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# Quantitative assessment of air borne fungal spores during morning and evening in Ujjain City

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***Abstract:*** *Air borne fungal pollutants have been recognized as major allergens and they cause various health problems in humans. The concentration of fungal spore in is a result of complex interaction of biological materials with environmental factors. We have studied the variation in number of airborne fungal spores during different times of day in different seasons by Gravity plate method. The study was conducted in the indoor and outdoor areas of Sabzimandi in Freeganj Ujjain. Our results show that there is seasonal variation in load of fungal spores in air and quantity fungal spore in air during the evening are more than the quantity of air borne fungal spores in the morning.*

***Key words:*** *Fungal pollutants, allergens, time of day, airborne fungi, Gravity plate method.*

## I. Introduction

Airborne fungal spores are important allergens and about 20-30% of total world population is affected by different allergic problems, out of which 30% suffer from fungal spore induced allergy. There are about 15-20 million asthmatic patients in India and their number is increasing every day. Fungal spores are the causative agents of bronchial asthma, allergic rhinitis, allergic bronchopulmonary mycoses, hypersensitivity pneumonitis, and atopic dermatitis (Chakrabarti *et al.,* 2012; Ghosh *et al.,* 2010; Kurup *et al.,* 2000). Fungal spores are dispersed into the environment due to air currents, water, insects, animals and people and also play an important role in plant pathology. The concentration of fungal spores in air is not static, but varies as a result of time of day, geographic location, air pollution, weather conditions, human activity, local sources of vegetation etc.

Regular estimation of fungal spores in air can help in building spore calendars which may be used for improving treatment of respiratory allergic diseases and for more efficient and reliable application of pesticides (Ianovici *et al.,* 2013; Rodriquez-Rajo *et al.,*2005; Grinn-Gofron 2015). A study conducted in Israel over an entire year shows that the total fungal spore concentrations vary throughout the year although the species variability was nearly the same (Lang-Yona *et al.,* 2011). Aero microbiological study in Jordan was done by settle plate exposures and the results indicated variation in total fungal counts and species diversity in different seasons (Mohammed *et al.,* 2010). Airborne indoor and outdoor bacteria and fungi were assessed in different public and residential areas of Kuwait using open plate technique. In this study higher microbial counts were detected as the level of hygiene and standard of housing decreased (Yassin & Almouqatea, 2010). Microbial load of air near dumpsites was studied in Nigeria and it was found that there was significant difference between microbial load of various dumpsites, periods of sampling and distance of sampling sites (Igborbor & Ogu, 2015). Both within-day and within-season differences in fungal spores in air in residences have been observed and it was related to peak of human activity in houses in Finland (Hyvarinen *et al.,* 2001). The present study was undertaken to assess the variation of fungal load in air during morning and evening hours in different seasons in indoor and outdoor areas of Sabzimandi in Ujjain City. This study may help people to and plan their daily outdoor activities avoid health hazards.

## II. Materials and Methods

**1. Study Site:** The quantitative estimation of airborne fungi was done inside and outside the Sabjimandi area of Freeganj in Ujjain City. The sampling was done between morning 8.00 A.M. to 10.00 A.M. in the morning and 5.00 P.M. to 7 P.M in the evening. The sampling was done during summer season (April to June), rainy season (July to September) and winter season (November to February) in the year 2013-2014.

**2. Sampling Method:** Gravity plate method was used were sampling air borne fungi. Potato dextrose agar plates (supplemented with rose Bengal and chloramphenicol) were exposed for 5 minute, 10 minute and 15 minute about 2-3 feet about the ground. The plates were incubated 28±2$^{o}$C and cfu/ plate were counted after 28-48h of growth. The sampling was done in triplicate and average values were calculated.

## III. Results and Discussion

The sampling was done inside as well as outside the Sabjimandi which is centrally located crowded area of Ujjain City. The petri plates were exposed for 5, 10 and 15 minutes in morning as well as in the evening during different seasons of the year. It was seen that with increase in sampling time the number of cfu/ plate increases because more time is given for spores of fungi to settle on the plates (Fig. 1). The trend remains same in all the sampling so in this paper we are presenting the results of air sampling for 15 minutes. The results of outdoor and indoor air samplings during different seasons and at different times of day are shown in Fig. 2 and Fig. 3 respectively.

The results of the study show that cfu/ plate were always higher during evening sampling than the morning samplings (Fig.2 and Fig. 3). This could be because by the evening large amount vegetable waste gets accumulated which harbors large number of fungal spores and could increase the amount of fungal load in air during the evenings. The high fungal load in air during evenings can also be related to increase in number of visitors (or buyers) during the evening than the morning in Sabzimandi. The increase in human activity may cause more disturbance and lead to increase in fungal pollutants in air. The relationship between human activity and fungal load in air has been seen by other workers also (Hyvarinen *et al.,* 2001). The trend was same in outdoor as well as in indoor air samplings. Thus our study indicates that morning air is comparatively less polluted with fungal spores and can be ideal time for allergic patients for planning their daily activities in this area.

The fungal load in air also shows variation according to seasons. The highest number of cfu/ plate were found during summer season followed winter and by rainy season during outdoor air samplings in the evenings. The reason behind this can be that in summer season the wind velocity is high which helps in spore dispersal and dry season helps in release of spores (Chakrabarti *et al.,* 20012; Mehta *et al.,* 2013). Moreover, during summer season the numbers vegetable buyers are more in evening as compared to winter and rainy season. The same trend was seen in air sampling in cowshed in Bangalore (Pawan & Manjunath, 2014).

During the outdoor air samplings in morning the highest amount of fungal load in air was seen in summer followed by rainy and winter season. This could be because during chilly winters of the Ujjain, the number of vegetable buyers increases during morning in comparison to rainy season. Thus the weather conditions as well as human activity appear to affect fungal load in air.

The results of indoor air samplings show that during summer season the fungal spores in indoor air were less that outdoor air in the morning whereas there was increase in fungal spores in indoor air as compared to outdoor air in the evenings. This again points out that increased human activity is related to increase in fungal pollutants. During rainy and winter season the number of fungal spores in indoor air were always less than or equal to outdoor air. This indicates that indoor air is a representation of outdoor air and in order to decrease indoor fungal pollution we have to decrease waste dumping and organic solid waste accumulation in our cities.

The study also shows high amount of fungal pollutants in this area which indicates unclean unhygienic conditions. Hence, every effort should be made to remove waste and keep the area clean so that adverse affects on human health can be minimized (Igborbor & Ogu, 2015).

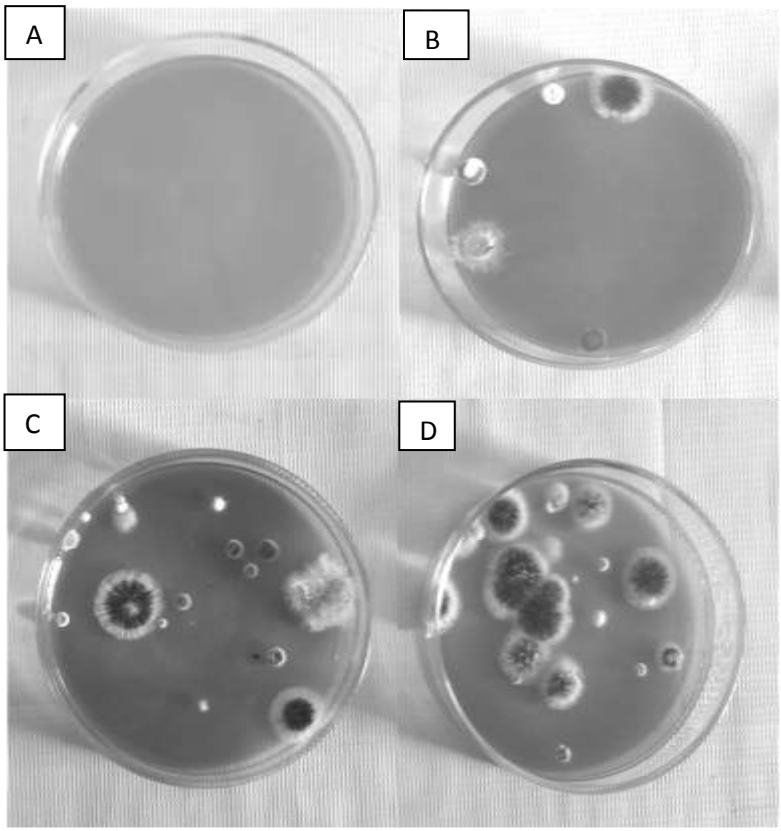


**Fig. 1**: Air sampling by Gravity Plate Method. (A) Unexposed control Petri plate, (B) Petri plate exposed for 5 minutes, (C) Petri plate exposed for 10 minutes, (D) Petri plate exposed for 15 minutes.

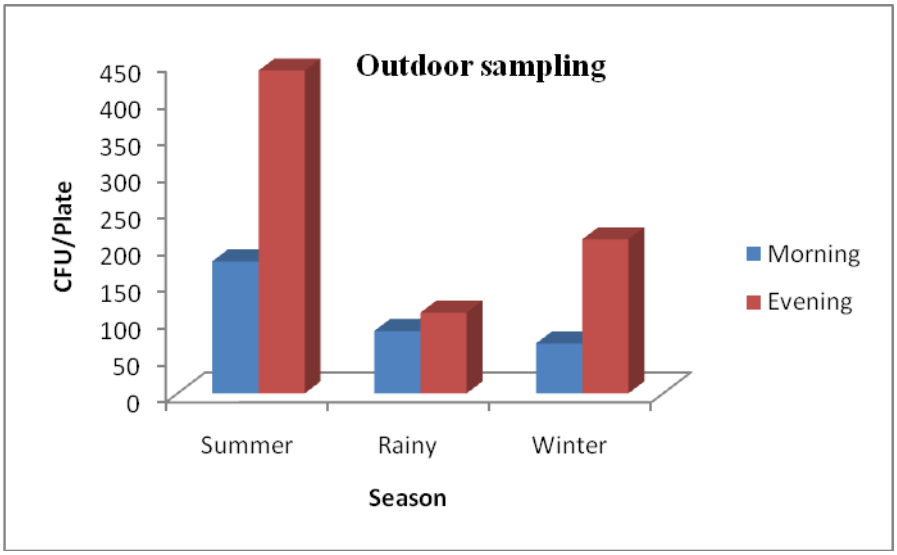


**Fig. 2:** Outdoor air sampling during different seasons and different times of the day.

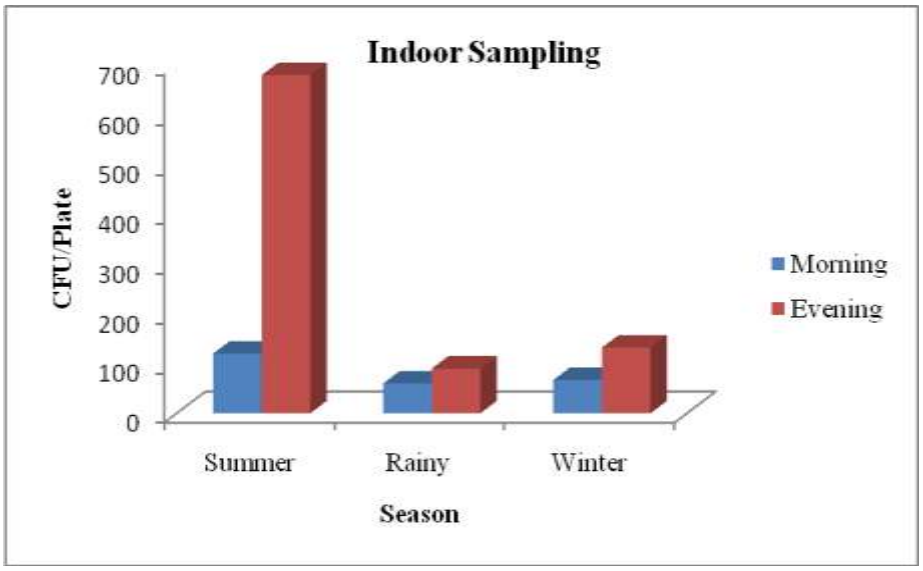


**Fig. 3:** Indoor air sampling during different seasons and different times of the day.

## IV. Conclusion

This study shows that Sabzimandi area of Ujjain City is highly polluted with airborne fungal spores. The fungal load is high in the evening as compared to morning. The fungal load in air varies according to seasons but it is highest in the evening hours during of summer season. The fungal load in indoor air is usually less than or equal to outdoor air except in the evening hours of summer season when excessive human activity leads to increase in indoor air borne fungal pollutants. This study suggests that asthmatic patients should plan their outdoor their activities in this area in the morning. Moreover, efforts should be made to keep the area and clean so that fungal load in air can be reduced and health hazards can be minimized.

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