

## **Assessment of fungal contamination present on RSPM/PM<sub>10</sub> and its association with human health.**

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### **Abstract**

Various health problems including symptoms and diseases are known to be associated with microbially contaminated air and can arise through inhalation of airborne fungal spores. The relationship between the viable air floating fungal contamination and the respirable particulate matter with aerodynamic diameter less than 10 µm (PM<sub>10</sub>) in the ambient air was studied. Samples were collected at each sampling period (10 sites in total) at residential, commercial cum traffic and Industrial sites in the city of Lucknow (Uttar Pradesh) during April, 2010 to June, 2011. The respirable dust sampler (Envirotech Model APM 460 NL) was used for the collection. 6 groups of fungi of environmental origin were detected on PM<sub>10</sub>. The concentration of airborne fungi was increased with increasing mass concentration of PM<sub>10</sub>.

**Keywords:** RSPM, PM<sub>10</sub>, urban traffic, inhalable particles, fungal contamination, health

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### **Introduction**

Airborne particles in the air that can be aspirated into the nose or mouth during normal breathing are known as "inhalable particles." Inhalability decreases gradually with increasing particle diameter, reaching a level of about 50 percent at 100 microns (µm). "Subfractions" of the inhalable fraction are the particles that can penetrate through the upper respiratory tract (head airways) and enter the thoracic airways (lower respiratory tract). The aerodynamic particle diameter for 50 percent penetration into the thorax is 10 µm, and air samplers that mimic this penetration are used to determine PM<sub>10</sub> (particulate matter of 10 micrometers [microns] or less in diameter), or thoracic particulate matter standards. Particulate matter is the term used to describe particles that are suspended in the air. Particles may be solid or liquid and are one of the most obvious forms of pollution as they are visible in the hazes that cover a city or region. Size is the main determinant of the behavior of an atmospheric particle. The size is usually in terms of the 'aerodynamic diameter' which refers to unit density of spherical particles with the same aero-

dynamic properties such as falling speed. Smaller particles (less than 10 µm, known as PM<sub>10</sub>) can remain in the air for several days and can be spread by winds over wide areas or long distances from the original source. These particles (PM<sub>10</sub>) are known as inhalable or breathable particles may penetrate deeply in the thoracic region of the lungs, where the toxic effect is most serious. They are generated by diesel and petrol motor vehicles and other combustion processes that burn fossil fuels such as power generation, industrial processes and domestic solid fuel heater. Various health problems, including respiratory symptoms and diseases, are known to be associated with microbially contaminated air and can arise, for example, through inhalation of airborne fungal spores. Major concerns for human health from exposure to PM<sub>10</sub> include: effect on breathing and respiratory system damage to lung tissue, cancer and premature death. Biological particles like bacteria, fungi and pollen are a part of the particle load found in indoor and outdoor air. Fungal spores commonly called mold spores are a normal component of the outdoor air. They are present in the atmosphere any-time that the ground is not covered with ice or snow. The spores are discharged from fungi growing as saprophytes

## Fungal contamination and RSPM.

(existing on dead or decaying organic matter in the soil or elsewhere in the environment) or parasites (infecting living tissues - most are plant pathogens). Many fungal spores (possibly all) are allergenic, capable of causing allergic responses in susceptible individuals. A small group of fungi are also human pathogens. While many human pathogens just cause mild or annoying conditions, such as athlete's foot and ringworm, other human pathogens can cause severe and debilitating diseases. Air borne microbes, allergens and chemicals cause respiratory disease, inflammation in the nose, throat, sinuses, upperway & the lung. The best way to utilize this study guide is to understand the characteristics by description & be familiar with the visual representation of the fungus on RSPM [1]. Some biological contaminants trigger allergic reactions, including hypersensitivity pneumonitis, allergic rhinitis and some type of asthma [2, 3, 4]. These contaminants may irritate the skin of humans & contribute to symptoms, such as, headache, fatigue, eye and/or nose and/or throat irritation [2]. Many infections are acquired by inhalation of pathogens that may remain in the respiratory system but also invade the rest of the body through lymphatic and blood circulation. This study therefore aimed to investigate identifies the fungal contamination present on respirable suspended particulate matter (RSPM/PM<sub>10</sub>) in urban areas of Lucknow.

## Material and Methods

Ten locations air samples (for fungal) were collected and analyzed. The maximum microbial load was in Aminabad whose optical density at 600 nm was 1.903. Indian Institute of Toxicology Research, Lucknow has set up air monitoring station network at 10 sites and 24 hours continuous air monitoring for PM<sub>10</sub> was carried out. The nature of ten monitoring sites represent residential areas (Ali

ganj, Vikas Nagar, Indira Nagar, Gomti Nagar); Commercial areas (Hussainganj, Charbagh, Alambagh, Aminabad, Chowk); and Industrial area (Amausi). Outdoor air PM<sub>10</sub> samples were collected from the respirable dust sampler (Envirotech Model APM 460 NL). It was installed at a height of 4 ft above ground level at each sampling site. Samplers were operated round the clock (24 h) with a replacement of fresh filter every 8 hrs for PM<sub>10</sub> glass fibre filter (EPAM-2000, size 8\*10 inches) was used weighed on 5 digit digital balance before & after sampling. The weight difference of filters between pre & post sampling was used to calculate the mass of particulate matter. Samples were collected from ten PM<sub>10</sub> glass filters on sterile swabs & were inoculated separately in liquid broth (Robertson Cooked Media). Fungi specimens were inoculated on Sabouraud 2% dextrose agar [5] and were incubated for 7-21 days at 25<sup>0</sup> C with daily observation. They were isolated & identified by cultural characteristics like different growth of rate & appearance of growth, pigment production, morphology like hyphae, branching pattern & structure of asexual spores.

## Results

Ten sterile swabs sticks are touched on PM<sub>10</sub> glass filters are immersed in the liquid media (Robertson Cooked Media) and keep it in the incubator for 72 hours at 37° C for the growth of bacteria. After 72 hrs the samples are taken out and O.D. is taken at 600 nm of each sample with the help of spectrophotometer. The maximum O.D. was found in spectrophotometer at commercial cum traffic area i.e., at aminabad followed by gomti nagar. 6 groups of fungi of environmental origin were detected on PM<sub>10</sub>. Fungi i.e., *Epicoccum*, *Chaetomium*, *Chyrosporium spp.*, *Aspergillus fumigatus* & *Aspergillus tereus*, *Philaphora verrucosa* were found on PM<sub>10</sub> (Table 1).

**Table 1.** Fungal contamination present on RSPM/PM<sub>10</sub>

Location	Source/Place	OD at A <sub>600</sub> (nm)	Fungal Study
			Sabr. Media
Residential	Aliganj	0.455	Chaetomium
	Vikas Nagar	1.064	Chaetomium
	Indira Nagar	0.446	Epicoccum
	Gomti Nagar	1.505	Aspergillus tereus
	Aminabad	1.903	Aspergillus fumigates
Commercial cum traffic	Hussainganj	1.166	Aspergillus fumigates
	Chowk	0558	Chyrosporium spp.
	Alambagh	1.069	Aspergillus tereus
	Charbagh	0.500	Philaphora verrucosa; Chaetomium
Industrial	Amausi	0.430	No growth
Sample without Innoculum		0.112	No growth

## Discussion

The objective of this study is to show the association of PM<sub>10</sub> and microbial pollutants and their affect on human respiratory health. We have shown that the microbes that are present on inhalable particles i.e., PM<sub>10</sub>/RSPM are responsible for various adverse affects on human health. Air pollution is commonly perceived as an urban problem associated with motor vehicles and industries. Deteriorating air quality is a major environmental problem in many large urban areas

in both developed and developing countries. *Phialophora verrucosa* is the principal causative agent of chromoblastomycosis in tropical and subtropical areas, particularly at Japan and South America. The health effects of biomass smoke inhalation may not be restricted to the lungs because biomass smoke contains fine and ultrafine particles [6] that readily cross the alveolar-capillary barrier and reach vital organs of the body through circulation (7). Motor vehicle exhausts also produce particulate matter (PM<sub>10</sub>) in outdoor air [8,9,10]. A previous study showed particulate levels correlated with aerosols levels because the dust had microbes attached [11]. A study in Korea found four airborne fungi: *Fussarium* spp., *Aspergillus* spp, *Penicillium* spp, and *Basipetospora* spp [12]. These may affect human health, especially traffic police and street venders, who spend most of the working time in high density traffic areas. When inhaled in sufficient concentrations they tend to produce acute neutrophilic airway inflammation associated with symptoms consisting of cough, bronchorrhea, dyspnea and wheezing [13]. Airborne microbes, allergens and chemicals cause respiratory disease, inflammation in the nose, throat, sinuses, upper airway and the lung. Many infections are acquired by inhalation of pathogens that may remain in the respiratory system but also invade the rest of the body through lymphatic and blood circulation [14].

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