SEASONAL ABUNDANCE OF AEROMYCOFLORA IN AND AROUND CHENNAI CITY

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ABSTRACT

'Biological pollutants' have major impact on atmospheric pollution. They arise from innumerable sources such as microbiological contamination, molds, human wastes, hides of animal, etc. Fungi plays fundamental ecological role to decide the condition of environment, as an important bio-pollutant and indicator, these fungi continuously release mycotoxins, the qualitative and quantitative blend of mycotoxins varies in all ecosystem including air, landfill and water. We assessed diversity of fungi in air of Chennai city, and correlated the abundance of different fungal species with seasonal changes. Sampling was done by settle plate method by using SDA medium. The obtained results were analyzed by using PAST 2.02 Package. In this present study south-west monsoon were reported with high number of colony forming units and high abundance of species of fungi, whereas summer season has been reported as high number of individual species, lowest fungal load recorded during north-east followed by winter.

Key Word's: Biological pollutants, mold, mycotoxins, ecosystem, diversity, abundance, SDA medium.

INTRODUCTION

Biological pollutants can be airborne and can have a significant impact on air quality (Gaikwad and Sonawane, 2012). Among several types of bio-pollutants, India accounts for 90% of airborne biota belonging to fungi. Spores of fungal are of the major types of microorganisms, can be present in all environmental, and may be transmitted through air (Beggs, 2003). Fungal spores, pollen grains, and some bacteria are among the most prevalent airborne particles which form the major components of our environment and also act as bio-pollutants, Rima *et al.,* (2012) correlated that the fungal concentration and the seasonal variation with human diseases from her study.

The survival time of microorganisms in bio-aerosol decreases at low contents of humidity and high UV radiation. Therefore, the number of microorganisms in the air fluctuates during the year. The impact of UV radiation on the airborne microbes is inversely proportional to dustiness of the air. Exposure to bio-aerosols, containing airborne microorganisms and their by-products, can result in respiratory disorders and other adverse health effects such as infections, hypersensitivity pneumonitis and toxic reactions (Gorny *et al*., 2002; Fracchia *et al*., 2006). Premila (2013) revealed that there exists seasonal variation of airborne spores correlates with meteorological factors and suggest the need for a long-term study on the spore loads present in the residential air, which might be helpful in apprehension of an outbreak of allergic diseases.

Fungi produce large number of spores which easily become airborne. The abundance of fungal spores increases depending on air pollution, thus constituting an important component in microbial aerosols. Nevertheless, fungal density in the air varies in accordance with the geographical diversification and seasonal changes, besides climatic parameters such as wind, humidity, temperature and precipitation, altitude and flora

combination may also affect the type and amount of fungi in the air (Asan *et al*., 2002). The presence of high concentration of airborne microorganisms within the environments results in the increasing concern with respect to many acute diseases, infections and allergies (Lugauska and Krikstaponis, 2004), and it is an indication of degree of cleanliness of these environment. Fungi can cause serious diseases in humans, several of which may be fatal if untreated.

In an environment the spores of molds may become airborne and are therefore ubiquitous. They can enter indoor areas either by means of passive ventilation or by means of ventilation systems. In many cases, normal flora is not harmful. Studies have shown that ambient fungal variations are associated with meteorological conditions (Ho *et al*., 2005). Trout and Levetin (2001) found that dry-air spora were more abundant in warmer climates, and the high humidity facilitated wet-air spora to release spores. Several studies have shown that the concentration of airborne fungi increase with other climate factors and air pollutants have been inconsistent (Hollins *et al*., 2004).

MATERIALS AND METHODS

Sample site:

The sampling was conducted in outdoor atmosphere at different places of Chennai Metropolitan City especially Coastal areas, Industrial areas and Residential places of the city from January 2012 to December 2012.

Sample collection:

The air samples were collected by settling plate culture method (Sampath Kumar *et al.*, 2013; Olugbue, 2013) using Saboraud Dextrose Agar (SDA) media. To avoid bacterial contamination, Chloramphenicol was added to the media (Sampath Kumar, 2014). The Petri dishes (9 cm-diameters) containing 20 ml selected media were exposed at 1 m height from ground level in at all the selected places for 30 min. Then the plates were taken into the laboratory and incubated at 28±2^{o}C for 5-7 days. Report from Metrological Department of Chennai City was collected to know the influence of weather condition on fungal growth.

Microbial examination:

The fungal colonies were enumerated after their growth on the plates. Identification of fungal colonies was made by visual and microscopic examinations. Identification up to generic level was done with the help of standard mycological books and manuals. Details regarding the qualitative nature of the mycoflora, their incidence, abundance and percentage contribution were recorded. The percentage contribution of each genus was calculated on the basis of the number of colonies of the genus against total number of colonies of all recorded genera.

Conversion of CFU: (Polish Standard PN 89/N-04008/08)

The colonies of individual organisms were converted to number/m3 of air by multiplying with a factor and calculated as follows and the counts are expressed as Colony Forming Units (CFU)/cubic meter of air (m3) according to equation.

$$CFU/m3 = a \times 1000/p \times t \times 0.2$$

The results are expressed as number of Colony Forming Units (CFUs) per unit time (Checklist of settling plates QU-04-0003-FRM; Rules and guidance for pharmaceutical manufacturers and distributors, 2002). The fungus from each location was identified using the Manual of Medically important fungi by Larone (2002) and Indoor mould isolation and identification by Udaya Prakash (2004) after staining and the photomicrography was prepared for further analysis.

Meteorological parameters:

Climatically parameters like temperature (°C), relative humidity (%), rainfall (mm) and wind speed (km/h) for all the sampling days were obtained for comparison of data from the Regional Meteorological Center, Government of India, Chennai. With the help of these parameters the Seasonal variation of different

fungal colonies were studied. According to the reports from Metrological Department of Chennai, Chennai climate was divided as winter, summer, southwest-monsoon and northeast-monsoon.

RESULTS AND DISCUSSION

According to statistical analysis (ANOVA), the Post Hoc tests for 'multiple comparisons' within the groups of colony count and during the monsoon period, it shows significance between all the groups, except in winter and northeast monsoon which indicates there is a similarity between these groups. The plotted graph clearly shows that there is a drop in colony count during winter and northeast monsoon (Fig - 1). Similarly report from Rajshahi by Ferdousi Begum *et al*., (2009) showed highest incidence during the 3rd and 4th seasons (May to October) in PDA medium and Analysis of variance showed significant ($F_{3, 89} = 3.977$; $P<0.05$) results in different seasons and in different fungi. Chao *et al*., (2003) reported that total airborne fungal concentrations varied significantly by season and have noted highest in summer and lowest in winter.

High numbers of colonies were observed during southwest monsoon and summer periods; this increase is because of the increase in temperature with combination of humidity (Fig – 1). Humidity helps the growth of fungi in the surroundings, but the temperature helps to release the spore in the air by freeing them from moisture. Due to this moisture free condition the fungal fragments were observed more numbers in such seasons.

Comparing the results of colony count verses monsoon against temperature, rainfall, wind speed and relative humidity it shows that the colony count is directly proportional to the temperature and indirectly proportional to the rainfall and humidity. The wind speed remained nearly the same in all monsoons. This can be seen in the Post Hoc test for wind speed where southwest monsoon has significant value against all other monsoon groups. The availability of sufficient humidity in the atmosphere the fungi may grow on almost all organic substances. Above the 70% relative humidity may be optimal for fungal growth in indoor. But from this study we have reported that whenever there is increase in relative humidity in outdoor environment above the 70%, it influences the colony number negatively. This difference could be due to the moisture condition which may arrest the free flow of the spore in outdoor air. Similarly, Post Hoc test for relative humidity has significant value for southwest and northeast monsoon against other groups. Summer and winter monsoon have no significance between each other which indicates the relative humidity remained nearly same for these monsoons. A negative mean difference for southwest monsoon and a positive mean difference for northeast monsoon indicate a fall and an increase in relative humidity respectively (Fig – 2).

Post Hoc test for rainfall shows winter and southwest monsoon has no significant variance in rainfall. A large mean difference values for northeast monsoon against other monsoon indicates a high rainfall in that season. Tamil Nadu received maximum rain from northeast monsoon (Courtesy report from Metrological Department of Chennai). Plot graph clearly showed that the values of temperature are significant values across the groups. Winter has negative mean difference against other groups indicating lowest temperatures and summer has positive mean difference against other groups indicating highest temperatures. Uddin (2005) reported that temperature and relative humidity is probably not so significant for aeromycoflora of jute fields but the incidence of aeromycoflora is inversely proportional to the total rainfall. These reported metrological factors can explain the significantly influence on the concentration of fungal spores. The effect of meteorological conditions on release, dispersal, deposition, and concentration of airborne fungal spores was previously reported by Millington (2005) and Levetin (2006).

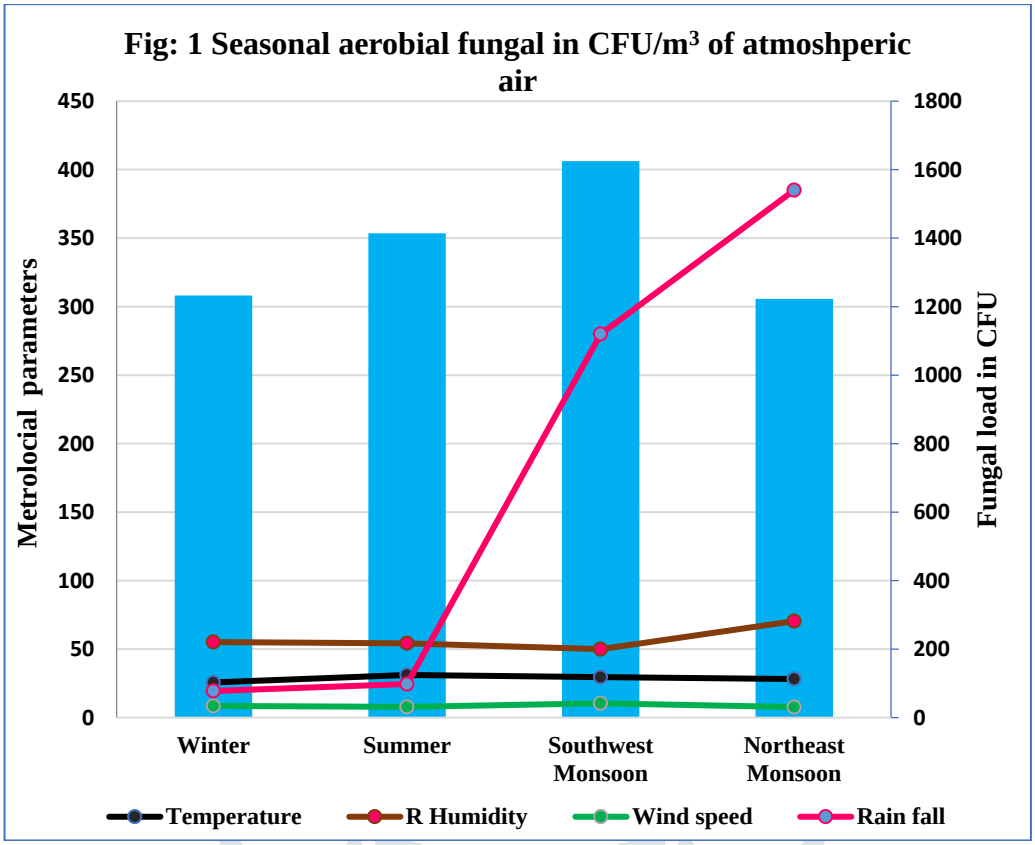
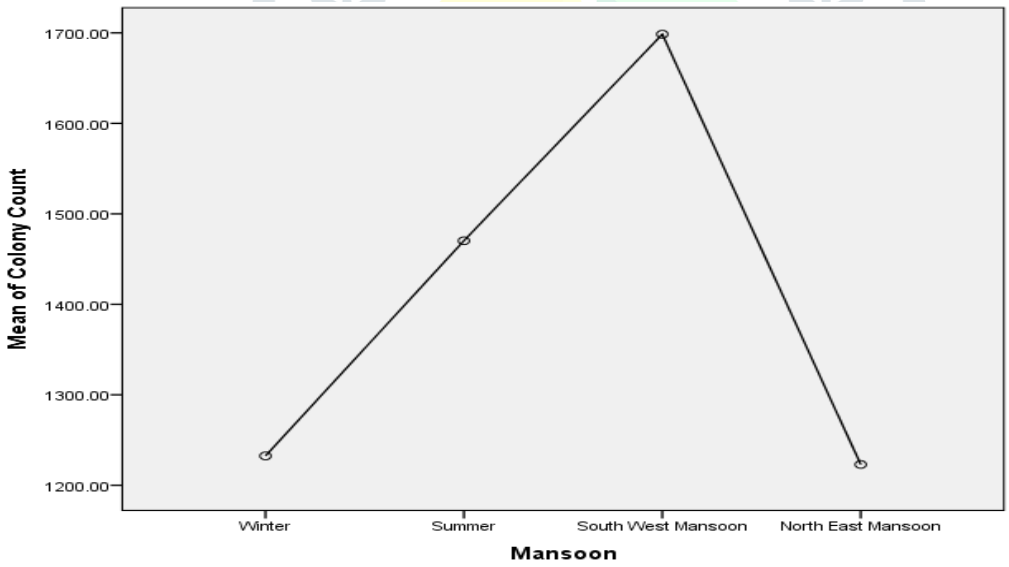


Fig: 2 Seasonal mean value of fungal colony count



Season wise species diversity, during the summer and south-east monsoon 41 species were recorded as highest, followed by winter (39 species), North-east monsoon with 37 species were recorded (Fig – 3). But the number of individuals from seasons is differs as fungal load for different species. The abundance of fungal population were recorded very high during southwest-monsoon with 1652 CFU/m3 of air by 30.2% contribution over other seasons, followed by summer (1470 CFU/m3) with the contribution of 26.14%, and the lowest number of colony forming units were recorded from northeast-monsoon (1223 CFU/m3) with 21.74% followed by winter (1232 CFU/m3) with 21.18% from the atmospheric air of Chennai city (Fig – 4).

Fig: 3 Seasonal distribution fungal species

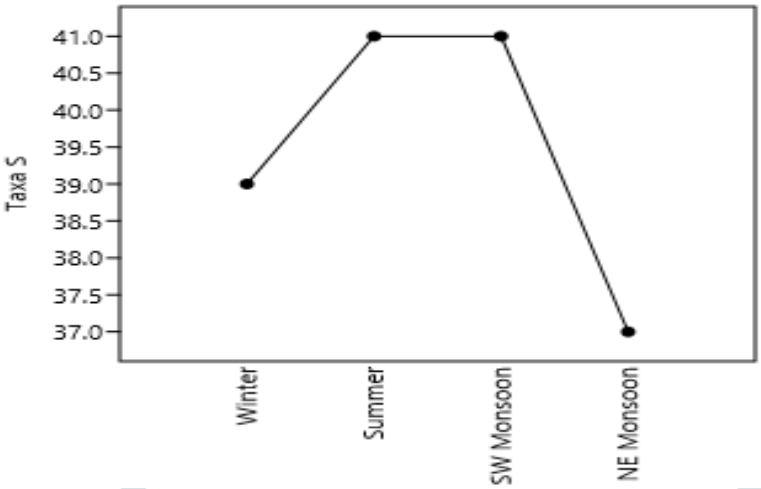
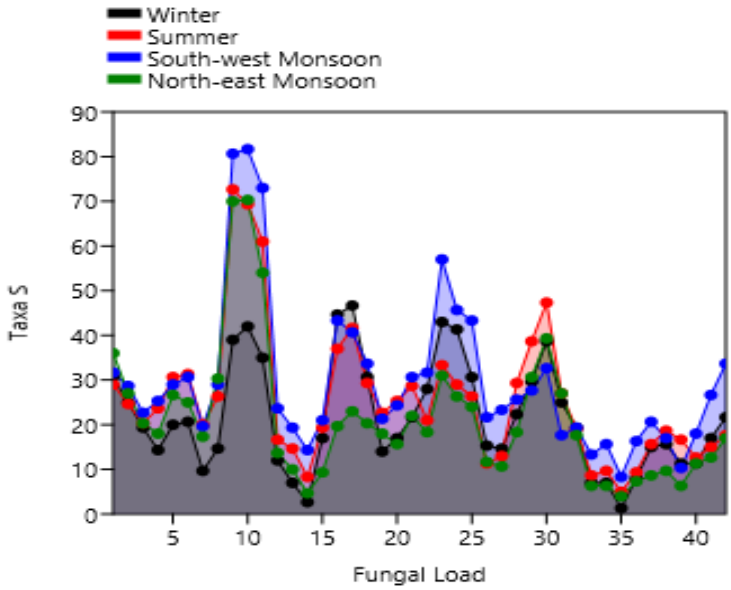


Fig: 4 Abundance of fungal species with seasonal distribution and diversity



CONCLUSION

Seasonal abundance of aerobial fungi from the atmospheric air of Chennai city were analyzed for the period of one year (Jan-Dec 2012). Fungal load and mold distribution showed significant influence by the climatical parameters like Temperature, Relative Humidity, Rain fall and Wind speed. This study indicates level of fungal load is **south-west monsoon > summer > winter > north-east monsoon**. The sudden lose in the fungal load during the North-east monsoon may be due to wash away of fungal spores from the atmospheric air by heavy rain. Biogenic aerosols including fungi are relevant for the earth system, climate and public health on local, regional and global scales. By knowing the period and allergic characteristic, one can prepare a personal calendar to avoid allergic diseases as well as metrological forecasting the weather conditions.

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