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Airborne Allergenic Fungal Spores of Jhajjar District, Haryana, India

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ABSTRACT

Airborne fungal spores are important bioparticles that are the leading cause of allergic reactions in humans. Therefore, weather information and in which month the maximum number of fungal spores are found are all beneficial in treating fungal allergy patients. Keeping all these in mind, an aerial survey was conducted in Jhajjar City for one year (August 2020 to July 2021). We used a volumetric Petri plate and a Durham gravity sampler. A total of 39 fungal spore were detected during the whole year. In which 30 genera were viable and Non-viable fungal spores. The highest concentration of *Cladosporium* spp. (26.18%) of recorded was followed by *Aspergillus niger* (11.61%), *Alternaria* (9.98%), *Epicoccum* (8.93%), and *Candida albicans* (8.20%). A total of ten Fungi were recorded in the highest concentration.

Key words: *Allergenicity, Durham gravity sampler, Cladosporium, Epicoccum*

Introduction

Fungi are diverse organisms found in ecological niches. Fungi have the ability to be both ubiquitous and cosmopolitan, and they may grow on any environmental substance (Kumar *et al*., 2022). The local weather, particularly in an outdoor area, has a significant impact on the growth of airborne fungus spores. Weather conditions have an impact on both the biology and dispersal of fungus spores (Chakraborty *et al*., 2021; Kunjam *et al*., 2021). Fungi produce spores in large amounts. These spores cause fungal allergies. Allergy-causing particles are known as allergens. According to other research, major allergies induced in the respiratory tract (nearly 80 genera) and human and animal infections (about 100 species) are other causes of plant infections. Significant allergens are fungal spores, which cause respiratory allergies and infect the lungs and alveoli. Fungal spore diversity depends upon vegetation and anthropogenic activities. Different factors such as air, temperature, precipitation, wind speed, and humidity affect spore release-fungi involved- *Cladosporium*, *Alternaria*, *Penicillium*, *Aspergillus*, Smut, and rust. Because these problems arise in susceptible individuals such as "hypersensitivity, associated Bronchial asthma, allergic rhinitis, allergic bronchopulmonary mycoses, hypersensitive twitch pneumonitis, and atopic dermatitis". The higher the airborne concentrations of fungal spread, the more critical the diagnosis and medical management of the allergic disease are to have a comprehensive knowledge of susceptibility to fungal allergens. Chakrabarti *et al*., 2012; Sanjeeta Kochar *et al*., 2014). There isn't much literature from the northern Indian state of Haryana, which is not known for its prevalence of aeroallergens. The present paper introduces the aeromycological survey in the Jhajjar area of Haryana, India. In the present paper, we discuss the isolation and identification of airborne fun-

gal spores with seasonal variation.

Materials and Methods

Aerial Investigation

Haryana's Jhajjar district is between 28^0 22'and28^0 49' North latitudes and 76^0 18'and76^0 59' East longitudes. The district is located in the state of Haryana's south-eastern region.

Aeromycological studies were carried out at a fixed location for one year (August 2020 to July 2021) at human height (1.8 m) to determine the predominant airborne fungi in the environment of the Jhajjar area and agreed that sampling had taken place at a set location. For the research, two volumetric samplers and one gravity sampler were examined. Plates were opened for 10 min at human height (1 m above foot level, which is approximately the human breathing zone); for one week, samples were taken to the mycology laboratory in triplicate and cultured at room temperature 28–31 °C.

This fungus was identified using cultural and physical characteristics and comparisons with fixed specimens of other species in relevant publications (Sanjeeta Kochar *et al*., 2014) Measured the number of colonies/m^3 of air tested in colony-forming units (CFU).

Meteorological parameters

Meteorological data were collected from the site near Jhajjar station. We conducted meteorological data from the IMD (India Meteorological Department) station near Jhajjar, India. Includes average, maximum and minimum temperatures; relative humidity; dew point, and wind speed.

Results

Airborne Fungal Spectrum

The present investigation identified 39 fungal kinds, comprising 30 genera of viable/ culturable and non-viable/non-culturable fungal spores, and 31 identified viable fungal spores in Table 1. *Cladosporium* fungus has the most significant proportion (26.18%) of all fungi among the total viable fungal kinds known, followed by *Aspergillus niger* (11.61%), *Alternaria* (9.98%), *Epicoccum* (8.93%), *Candida albicans* (8.20%), *Rhizopus* (6.30%), *Ulocladium* (6.04%), *Fusarium* (5.89%), *A. fumigatus* (5.83%), *Curvularia* (2.62%). Fungi, excluding these fungi, accounted for less than 2% of the total fungal airspora. The viable spore was 1902 CFU/m^3, as given in Table 2.

Table 1. Total identified airborne fungal spore

S. No.	Fungal spore	Total CFU/m^3 (2020-2021)
1.	*Absidia* spp.	0
2.	*Alternaria* spp.	190
3.	*A. flavipes*	25
4.	*A. fumigates*	111
5.	*Aspergillus niger*	221
6.	*Candida albicans*	156
7.	*Chaetomium* spp.	9
8.	*Choanephora* spp.	0
9.	*Cladosporium* spp.	498
10.	*Curvularia* spp.	50
11.	*Epicoccum* spp.	170
12.	*Fusarium* spp.	112
13.	*Microsporum* spp.	1
14.	*Mucor* spp.	2
15.	*Neurospora* spp.	7
16.	*Nigrospora* spp.	3
17.	*Penicillium chrysogenum*	15
18.	*P. citrinum*	35
19.	*P. digitatum*	5
20.	*P. frequentens*	0
21.	*P. funiculosum*	4
22.	*P. oxalicum*	25
23.	*P. restrictum*	10
24.	*Rhizopus* spp.	120
25.	*Scopulariopsis* spp.	5
26.	*Syncephalastrum* spp.	5
27.	*Sterile Mycelium*	2
28.	*Tricoderma*	0
29.	*Trichophyton* spp.	3
30.	*Trichosporon* spp.	3
31.	*Ulocladium* spp.	115
	Total	1902

Seasonal variation

Ten significant fungi were found among all fungi, contributing more than 2% of the total air spores.Viable/culturable fungal spore-When the seasonal dynamics were examined for all viable fungal spores, it was found that there were two peaks: the peak in February - April (spring) and the second in September - October (fall/autumn). The maximum catch (226 CFU/m^3) was seen in April 2020, followed by the winter catch (220 CFU/m^3) in January 2021. Then the observed concentration (204 CFU/m^3) in October (autumn), and obtained the lowest concentration (17 CFU/m^3) in June 2021 summer season given in Fig. 1. The dominant fungi

Table 2. Contribution percentage, Peak Season percentage and fungal concentration of major viable fungal spore types.

Fungal types	Average% contribution	% during peak season	Total number of fungi in 360 samples
Cladosporium spp.	26.18	34.73	498
Aspergillus niger	11.61	32.57	221
Alternaria spp.	9.98	42.10	190
Epicoccum spp.	8.93	43.52	170
Candida albicans	8.20	29.48	156
Rhizopus spp.	6.30	30.84	120
Ulocladium spp.	6.04	27.82	115
Fusarium spp.	5.89	27.67	112
A. fumigatus	5.83	29.72	111
Curvularia spp.	2.62	28	50
Total			1573

observed in the first Season were *Candida albicans, Epicoccum,* and *Ulocladium,* and in the second season were dominated by *Aspergillus niger, Curvularia,* and *Fusarium*. However, both *Cladosporium and Alternaria* contributed significantly in both seasons (Spring and autumn). *Cladosporium* spp. fungal air spores maximized from November to February and observed the minimum count in July. *Aspergillus niger* levels increased from August to October, and the lowest concentration was observed in January. *Alternaria* spp. fungal spores grow in large numbers from February to April.

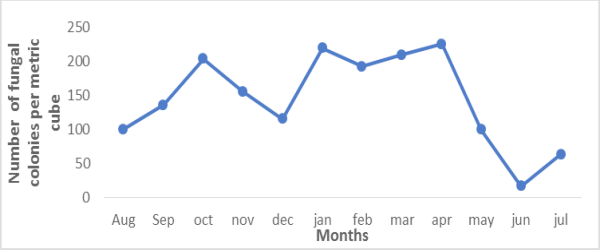

Fig. 1. Seasonal variation of viable fungal spore type

Discussion

31 viable fungal types were linked to 23 genera of viable spore 22 of them are from the class of Deuteromycetes, 4 belong to Zygomycetes, 1 belong to Ascomycetes, and 1 from Mycelia sterilia. Similar findings were made in Raipur City, where 35 fungal species were found in six sites, including four Zygomycotina species, seven Ascomycotina species, and two mycelia sterilis species (Kunjam *et al*., 2021) Rohtak city has shown Deuteromycetes also the major contributor to the airborne fungal spore types (Sanjeeta Kochar *et al*., 2014). In this study, we obtained 4 species *(Aspergilllus flavus, A. fumigatus, A. niger, A. flavipes)*. Similar results were found in Nagpur, Maharashtra (Mohture *et al*., 2017). Similar to our finding *Cladosporium* was the dominant fungus in Raipur city, (Kunjam *et al*., 2021) Nagpur, (Mohture, *et al*., 2017) and Rohtak (Sanjeeta Kochar *et al*., 2014) Also genera recorded mainly *Cladosporium, Aspergillus, Alternaria* as dominating types fungal spore (Kunjam *et al*., 2021) Theviable fungal spore types revealed two seasonal peaks: February-April (Spring) and September-October (autumn). High fungus concentrations correspond to good vegetation, rich organic matter, and favorable environmental conditions for spore development, sporulation, and dispersion during peak seasons. Other places in India have documented the presence of two peaks of high fungal density, including Rohtak, (Sanjeeta Kochar *et al*., 2014) Raipur city, (Kunjam *et al*., 2021) and Nagpur (Mohture, *et al*., 2017) Maharashtra discovered the greatest peak concentration in the Chandrapur district in October and November, and the second highest peak in August and September. It was found that mild rainfall, high relative humidity, and moderate temperatures all encouraged fungal growth, supporting our findings (Kumar, *et al*., 2022)

Conclusion

The current research is unique in that it is the first of its sort in Jhajjar District. A fungal spore based on seasonal periodicity and monthly patterns of aeromycota can offer information on the region's aerospora concentration. This information will be beneficial to physicians in identifying and managing

local patients with nasobronchial or fungal-related allergies. The current study used morphological criteria to determine the seasonal fluctuation of fungus and their diversity. It may benefit patients with respiratory allergies in the Jhajjar region by avoiding fungal exposure and taking necessary precautions in the months when fungal spores are likely to be high.

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