Indoor aeromycoflora of saw mills in Lucknow*

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The present investigation was carried out to analyse both the quantitative and qualitative estimates of the fungal components present in the indoor environment of the saw mills in Lucknow and to find out the aeroallergens responsible for occupational health hazards.

The aeromycological studies were carried out in saw mills spread all over Lucknow for one year by gravity petridish method. Fifty types of fungal spores were isolated. *Aspergillus* constituted the dominant component of the fungal population represented by sixteen species. It was followed by species of *Penicillium, Cladosporium, Alternaria, Curvularia* and *Fusarium*.

The allergenicity of *Aspergillus flavus, A. fumigatus, A. japonicus, A. melleus, A. nidulans, A. niger, A. tamarii*, and *A. terreus, Cladosporium herbarum, Curvularia lunata* var. *aeria, Mucor hiemalis, Paecilomyces fusisporus* etc. have been proved clinically significant amongst the saw mill workers of Lucknow.

Key-words- Aeroallergens, Allergenicity, Aeromycoflora.

INTRODUCTION

THE first thing a human being does immediately after birth is to breath air and the immediate target organ is the respiratory system. Air is the carrier of several suspended particles of biological origin such as pollen grains, fungal spores and mycelia, insects and their body parts, plant debris, dust mites etc.

The role of fungi as a causative agent in respiratory allergic disorders is well established for effective diagnosis and disease management of such ailments, a proper knowledge of the qualitative and quantitative prevalence of various airborne fungi is a prerequisite. Although much work has been done to know the fungal concentration in outdoor environment, less attention has been paid to indoor occupational sites and their relation to respiratory disorders among workers (Prince Marrow & Mayer, 1964; Gupta & Singh, 1983; Lacey & Crook, 1988; Hodgson & Morey, 1989; Burge, 1985, 1989; Misra *et al.* 1988). The present investigation is aimed to survey the airospora of saw mills on Lucknow due to the fact that the saw dust and wood provide the suitable substrate for the growth and development of fungi. The workers of these saw mills inhale the saw dust for 8-10 hours a day and some times develop serious upper respiratory tract infection.

MATERIAL AND METHOD

Mycoflora of indoor and outdoor environment of fifty saw mills situated at all four directions [North (7), South (28), East (10) West (5)] in Lucknow were surveyed using gravity sedimentation method. Petri plates (9 cm. diam.) containing sterilized potato - dextrose agar, czapek-dox agar and Sabouraud's agar media were exposed at different sites of a mill for 5 minutes. Exposed plates were incubated at 27±1°C for 3 -5 days. The colonies were isolated and maintained on appropriate agar slants.

Petri plates having suitable media were also exposed outside the mills to collect fungi and to compare their load for indoor and outdoor environment. The fungi were separately cultured in Sabouraud broth (pH -8.8) for 15-20 days at 27±1°C after which time they were harvested, washed with distilled water, and lyophlized mycelium and spores were pulverised, defatted with solvent ether (48 hrs. at 4°C), and filtered and dried at room temperature. Antigens were extracted in Cocas solution up to 48 hrs., centrifuged at 5000 rpm and filter

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sterilized. Antigens so obtained were stored at cool temperature. The tests were performed on the upper and lower arms of the patients, after surface sterilisation with alcohol (70%), by injecting 0.01 ml of the antigen (dilution 1:500) into the intradermal layer. Buffer saline was used similarly as control test. The results were recorded within 15-20 minutes of injection.

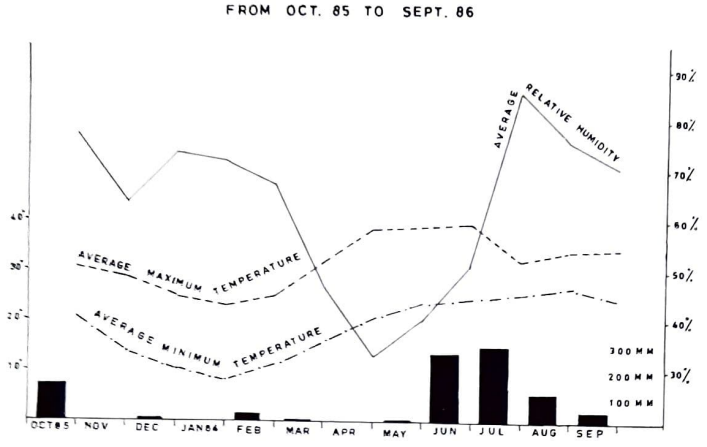

Fig 1:-Rainfall, relative humidity, maximum & minimum temperatures from Oct. 85 to Sept. 86.

RESULT

As shown in Fig. 1, the maximum temperature was recorded in the month of May and June while the lowest in the month of January. Percent relative humidity was highest in February and the lowest in the month of April and May.

During the course of investigation, a total of fifty species were isolated from the indoor air of the saw mill and forty one species of fungi respectively were recovered from their nearby out-door environment (Table-1). As is evident from the table, there is dominance of the genus *Aspergillus* as 16 species of the fungus were isolated from the saw mills. It has been listed major storage fungi constituting 52% of the total airo spora in the working environment (Love *et. al.* 1988).

The commonly occurring *Aspergillus* species were *A. niger, A. flavus, A. fumigatus, A. niveus, A. terreus, A. tamarii* with occasional occurrence *of A. japonicus, A. sydowi* and *A. versicolor.*

Aspergillus is followed by *Penicillium, Alternaria, Fusarium, Curvularia* and *Cladosporium.* Other fungal flora consisted *Helminthosporium, Mucor, Nigrospora, Pestalotia, Paecilomyces, Periconia, Phoma, Pithomyces, Rhizoctonia, Stemphylium, Syncephalastrum, Sterile mycelium, Torula, Trichoderma, Trichothecium* and *Verticillium* present in various concentrations in different months. Generally these spores are maximum in the month of October and November and minimum in the month of April and May. Some spores are totally absent in the rainy season (Durham, 1942; Hirst, 1953).

This survey indicates that the fungal load of the occupational atmosphere shows regular seasonal variations. They play main role in the aetiology of respiratory allergies among saw mill workers.

The allergenic response of patients tested intradermally for 12 fungal antigens are presented in (Table-2) The fungal antigens tested were that of *Aspergillus flavus (80), A. fumigatus (80), A. japonicus* (80), *A. melleus* (80), *A. nidulans* (80), *A. niger* (80), *A tamarii* (80), *A. terreus* (80), *Cladosporium herbarum* (80), *Curvularia lunata* var. *aeria* (80), *Mucor hiemalis* (40), *Paecilomyces fusisporus* (40). The number of patients tested for each are as given against them in parentheses. Out of 880 patients tested, 801 were found to be positive ie. *Aspergillus flavus* 82.25%, *A. fumigatus* 83.00%, *A. japonicus* 60.25%, *A. melleus* 92.50%, *A. nidulans* 95.00%, *A. niger* 92.25%, *A. tamarii* 85.30%, *A terreus* 90.25%, *Cladosporium herbarum* 65.35%, *Curvularia lunata* var. *aeria* 60.20%, *Mucor hiemalis* 78.32%, *Paecilomyces fusisporus* 55.30%.

Table-1. Showing fungal forms recoverd from Saw Mills and its out-door environment.

S. No.	Fungus	Saw Mill	Outdoor
1	2	3	4
1.	*Alternaria alternata** Nees ex Pers.	+	+
2.	*Aspergillus candidus* Link	+	-
3.	*A. carbonarius* (Bainier) Thom	+	+
4.	*A. carneus* (Van Tieghem) Bloch.	+	+
5.	*A. flavus** Link	+	+
6.	*A. fumigatus** Fres.	+	+
7.	*A. japonicus** Saito	+	+
8.	*A. melleus** Yukawa	+	+
9.	*A. nidulans** (Eidam) Wint.	+	+
10.	*A. niger** Van Tieghem	+	+
11.	*A. niveus* Bloch	+	+
12.	*A sydowi* (Bain. & Saito) Thom & Church	+	+
13.	*A. tamarii** Kita	+	+
14.	*A. tereus** Thom	+	+
15.	*A. ustus* (Bain) Thom & Church	+	+
16.	*A. versicolor* (Vuil) Tiraboschi	+	+
17.	*Botryotrichum* sp.	+	-

1	2	3	4
18.	*Cladosporium cladosporiodes* (Fresen.) de Vries	+	+
19.	*C. epiphyllum* Person	+	+
20.	*C. herbarum** (Pers.) Link ex S.F. Gray	+	+
21.	*C. lingnicolum* Corda	+	+
22.	*Curvularia lunata* var. *aeria** (Batista, Lima & Vas.) Ellis	+	+
23.	*C. tetramera* (Mc Kinney) Boedjn	+	+
24.	*Doratomyces microsporus* (Sacc.) Morton & Smith	+	-
25.	*Drechslera hawaiiensis* (Bugmicourt) Subran. & Jain ex Ellis	+	+
26.	*Emericella nidulans* var. *lata* (Thom & Raper) Subran	+	+
27.	*Fusarium oxysporum* Schlech. ex Fr.	+	+
28.	*F. roseum* Link	+	+
29.	*F. trichothecoides* Wollenweber	+	+
30.	*Gliocladium* sp.	+	-
31.	*Helminthosporium hawaiiense* Bugn.	+	+
32.	*Mucor hiemalis** Wehmer	+	+
33.	*Nigrospora sphaerica* (Sacc.) Mason	+	+
34.	*Paecilomyces fusisporus** Saksena	+	+
35.	*P. varioti* Bain	+	+
36.	*Penicillium citrinum* Thom	+	+
37.	*P. funiculosum* Thom	+	+
38.	*Periconia* sp.	+	+
39.	*Pestalotia pezizoides* de Not	+	-
40.	*Phoma herbarum* Westd.	+	-
41.	*P. jolyana* Pirozynski & Morgan-Jones	+	-
42.	*Pithomyces* sp.	+	+
43.	*Rhizoctonia* sp.	+	+
44.	*Stemphylium* sp.	+	+
45.	Sterile mycelium	+	+
46.	*Syncephalastrum racemosum* (Cohn) Schroeter	+	-
47.	*Torula ellisii* Yadav & Lal	+	+
48.	*Trichoderma lignorum* (Tode) Herz.	+	+
49.	*Trichothecium roseum* Link	+	-
50.	*Verticillium* sp.	+	+
Total		50	41

* Known for their allergenic behaviour

+ Present

- Absent

Table-2. Allergenic potentialities of fungi

		Total patients tested (N=880)	Positive cases (%)
1	*Aspergillus flavus*	80	82.25
2	*A. fumigatus*	80	83.00
3	*A. japonicus*	80	60.25
4	*A. melleus*	80	92.50
5	*A. nidulans*	80	95.00
6	*A. niger*	80	95.25
7	*A. tamarii*	80	85.30
8	*A. terreus*	80	65.35
9	*Cladosporium herbarum*	80	65.35
10	*Curvularia lunata* var. *aeria*	80	60.20
11	*Mucor hiemalis*	40	78.32
12	*Paecilomyces fusisporum*	40	55.30

DISCUSSION

As it is clear from the foregoing statement that fifty of fungi belonging to different groups were recovered from saw mills surveyed, while forty one from outside. In both the places, the dominance of Deuteromycotina was found. Such dominance of Deuteromycotina in the other aerobiological studies conducted by various workers of India has also been found, of course, with variations in the species content (Rogers, 1984; Sinha *et al.*, 1984; Tilak & Saibaba, 1984). There was lesser number of fungi recovered in the outdoor environment than indoor environment. This finding is in agreement with the opinion of (Gregory 1961) who has reported that fungi occur in higher concentration in the indoor air than outdoor. Present study clearly indicates that dominance of the species of the genus *Aspergillus* in the indoor air is in conformity with the reports of Tilak & Chakre (1979); Jay Prakash *et al.* (1978); Jay Prakash & Ramalingam; (1981, 1983); Santra & Chanda (1981); Singh (1981); and Mehta & Sandhu (1983). Furthermore, *Aspergillus flavus* and *A. niger* were the most common fungal species at both outdoor and indoor environment. Similarly, Sinha *et al.* (1984) have also found the abundance of *A. niger* in the air at Calcutta.

Other sub-dominant genera were *Penicillium, Cladosporium, Alternaria, Curvularia* and *Fusarium* in both environs. The isolation of two species of *Phoma, ie., P. herbarum* and *P. jolyana* from saw mills only, indicates that there does exist relationship between the fungal flora of the enclosed environment and the materials present there. Presence of *Phoma* in the habitat where

there is plenty of woody material is justified as the genus has wood-loving nature (Sutton, 1980).

Therefore, survey of saw mills for having complete picture of spores which may remain suspended in the air and can be the causative agent of allergenic diseases, warrants immediate attention.

Almost all fungi proved to be most effective in causing allergy in susceptible human beings as is evident from the data which indicate that 93% of the patients tested showed positive reaction to the antigens. Individually, all fungal antigens exhibited 55% positivity among the patients.

Thus, sufficient variation in the allergenic behaviour of antigens has been seen. No specific reason for such variability in the allergenic behaviour of different genera and species of the tested fungi can be attributed on the basis of the present result obtained, except that, it may possibly because of the variation in different genera and species for their spore size, density, surface topography and chemical behaviour. The most important reasons regarding the variability in allergenicity may be the variation in the chemistry of different antigens tested during the present study (Schumacher & Jeffery, 1976; Sward-Nordmo *et al.*, 1984, a, b, and Vijay *et. al.*, 1984, 1985).

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