

Study of Common Air Borne Fungal Species in and Around Sugar Industries of Davangere District, Karnataka, India

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Abstract: *The present investigation deals with the study of airborne fungal species in sugar industries of Davangere district. The observations were conducted during the one year period. Study of airborne fungi at different sugar industrial sites has been done. During the investigation the airborne fungi in January 2013 to December 2013 shows some common fungal species appearance in the air. Dominating fungal species are of duteromycetes (*Aspergillus fumigates*, *Cladosporium*, *Curvularia*, *Fusarium*, *Alternaria*,) of five species and phycomyces (*Mucor*, *Rhizopus*) of 2, species were identified. Out of which some of pathogenic species and some are saprophytic. The *Aspergillus*, *Mucor*, *Rhizopus*, is highly allergenic, causing diseases to industrial workers and the surrounding residential areas.*

Keywords: *Air borne fungi, Pathogenic fungi, allergic fungi, sugar industries.*

1. INTRODUCTION

Bioaerosols are collections of airborne biological material. Components of the airborne material might result in health effects to exposed individuals in both the outdoor and indoor environment [1]. Bioaerosols can consist of bacterial cells and cellular fragments, fungal spores and by-products of microbial metabolism, which can be present as particulate, liquid or volatile organic compounds. The particulate in a bio aerosol is generally 0.3–100 μm in diameter; however, the respirable size fraction of 1–10 μm is of primary concern [1]. Bioaerosols that range in size from 1.0–5.0 μm generally remain in the air; where as larger particles are deposited on surfaces [4]. Physical and environmental factors affect the settling of aerosols. Air currents, relative humidity and temperature are the most important environmental parameters affecting bioaerosol settling. The most significant physical parameters are particle size, density and shape [4] & [5]. Additionally fungal spores, mycotoxins, endotoxin and other non-infectious agents released into the air in buildings are of indoor air quality. Exposure of building occupants to certain microorganisms and elevated concentrations of environmental organisms could result in allergenic reactions, irritant responses, toxicosis, respiratory illness and other health effects.

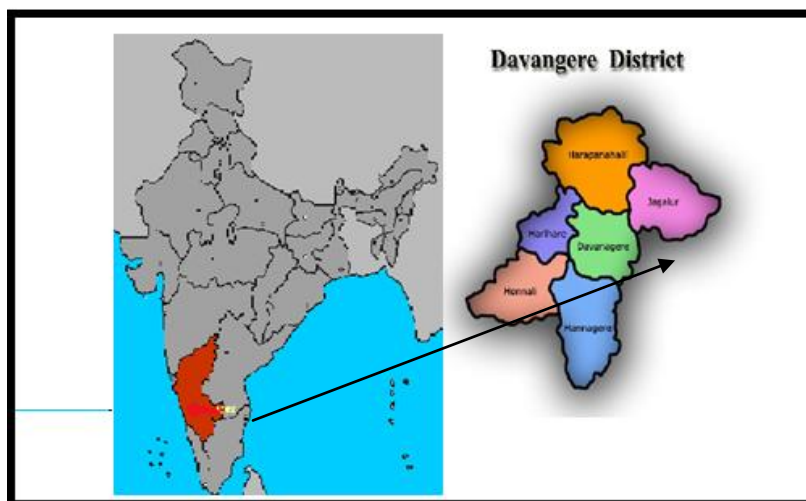
Inhalation of microbial aerosols particles may cause allergic responses and infectious disease it depends in part on the viability and infectivity of the inhaled microbes and their landing sites of air borne fungal, Actinomycete and fungal spores are capable of causing diseases in man and animals by direct infection (living tissues is invaded by the microbes), by toxicoses (ingestion of toxic metabolites of microbes), or by allergy (sensitivity to microbial proteins and polysaccharides). Respiratory allergy in man may develop immediately in hay fever or asthma, or it can be delayed as in Farmer's lung. Potential source of hazardous airborne spore are many stored products including hay, straw, grain, wood chips, and composts. Spore laden dust is also released in to the air in many ways including, distributing hay to animals, spreading out bedding and moving stored grain.

2. MATERIAL AND METHODS

2.1. Localities

Unique district located in the central part of northern Karnataka lies between 13 .5' and 14 .50' north latitudinal parallel and 75. 30' and 76. 30' east longitudinal parallel. The district is bounded

by five districts namely Haveri and Shimoga on the west, Bellary on the north, Chitradurga on the east. District has number of sugar factories, it clearly manifest that Davangere is a prominent industrial centre in the State.



Map of India- Karnataka and Davanagere district

Station I: Shamnur sugar Industry

Shamnur sugar industry is just 2 KM away from the main city of Davanagere. This location is having bioaerosol, and solid waste dust in atmosphere which is responsible for the growth of air borne fungi in the site.

Station II: Dugavathi Sugar Industry

This sampling station is located in Dugavathi village of Harpanahalli taluk of Davangere district. The Dugavathi sugar industry have more than 500 workers, they were exposure and inhalation of bioaerosol which is emitted during sugar processing.

Station III: Kukuwada sugar industry

The Kukuwada sugar industry is situated in the city of Davangere, the sugar industry have less than 200 workers, and minimum exposure of bioaerosol were noticed.

2.2. Method

The study were carried out by the Petri plate exposure method over a period of one year from january 2013 to December 2013. The plate containing czapeck dox agar medium were exposed at each of the selected sites at monthly intervals. Of 15 sites selected for exposure of Petri plates, five were at the shamnur sugar industry , six at Dugavathi sugar industry, and four at the Kukuwada sugar industry. The exposure time of Petri plates is 10 minutes. The exposed plates were incubated at 26°C for 48-72 hour and colony counts with the help of colony counter. Identification of fungal species by dirict microscopic method.

3. RESULT AND DISCUSSION

Table1. Monthly occurrence of different groups of fungal species diversity in all sampling stations From January 2013 to December 2013

Name of the Fungal species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	Operational						Non Operational						
	Number of colonies CFU/Plate												
Aspergillus fumigates	25	24	23	21	23	19	16	9	7	9	2	10	188
Cladosporium	4	3	5	9	6	7	6	5	5	1	4	1	56
Curvularia	13	7	6	4	3	3	3	7	9	5	0	4	64
Fusarium	19	5	13	5	8	7	9	9	5	6	2	7	95
Alternaria	5	9	4	4	12	6	5	6	8	1	6	4	70
Mucor	8	3	6	6	8	9	6	9	8	5	1	4	73
Rhizopus	12	1	2	9	4	5	7	8	0	2	4	4	58

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Table2. Percentage contributions of different groups of fungal species distribution in all sampling stations from January 2013 to December 2013

Sites	Number of Plate Espoused	Total Colony counted	Operational period % of colony count							Non Operational period % of colony count						
			A.fumigates	Cladosporium	Curvularia	Fusarium	Alternaria	Mucor	Rhizopus	A.fumigates	Cladosporium	Curvularia	Fusarium	Alternaria	Mucor	Rhizopus
SSI	60	313	46	3.8	8.0	14.7	7.6	10	9.5	35.9	3.8	10.6	8.7	11.6	17	11
DSI	72	182	25	18.8	9.9	14.8	13.8	11.8	4.9	9.8	17.2	14.8	24.6	12.3	13	7.4
KSI	48	109	18	10.9	14	17.1	15.6	10.9	12.5	17.7	8.8	11.1	20.0	17.7	8.8	15

*Note:SSI= Shamnur Sugar Industry,DSI= Dugavathi Sugar Industry,KSI=Kukuvada sugar industry

Table3. Variation of fungal species during operational and non-operational period in sampling stations

Station Name	Operational	Non -operational
	Mean ±SD (Min-Max)	Mean ±SD (Min-Max)
Aspergillus fumigates	22.5±2.16 (19-25)	8.8±4.5 (2-16)
Cladosporium	5.6±2.16 (3-9)	5.6±2.16 (1-6)
Curvularia	6.0±3.7 (3-13)	4.66±3.14 (0-9)
Fusarium	9.5±5.5 (5-19)	6.3±2.6 (2-9)
Alternaria	6.6±3.2 (4-12)	1.5±1.64 (1-8)
Mucor	6.6±2.16 (3-9)	5.5±2.8 (1-9)
Rhizopus	5.5±4.2 (1-12)	4.16±2.9 (0-8)

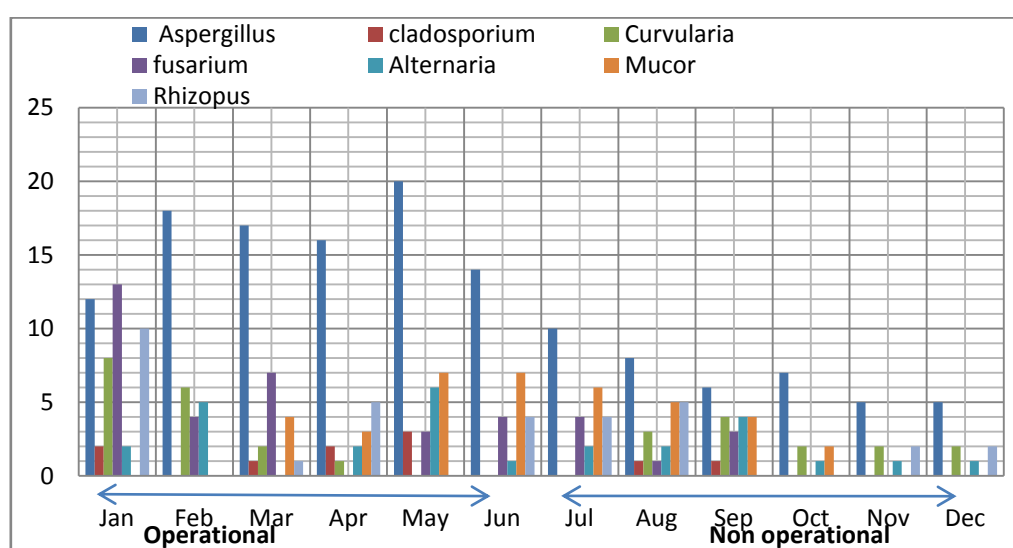


Figure1. Monthly occurrence of different groups of fungal species diversity in station I Shamnur sugar industry, January 2013 to December 2013

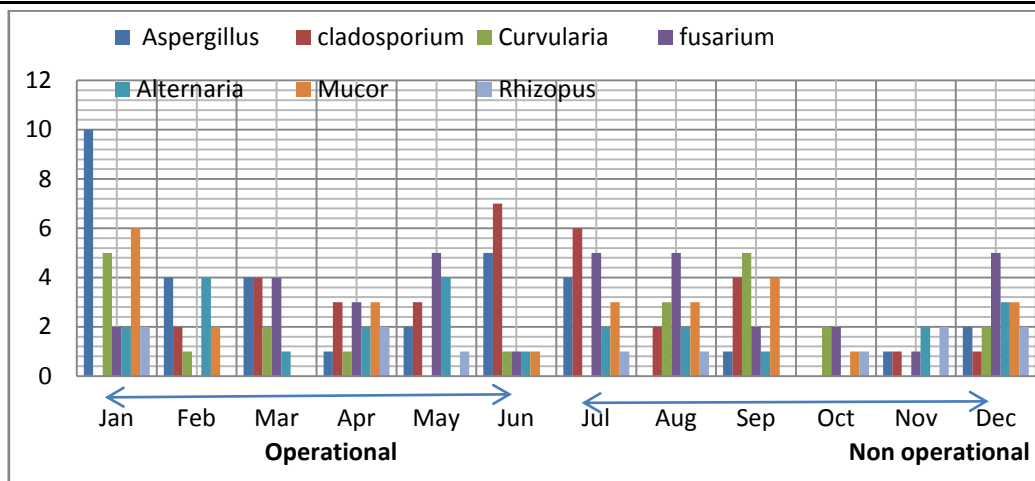


Figure2. Monthly occurrences of different groups of fungal species diversity in station II Dugavathi sugar industries, January 2013 to December 2013

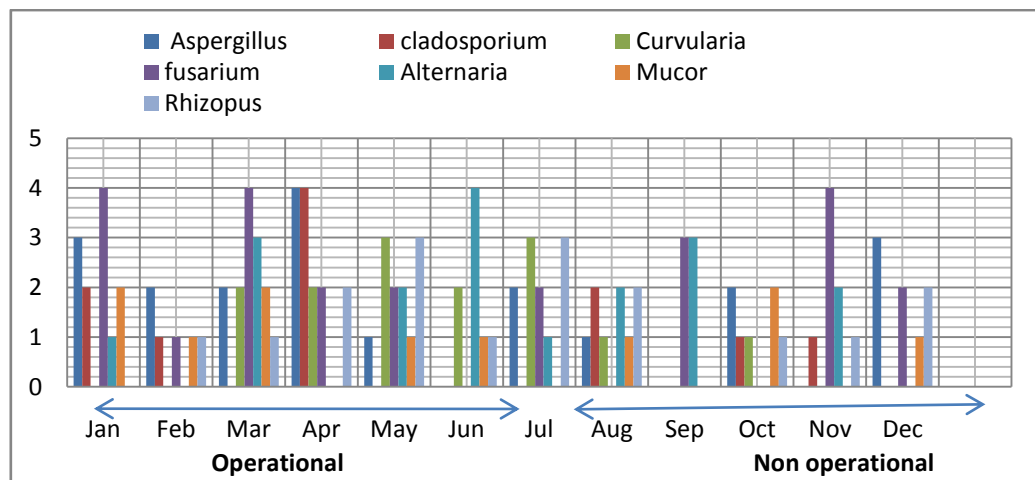


Figure3. Monthly occurrences of different groups of fungal species diversity in station III Dugavathi sugar industries, January 2013 to December 2013.

The air borne fungal survey were done at the selected sugar industries of Davanagere disstrict. The diversity of *A. fumigatus* at the shamnur Sugar industry were significantly higher than that at Dugavathi sugar industry and at the Kuvuvada sugar industry. During operational period the diversity of fungus at shamnur sugar were considerably higer *A. fumigatus* (46%) than with other species *Cladosporium* (3.8%), *Curvularia* (8.0%), *Fusarium*, (14.7%) *Alternaria* (7.6%), *Mucor* (10.0%), *Rhizopus* (9.5%). The diversity of fungi *A. fumigatus* (35.9%), *Fusarium* (10.6%), drastically decreases during non-operational period. The present investigation station I show that the diversity of fungi varies during operation and non-operational period in the shamnur sugar industries, it also shows that the unhygienic condition of the sugar industry is to increases the diversity of fungi.

In station II Dugavathi sugar industry shows *A. fumigatus* (25%), *Cladosporium* (18.8%), *Curvularia* (9.9%), *Fusarium*,(14.8%) *Alternaria* (13.8%), *Mucor* (11.8%), *Rhizopus* (4.9%) during operational period. In non-operational period shows *A. fumigatus* (9.8%), *Cladosporium* (17.2%), *Curvularia* (14.8%), *Fusarium*, (24.6%) *Alternaria* (12.3%), *Mucor* (13.5%), *Rhizopus* (7.4%) were identified. In this station *A. Fumigates*, *Cladosporium* and *Alternaria* species shows maximum concentration during operational period than non-operation period, because of environmental condition give better survivability to these species

The station III Kuvuvada sugar industry shows the moderate diversity in both operational and non-operational period. The investigation shows that there is no much more variation of fungal diversity due to hygienic condition and less pollution from industry. The available data shows fungal diversity higher variation may be possible if the surrounding environment is polluted by bioaerosol.

A. fumigates were found higher than the other species, this study demonstrated high exposure of air borne fungi of *A. fumigates* species. The other fungal species also detected during the survey

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which pose a potential health hazards. The exposure of *A. Fumigates* fungi in operational period were much higher those measured in non-operational period. The comparison of exposure of fungi in the sampling station indicates that the *A. fumigates* species were higher and able to survive in the sugar industrial environment, and seasonal fluctuation such as temperature, humidity of environment does not much more effect to the growth of *A. fumigatues*. But other identified fungal species were varied due to the climatological condition of the environment.

Detailed observations on the aerial prevalence of *A. fumigates* and other fungi at the shamnur sugar s, Dugavathi sugar industry and Kuvuvada sugar industry are presented in figures I, II and III.

4. CONCLUSION

The environmental occurrence of *Aspergillus fumigatus* and other fungal species were studied in 3 sugar industries of Davangere district. The high percentage of fungal species at the shamnur Sugar industry and low at Kuvuvada sugar industry were identified. *Aspergillus fumigatus* accounted for 46.0% of the total aerial fungal colony counts recorded during operational period in the shamnur sugar industry against 21.2 % in Kuvuvada sugar industry. The high incidence of isolations of *A.fumigatus* and other fungi identified due to dense pollution of bioaerosol in the site.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the Department of environmental science government first grade college and Bharthiar University Coimbatore for providing necessary facilities to undertake this research work.

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