023 to January 2024 in three different sections of Ramdeobaba Solvent Bramhapuri.

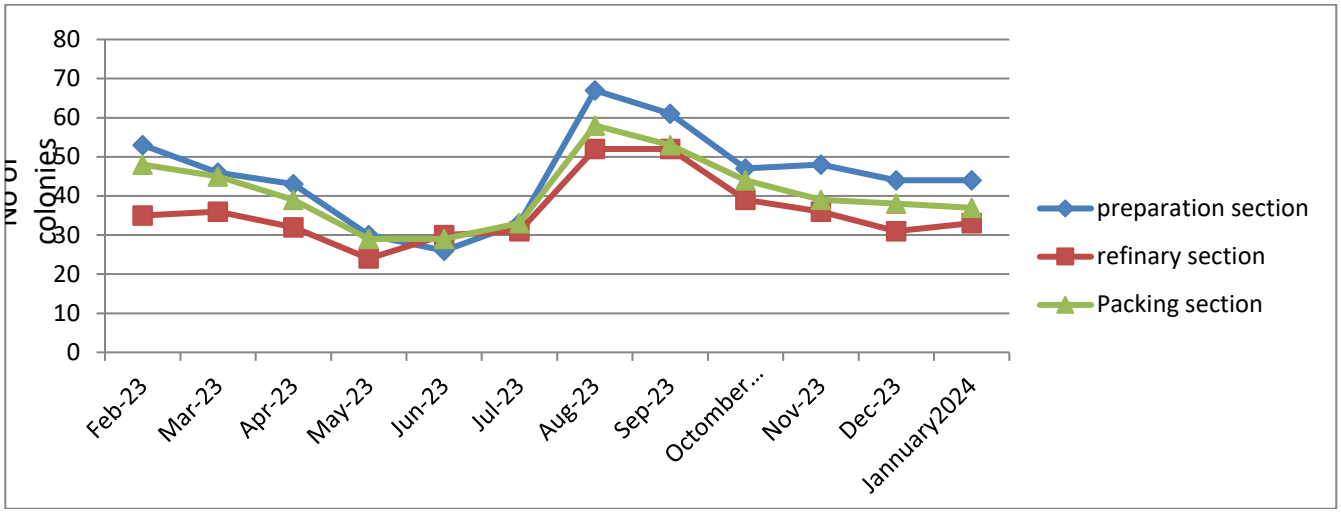
Season	Month	Total No of colonies in preparation section	Total No of colonies in refinary section	Total No of colonies in Packing section	Total fortnightly	Toatal monthly	percentage	Seasonal percentage
Summer season	Feb 2023	28	19	22	69	136	9.33	30.95
		25	16	26	67			
	March 2023	26	22	24	72	127	8.71	
		20	14	21	55			
	April 2023	24	17	22	63	114	7.82	
		19	15	17	51			
	May 2023	18	15	16	49	74	5.07	
		12	09	13	25			
Rainy season	June 2023	15	13	15	43	85	5.83	36.10
		11	17	14	42			
	July 2023	16	16	17	49	98	6.72	
		18	15	16	49			
	August 2023	36	27	30	93	177	12.14	
		31	25	28	84			
	September 2023	27	24	23	74	166	11.39	
		34	28	30	92			
Winter season	October 2023	25	21	24	70	130	8.92	32.94
		22	18	20	60			
	November 2023	24	20	21	65	123	8.44	
		24	16	18	58			
	December 2023	21	17	18	56	113	7.75	
		23	14	20	57			

	January 2024	24	18	20	62	114	7.82	
		20	15	17	52			
	Total	**543**	**431**	**492**	**1457**	**1457**		

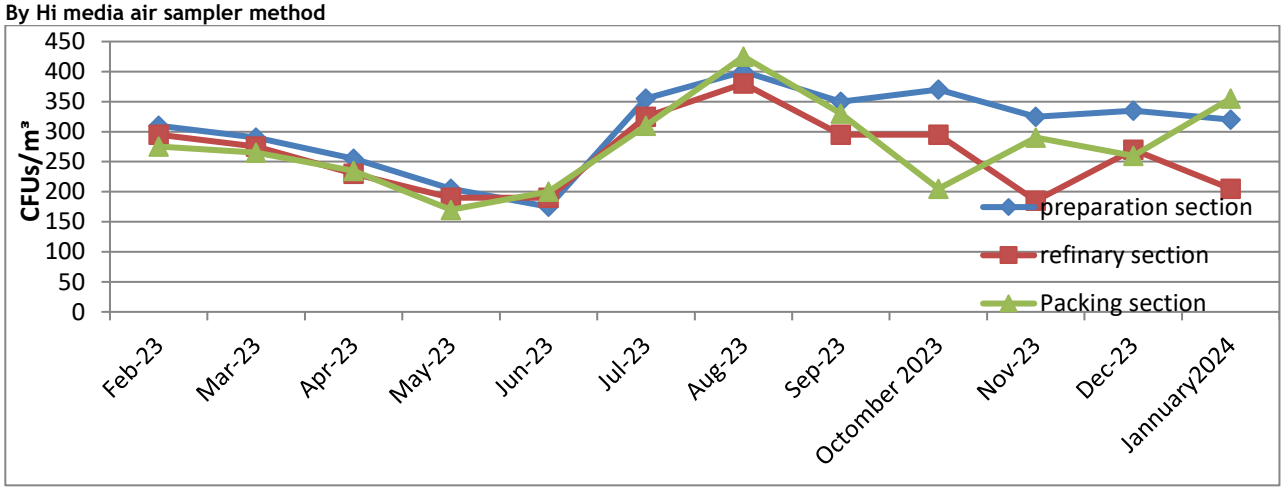
Table 3
Hi media air sampler method
Fungal spore concentration Observed from February 2023 to January 2024 in three different sections of Ramdeobaba Solvent Bramhapuri.

Season	Month	CFUs/m^3 in preparation section	CFUs/m^3 in refinary section	CFUs/m^3 in Packing section	Total fortnightly	Total monthly	percentage	Seasonal percentage
Summer season	Feb 2023	160	140	130	430	880	8.26	28.13
		150	155	145	450			
	March 2023	135	145	140	420	830	7.79	
		155	130	125	410			
	April 2023	130	120	110	360	720	6.76	
		125	110	125	360			
	May 2023	95	100	70	265	565	5.30	
		110	90	100	300			
Rainy season	June 2023	80	85	90	255	565	5.30	36.02
		95	105	110	310			
	July 2023	190	170	140	500	990	9.30	
		165	155	170	490			
	August 2023	210	200	230	640	1205	11.31	
		190	180	195	565			
	September 2023	170	155	210	535	1075	10.09	
		180	140	220	540			
Winter season	October 2023	190	165	170	525	970	9.11	34.89
		180	130	135	445			
	November 2023	150	135	145	430	900	8.45	
		175	150	145	470			
	December 2023	165	140	135	440	865	8.12	
		170	130	125	425			
	January 2024	165	170	200	535	980	9.20	
		155	135	155	445			
	Total	**3690**	**3335**	**3520**	**10645**	**10645**		

Monthly variation of fungal spore concentration in three different sections of Ramdeobaba Solvent Bramhapuri by Exposer petriplate method



By Hi media air sampler method



Fungal growth on Czapeks Dox Agar

Fungal growth on rose Bengal strip

CONCLUSION

- The present study revealed that monthly variation exhibited the maximum fungal spore concentration(177 and 1205 CFUs/m^3) in month of August by both methods.
- Also highest concentration was found in preparation section where the favourable condition for fungal growth is present. while minimum concentration was recorded in refinery section where more temperature is more that reduced the proliferation of fungi.
- Minimum concentration (74 and 565 CFUs/m^3) was found in month of May .
- According to seasonal variation both methods showed 36.10% and 36.02% spore concentration in rainy season which is highest .While in summer season it was minimum with 30.95% and 28.13%.
- Fungal spore concentration varied seasonally as well as monthly according to meteorological parameters.
- Humidity more than 80% and average temperature between 25°C to 30°C provides best environment for the fungal growth.
- The precipitation was more from June to September and fungal spore concentration were high during that period. There were appreciable increase in indoor aeromycospora of oil industry during the month of July and August having maximum rainfall.
- During this study the dominant genera of fungi found in Ramdeobaba Solvent were *Rhizopus, Mucor, Alternaria, Aspergillus, Penicillium, Chaetomium, Cladosporium, Curvularia and Fusarium.*

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