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AEROMYCOLOGICAL STUDIES OF INDOOR ENVIRONMENT OF ADIWASI ASHRAMSHALA,BRAMHAPURI DIST.CHANDRAPUR (MAHARASHTRA) INDIA

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ABSTRACT

The aim of this study was to determine fungal spore concentration in the indoor environment of Adiwasi ashramshala Bramhapuri dist. Chandrapur (Maharashtra) India and identification of dominant genera. The indoor places having organic substrate occurs more concentration of fungal propagules as compared to the outdoor environment. Meteorological parameters like temperature, humidit , rain fall and the availability of substrate affects fungal spore concentration . In the present study air samples were collected every month fortnightly from February 2023 to January 2024 by exposer Petri plate method and Hi air sampler method to determine monthly and seasonal variation in fungal spore concentration. The dominant genera of fungi found in Adiwasi Ashramshala were *Alternaria,Rhizopus, Mucor, Penicillium, Aspergillus, Chaetomium, Cladosporium, Fusarium andCurvularia* . Maximum fungal spore concentration was found in the month of August while minimum concentration was in the month May at different sections of sites. Comparatively the concentration of fungal spore varied in accordance with meteorological parameters of every month and availability of substrate at different sections of study area.

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[1]. They are heterotrophic on the basis of nutrition. Some fungi are parasitic, some are saprophytic usually having filamentous, devoid of chlorophyll and with chitinous cell wall. Aeromycoflora refers to airborne fungal contributors of the environment.[2][3]. The fungal spores are very light weight and buoyant thus having easy access to the indoor environment of various packed buildings[4]. Various indoor places are contaminated by fungi and their spores and also are emitted in the outdoor air. In particular indoor places, biotic as well as abiotic factors are affected by air borne fungal spores. Most of the fungi grows on dead decay organic matter called as substrate. In the indoor places having substrate and suitable environment fungal spores germinates to complete their life cycle and emits spores in indoor air. . 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 [5].

The grains in warehouses, food material in the kitchen of the schools,books in a library and other organic products are good substrate for the growth of fungi. 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 [6]. 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 concentration of fungi in the air. The concentration of fungal spore varies according to season and different environmentsof the indoor places [7]. So many aeromycological studies have been performed in different indoor places till now like, [6],[8],[9],[10],[11],[20],[21].

Adiwasi Ashramshala is a residential school located in Bramhapuri. The name of this school isAnudanit Madhyami v Uchh Madhyamik Ashramshala , Bramhapuri.There are three Sections selected for collection of air samples by exposer Petriplate method and Hi media air sampler method1.Kitchen area 2. Classroom area 3. Boy's hostel.

The aim of this study was the determination of fungal spore concentration, identification of dominant genera and impact of meteorological parameters on fungal growth and seasonal variation of fungal spore concentration inindoor environment of Adiwasi Ashramshala of Bramhapuri.The study of monthly and seasonal fluctuation pattern of airborne fungi is very helpfulin understanding proper diagnosis and treatment related to health problems [12].

Material and methods

Study Area

The present study was performed in Adiwasi Ashramshala of Bramhapuri dist. Chandrapur (Maharashtra) India located at latitude 20.6137968˚ and longitude 79.8713417 established in 1994.

Air Sampling

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

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 fortnightly before day of sampling in every month in packed Petri plate and then brought to Adiwasi Ashramshala to collect the air samples from the indoor environment of three sections. In Petri platemethod ,Petri plate were exposed for 8- 10 min to settle the fungal spores in Petri plate after that sealed these Petri plateand brought to the laboratory for incubation at room temperature for 4-6 days and observed the growth of fungal colonies.

Hi media air sampler mark II

Air samples were collected by Hi media air sampler mark II by using Rose Bengal Strips [13]. After going to sites Rose Bengal strip was loaded in air sampler and collected the air sample for five minuts from three sections of the Ashramshala. After that rose Bengal strip was removed from air sampler, sealed and brought to the 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

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

Result and Discussion

Throughout the year total fungal spore concentration in three sections of Adiwasi Ashramshala by exposer Petri plate method and Hi media air sampler method were found 1235 and 9075 CFUs/m³ respectively. The no of colonies captured by exposer Petri plate method in the kitchen area were 469 while in classroom area were 356 and in Boys hostel were 410 respectively. Whereas the total no of CFUs/m³ trapped by Hi media air sampler method in the kitchen area were 3410 while in theClassroom areawere2700 and in theBoys hostelwere2965 respectively. From the above study the maximum fungal spore concentration by exposer Petri plate method was found in the month of August 12.79% followed by September 12.14%, February 9.23%, October 9.06%, March 8.58%, November 8.34%,January 7.61%, December 7.53%, March 7.36%, July 6.47, June 5.58% and May 5.26%. Also by Hi air sampler method the maximum fungal spore concentration was found in the month of August 12.50% followed by July9.97%, September 9.69%, January 9.31%, October 9.20%, November 8.53%, February 8.42%, December8.20%, April 6.88%, March 6.55%, May 5.34% and June 4.22%. From the above data fungal spore concentration was highest in the month of August while the lowest concentration was found in the month of May. The meteorological parameters directly affect fungal growth, sporulation and dispersal [14].

In the present study aeromycospora showed seasonal variation by exposer Petri plate method. The Rainy season have highest fungal spore concentration 37.00% , followed bythe winterseason 32.55% while summer season has low concentration 30.44% by exposer Petri platemethod .Also by Hi air sampler method, the rainy season has highes concentration 36.19% followed by the winter season 35.26% while the summer season has low concentration 27.21%. This result was similar to previous study performed by [14], [15]. 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 the development of fungi. The correlation between fungal spore concentration and metrological parameter was reported [16]. 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 [7].

On the basis of the availability of substrate, the fungal spore concentration varied section to section. Maximum concentration was found in the kitchen area where food material is stored and cooked that enhanced the favorable condition for fungal growth. Mean concentration was found in Boys hostel. Minimum concentration was found in Classroom area where Organic material is very little. From the above study fungal spore concentrations were found in , 1.Kitchenarea , found by exposer Petri plate method and Hi air sampler method were469 and 3410 CFUs/m³ respectively.

2. Classroom area,found by exposer Petri plate method and Hi air sampler method were356 and 2700 CFUs/m³ respectively.
3. Boys hostel, found by exposerPetri plate method and Hi air sampler method 410 and 2965 CFUs/m³ respectively.

Airborne microbial quantity and quality vary with time of day, year, and location. The aeromycological survey of the indoor environment was carried out at different sites of Christanand hospital Bramhapuri and observed that the total fungal spore concentration and fungal type are varies in all the four sites of the Hospital. The number of fungal spores is maximum in O.P.D. followed by the general ward, Pathology laboratory and minimum in the Operation Theater[17].

During the investigation the dominant genera of fungi found in different three sections of Adiwasi Ashramshala 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., Alternaria Sp., Mucor, Curvularia, Fusarium , Rhizopus, Torula and Trichothecium. Aspergillus Sp., Penicillium Sp., Alternaria Sp. Are commonly observed in all four sites of Christanand Hospital Bramhapuri [17]. 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 plant epidemics [18].

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	302.07	49.0	98.3	76.3
October 2023	20.9	33.4	27.9	6.06	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 Adiwasi Ashramshala of Bramhapuri.

Season	Month	Total No of colonies in Kitchen Area	Total No of colonies in classroom area	Total No of colonies in Boys hostel	Total fortnightly	Toatal monthly	percentage	Seasonal percentage
Summer season	Feb 2023	24	16	18	58	114	9.23	30.44
		21	13	22	56			
	March 2023	22	19	20	61	106	8.58	
		16	12	17	45			
	April 2023	20	13	18	51	91	7.36	
		15	11	14	40			
	May 2023	14	12	12	38	65	5.26	
		11	07	09	27			
Rainy season	June 2023	12	11	11	34	69	5.58	37.00
		11	14	10	35			
	July 2023	13	12	14	39	80	6.47	
		16	13	12	41			
	August 2023	32	23	26	81	158	12.79	
		29	24	24	77			
	September 2023	24	22	21	67	150	12.14	
		30	26	27	83			
Winter season	October 2023	22	18	21	61	112	9.06	32.55
		20	14	17	51			
	November 2023	21	16	18	55	103	8.34	
		21	12	15	48			
	December 2023	18	13	15	46	93	7.53	
		20	10	17	47			
	January 2024	20	14	18	52	94	7.61	
		17	11	14	42			
	Total	**469**	**356**	**410**	**1235**	**1235**		

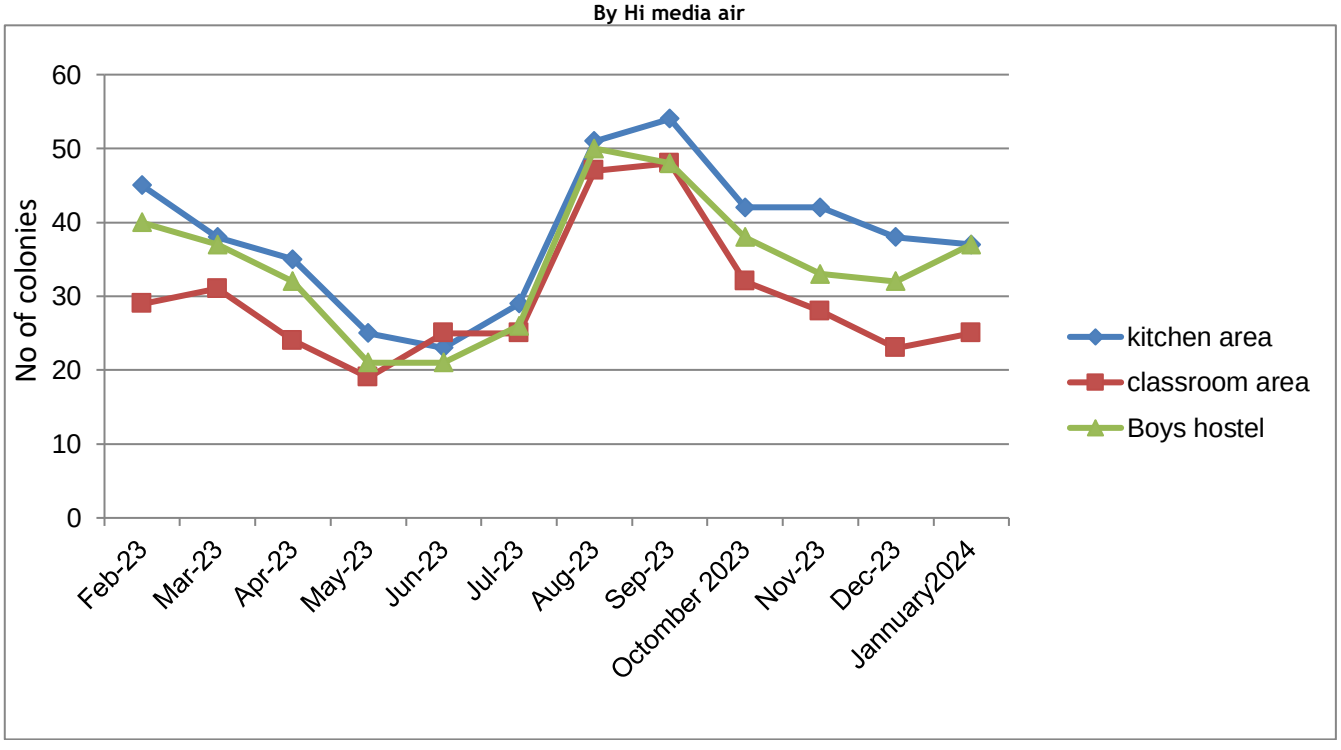
Table 3
Hi media air sampler method
Fungal spore concentration Observed from February 2023 to January 2024 in three different sections of Adiwasi Ashramshala of Bramhapuri.

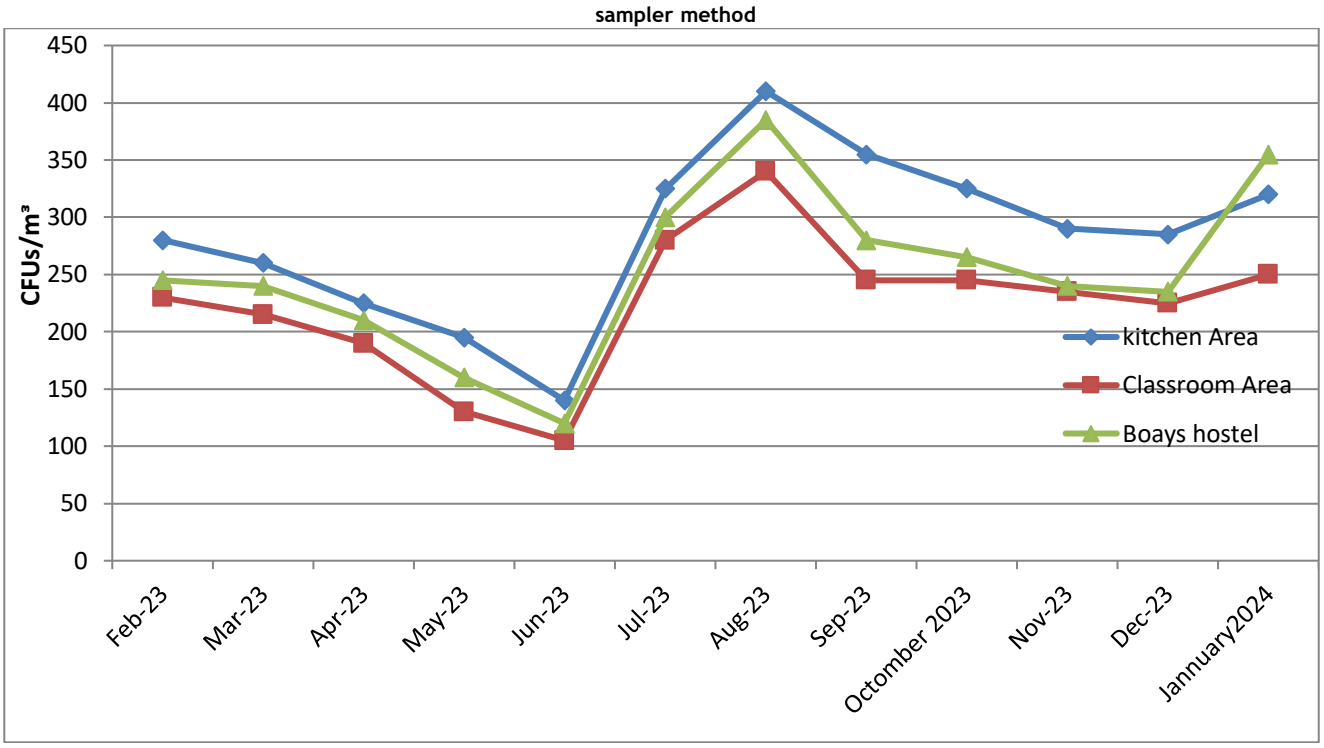
Season	Month	CFUs/m³in Kitchen Area	CFUs/m³ in classroom area	CFUs/m³ in Boys hostel	Total fortnightly	Toatal monthly	percentage	Seasonal percentage
Summer	Feb 2023	140	125	115	380	765	8.42	
		140	115	130	385			

season	March 2023	120	110	120	350	595	6.55	27.21
		140	105	120	245			
	April 2023	115	95	105	315	625	6.88	
		110	95	105	310			
	May 2023	90	55	80	225	485	5.34	
		105	75	80	260			
Rainy season	June 2023	65	45	50	160	365	4.22	36.19
		75	60	70	205			
	July 2023	175	145	155	475	905	9.97	
		150	135	145	430			
	August 2023	225	185	210	620	1135	12.50	
		185	155	175	515			
	September 2023	190	140	155	485	880	9.69	
		165	105	125	395			
Winter season	October 2023	165	135	145	445	835	9.20	35.26
		160	110	120	390			
	November 2023	135	120	125	380	775	8.53	
		155	115	125	395			
	December 2023	135	115	120	370	745	8.20	
		150	110	115	375			
	January 2024	175	135	150	460	845	9.31	
		145	115	125	385			
	Total	**3410**	**2700**	**2965**	**9075**	**9075**		

Monthly variation of fungal spore concentrationin three different sections of Adiwasi Ashramshala of Bramhapuri by Exposer petriplate method

By Hi media air





CONCLUSION

During the period of investigation, the analysis of data showed that there is no spore free period in theindoor environment of the school. The present study revealed that monthly variation .The maximum fungal spore concentration (158 and 1135 CFUs/m³) in the month of August by Petri plate methods and Hi media air sampler method. While the minimum fungal spore concentration (65) was found in the month of May byPetri plate methods and (365CFUs/m³) was found in the month of June by Hi media air sampler method. . The highest fungal spore concentration was found in Kitchen area where the favourable condition for fungal growth is present followed by Boys hostel while minimum fungal spore concentration was recorded in Classroom area where substrate is not present for the proliferation of fungi. The seasonal variation by Petri plate methods and Hi media air sampler method showed 37% and 36.19% fungal spore concentration inthe rainy season which is highest followed by the winter season (32.55% and 35.26%) .While thein summer season it was minimum with 30.44% and 27.31%. Fungal spore concentration varied seasonally as well as monthly according to meteorological parameters. The relative humidity and temperature directly affects the fungal spore concentration while rainfall plays an indirect role in affecting indoor temperature and relative humidity. Humidity more than 80% and average temperature between 25°C to 30°C provides best environment for the fungal growth. During this study the dominant genera of fungi found in Adiwasi Ashramshala were *Alternaria, Rhizopus, Mucor, Penicillium, Aspergillus, Chaetomium, Cladosporium, Fusarium andCurvularia*

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