

## AIRBORNE FUNGI ISOLATED FROM INDUSTRIAL SECTOR OF DAVANGERE CITY, STATE OF KARNATAKA, INDIA

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**Abstract.** *Aeromycological sampling during 2011 and 2012 industrial sector of Davanagere city in the atmosphere, showed a greater presence of spores. Airborne fungi are considered important causes of allergic rhinitis and allergic asthma. The knowledge of these fungi in a city or region is important for the ecological diagnosis and specific treatment of allergic manifestations induced by inhalation of fungal allergens. The airborne fungi of Davanagere City State of Karnataka, India, were studied during a one year period. Four hundred and twenty four Petri dishes with Sabouraud dextrose agar were exposed at eight different locations in the city. The dishes exposed yielded Two sixty three colonies of eight genera. The most predominant were: Aspergillus (61.21%), Penicillium (16.73%) Cladosporium (3.42%), Fusarium (2.66%), Rhizopus (2.66 %), Alternaria (4.18 %), Mucor (1.14%), Epicoccum (0.76 %), Verticillium (0.38%) Geotrichum (0.76%) Trichoderma (0.76%) and Phoma (1.52%) The results shown that Aspergillus, Penicillium, Cladosporium and Fusarium species are found to all months of the year. Anemophilous fungi and the high concentration of spores in the air are important because may result in an increased number of people with allergic respiratory disease.*

**Keywords:** *airborne fungi; allergic respiratory disease; fungal allergens, industrial sector.*

### 1. INTRODUCTION

Among the wide variety of biological particles present in the atmosphere, there is a very significant number of fungal spores. Fungi live as saprophytes on organic material or as parasites (mainly plant pathogens), so the majority of fungal spores in the air outdoors come from farms, forest stands and decomposing plant matter solid waste site, rice puffed industries. The intensity of fungi spores increases depending on air pollution Nevertheless, fungal density in the air varies in accordance with geographical region and seasons. Besides, climatic parameters such as wind, humidity, temperature and precipitation, and altitude and flora combination may also affect the type and amount of fungi in the air [2-6]. There are multi-thousands of recognized species of fungi. They are found in soil, in water, on animals, on vegetation, in humans, and in almost every part of the environment. Anemophilous fungi

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are spread by the atmospheric air [3]. Fungal spores are always present in the air, with rain and snow washing down most if not all spores from the air, and sunshine and wind cause an increase in the atmospheric distribution of such spores [1]. Fungi are eukaryotic, filamentous and mostly spore-bearing organisms, which exist as saprophytes or as parasites of animals and plants. The development of allergies to fungi follows the same biological phenomena as allergies to other environmental allergens. Fungal spores are ubiquitous and the number of fungal species present in the environment is estimated to be at least one million. Some genera of airborne fungal spores such as *Alternaria*, *Aspergillus* and *Cladosporium* are found throughout the world. The airborne spores of these fungi are generally considered to be important causes of both allergic rhinitis and allergic asthma. Qualitative and quantitative knowledge of these fungi in a given region is of great importance and concerns because they can cause several respiratory diseases in man such as asthma and rhinitis when inhaled [4]. Due to increasing awareness of the relationship of airborne fungi to allergy in patients suffering from asthma and rhinitis, many scientists and allergists began to study the presence and type of fungal spores in both indoor and outdoor air, using various collection methods. The most common procedure involves the use of microscope slide coated with petroleum jelly or silicone that is exposed to air for 24 hours. The fungal spores collected (as well as the pollens) are counted by the aid of microscope. To aid in identification of fungi, the culture plate exposure method (gravity method) was adopted routinely to study the number and type of fungi in the air [1]. Although certain genera of fungi are common in urban areas, those that are specific to cities or regions may be important in terms of epidemiology and therapeutics. The main purpose of this study was to determine the prevalence and seasonal variation of anemophilous fungi in the atmospheric air of industrial sector of Davangere city – Karnataka, in order to contribute to the knowledge of diversity of airborne fungi and distribution in the region.

## 2. MATERIALS AND METHODS

Industrial sector of Davanagere district in the State of Karnataka, India, at coordinates.14°30'25"N 75°48'00"E. Davangere climate is tropical semi dry, with an average annual temperature between 23 °C and 28 °C. Typically, there are three seasons, a rainy, winter and a dry. The rainy season extends from June to October with slightly lower temperatures. During the rainy season of the year of study, the following averages were recorded: precipitation, 108.20 millimeters; relative humidity, 84.5 %; wind velocity, 53.8 kph and temperature, 25.20 °C. During the dry season, which extends from January to May, the following averages were recorded: rainfall, 24 millimeters; relative humidity, 61.2 %; wind velocity, 65.2 kph and temperature 26.58 °C.

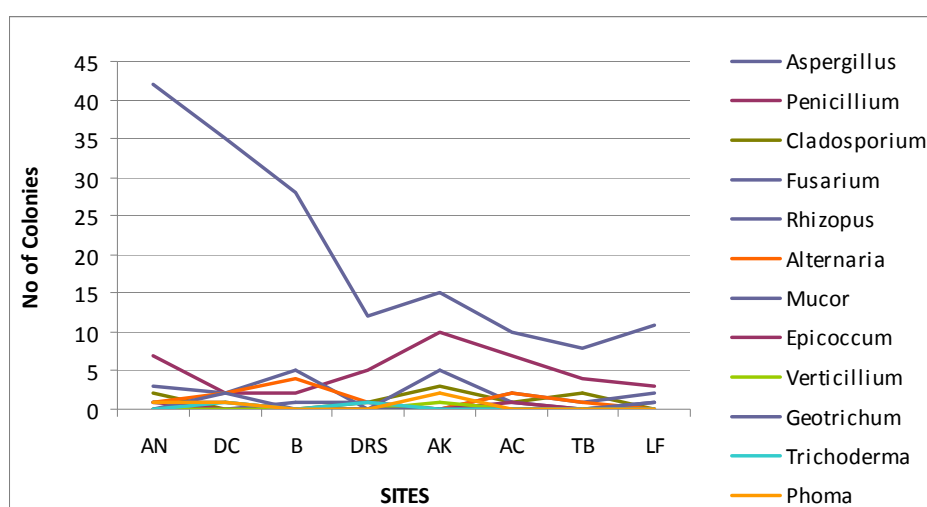
Eight locations of the city were selected for data collection: Azada nagar, (AN) Davangere City (DC), Bathi (B), Davangere railway station (DRS), A.K.Colony (AK), Ayyappa colony (AC), Tunga Bhadra river basin (TB), Lakshmi Foundary (LF),. Every month during the year of 2011 (January to December), samples were collected using Petri dishes containing a medium of Sabouraud dextrose agar. With the exception of rainy days, these were exposed to the air for 15 minutes, at 6 meters above the ground. Exposed petriplate is incubated in 28°C for 5 days, after incubation colony is counted by colony counter and colonies were isolated in the same medium for 7 days at ambient temperature for observation of formation micro colonies and identification of fungal species.

### 3. RESULTS AND DISCUSSION

The 424 dishes exposed yielded 263 colonies of 08 fungi. Table 1 shows the number of the colonies and frequency of each fungal genus in the city of Davangere and the eight collection sites. The ten most frequent airborne fungi isolated were: *Aspergillus* (61.21%), *Penicillium* (16.73%), *Cladosporium* (3.42%), *Fusarium* (2.66%), *Rhizopus* (2.66%), *Alternaria* (4.18%), *Mucor* (1.14%), *Epicoccum* (0.76%), *Verticillium* (0.38%) *Geotrichum* (0.76%) *Trichoderma* (0.76%) and *Phoma* (1.52%) In this work was verified that the *Aspergillus* is the genus most frequent with a half of airborne fungi colonies isolated in Davangere city (61.21%). In this study *Verticillium* was isolated only in A.K.Colony (AK), and *Geotrichum* only in Davangere City (DC). *Trichoderma* was isolated in Davangere City (DC) and Davangere railway station (DRS), *Phoma* in Azad Nagar (AN), and Davangere City (DC), *Epicoccum* in Azad Nagar (AN) and Ayyappa colony (AC), *Mucor* in Bathi (B), Davangere railway station (DRS), and Lakshmi Foundary (LF).

**Table 1. Number of colonies and geographic distribution of different airborne fungal genera Isolated in the city of Davangere at Eight different sites SITES.**

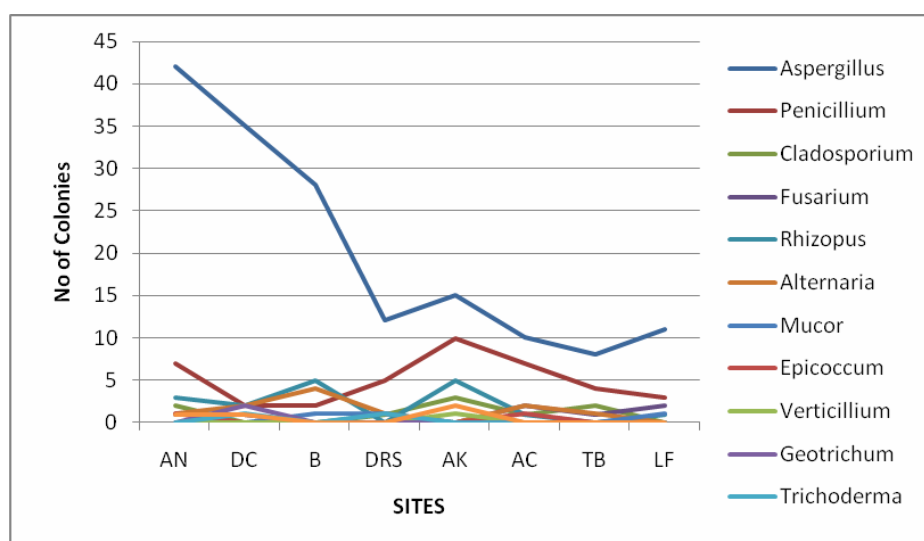
FUNGI	AN	DC	B	DRS	AK	AC	TB	LF	No. of colonies	%
<i>Aspergillus</i>	42	35	28	12	15	10	08	11	161	61.21
<i>Penicillium</i>	07	02	02	05	10	07	04	03	44	16.73
<i>Cladosporium</i>	02	00	00	01	03	01	02	00	09	3.42
<i>Fusarium</i>	01	01	00	00	00	02	01	02	7	2.66
<i>Rhizopus</i>	03	02	05	00	05	01	00	01	17	6.46
<i>Alternaria</i>	01	02	04	01	00	02	01	00	11	4.18
<i>Mucor</i>	00	00	01	01	00	00	00	01	3	1.14
<i>Epicoccum</i>	01	00	00	00	00	01	00	00	2	0.76
<i>Verticillium</i>	00	00	00	00	01	00	00	00	1	0.38
<i>Geotrichum</i>	00	02	00	00	00	00	00	00	2	0.76
<i>Trichoderma</i>	00	01	00	01	00	00	00	00	2	0.76
<i>Phoma</i>	01	01	00	00	02	00	00	00	4	1.52
<i>Total</i>	58	46	40	21	36	24	16	18	263	



**Fig. 1. Number of colonies and geographic distribution of different airborne fungal genera Isolated in the city of Davangere at Eight different sites**

**Table 2. Monthly distribution and number of colonies of airborne fungi isolated in Davangere city.**

FUNGI	MONTHS											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
<i>Aspergillus</i>	46	31	25	16	10	12	10	6	2	0	1	2
<i>Penicillium</i>	21	9	7	1	0	0	2	1	1	0	0	1
<i>Cladosporium</i>	0	1	2	1	0	0	0	2	1	1	0	1
<i>Fusarium</i>	1	0	1	0	3	0	0	1	0	0	1	0
<i>Rhizopus</i>	3	1	2	0	1	0	1	4	2	1	1	1
<i>Alternaria</i>	0	3	1	1	1	1	0	0	0	1	2	1
<i>Mucor</i>	1	0	0	0	1	0	0	0	1	0	0	0
<i>Epicoccum</i>	0	0	0	0	0	0	0	0	0	1	0	1
<i>Verticillium</i>	0	0	0	1	0	0	0	0	0	0	0	0
<i>Geotrichum</i>	0	0	0	0	0	1	0	0	1	0	0	0
<i>Trichoderma</i>	0	0	1	0	0	0	1	0	0	0	0	0
<i>Phoma</i>	0	1	0	1	0	0	0	1	0	0	1	0
<b>Total</b>	<b>72</b>	<b>46</b>	<b>39</b>	<b>21</b>	<b>16</b>	<b>14</b>	<b>14</b>	<b>15</b>	<b>8</b>	<b>3</b>	<b>6</b>	<b>6</b>

**Fig. 2. The monthly distribution of each genus.**

The most frequent airborne fungi, *Aspergillus*, *Penicillium*, *Cladosporium*, *Fusarium*, *Rhizopus* and *Alternaria* were found all months of the year. *Mucor* was more frequent during dry season. *Verticillium* were isolated only in April. *Geotrichum* and *Trichoderma* were isolated in June, September, March and July. *Epicoccum* only in October and December. The remaining genera were randomly present throughout the year. Because of the climatic differences it becomes difficult to make seasonal comparison of the fungal genera common to different regions [5].

Reports and surveys of airborne fungi from all parts of the world appear in the literature. Among the airborne fungi that spread air spores and are important aeroallergens in the world are *Aspergillus*, *Cladosporium*, *Alternaria*, *Penicillium* and others. These data are similar to those found in our work. The 424 Petri dishes exposed yielded 263 colonies of 12 fungi and the airborne fungi predominant in the air of the Davangere city were: *Aspergillus* (61.21%), *Penicillium* (16.73%), *Cladosporium* (3.42%), *Fusarium* (2.66%), *Rhizopus* (2.66%), *Alternaria* (4.18%), *Mucor* (1.14%), *Epicoccum* (0.76%), *Verticillium* (0.38%), *Geotrichum* (0.76%), *Trichoderma* (0.76%) and *Phoma* (1.52%) (Table 1).

Fungal spores are especially important in the tropics, in which climatic conditions are very favorable to the growth of fungi and may result in a high concentration of spores in the air, which in turn causes an increased incidence of allergic diseases. In several countries *Penicillium* and *Aspergillus* had the higher concentration of spores, as in our study. In our study, we found that the airborne fungi of Davangere city, Karnataka state, air pollution caused by milk processing industries, rice puff industries, and sugar factories among others, was composed by 5 common, 2 rare and two constant fungal species, among the obtained fungi, related to plant diseases and associated to respiratory allergy and plant pathogens. Our work found fungi associated to allergic, plant pathogens and respiratory disease. The genera most frequently found in Davangere were the same identified in other cities of Karnataka. *Aspergillus*, *Penicillium*, *Cladosporium*, *Fusarium*, *Rhizopus*, *Alternaria*, *Mucor*, *Epicoccum*, *Verticillium*, *Geotrichum*, *Trichoderma*, *Phoma*. The continuous presence of spores of genera *Aspergillus*, *Penicillium*, *Cladosporium* and *Mucor* alerts physicians to the importance of continuously monitoring patients with allergies for these fungi.

Davanagere and Harihara are close and climatically identical cities. *Aspergillus* and *Penicillium* were more frequent in Davanagere and Harihara. *Epicoccum* appears with most frequency only in Davanagere. *Rhizopus* and *Mucor* is common in the three cities. In our study, 263 colonies of airborne fungi were detected and identified. Months from January through July, with optimum temperatures, showed a higher incidence of fungal spores with 223 colonies of the airborne fungi, and a lower incidence during the months of September (8 colonies) October (3 colonies) November (6 colonies) December (6 colonies) (Table 2). In the collections in Azad Nagar (AN) the greatest number of the airborne fungi genera was isolated (Table 1). Azad Nagar is, an industrial region, nearly, presents a high level of air pollution. In Tunga Bhadra river (TB) was isolated a smaller number of airborne fungi, these results suggesting the existence of pollutants that inhibit the sporulation of the fungi. Therefore, the absence of significant differences in the number of colonies of fungi among the Eight collection sites in Davanagere suggests low and homogeneous level of air pollution. This is probably linked to the small number of industries in the city and the fact that the existing ones are of the non-polluting types.

#### 4. CONCLUSIONS

Fungal spores are ubiquitous constituents of both indoor and outdoor air samples. Some genera of airborne fungal spores such as *Alternaria* and *Cladosporium* are found throughout most of the world. Spores are generally considered to be important causes of both allergic rhinitis and allergic asthma; mould allergy, however, is the least understood and studied of the major forms of inhalant allergy. In order to diagnose the presence of airborne fungi, several qualitative and quantitative techniques are used depending on the study place; in our study the airborne fungi spores were performed by the Petri plate exposure method.

The occurrence of the great number of the allergenic fungal emphasizes the importance of the study of airborne fungi in Davanagere. Fungal spores are especially important in the tropics, in which climate conditions are very favorable to the growth of fungi and may result in a high concentration of spores in the air, which in turn causes an increased incidence of allergic respiratory diseases.

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