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INDOOR FUNGAL ALLERGENS

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ABSTRACT

In all 56 species of fungi belonging to 19 genera were isolated and identified from the indoor environment of Karachi City. Hospital records show that there is an increase in dermal and respiratory diseases among the residents of Karachi City. Some of the isolated fungi from Karachi have been reported to cause allergic diseases in countries where atmospheric fungi present indoors have been studied in detail in relation to such diseases. It is advisable to safely dispose off discarded food and other organic matters immediately so as to prevent the growth and multiplication of microbial propagules. For further reduction of air pollutants the use of leaded petrol in transport system should be replaced by environment friendly CNG gas and chemical factories situated inside the city should be shifted far away to do away with the particulate matter impregnated with toxic chemicals and thereby reduce the incidence of allergic diseases.

Key-words: Airborne fungi, allergens, Karachi.

INTRODUCTION

Environmental pollution is a serious problem facing all nations of the world. The rapid urban and industrial growth of Karachi City has resulted in over population and accumulation of solid waste. The solid wastes particularly polyethylene shopping bags and discarded plastic items cause obstruction in the flow of sewerage system. The particulate matters (dust particles) emanating from overflowing gutters and hospital waste impregnated with toxic chemicals strewn carelessly at vacant places all over the city is causing serious air pollution. This problem has been further compounded due to the release of poisonous gases emitted from transport vehicles and toxic fumes released from factories in the city. In addition there are microbiological propagules growing and multiplying on discarded organic waste matters which remain exposed providing a natural substrate for the growth and multiplication of microbes. The microbiological propagules enter into the indoor-environment and settle on quilts, carpets, rugs and other household effects. The residents of indoor environments during the process of inhaling take in these microbiological propagules and/or gaseous fumes and dust particles impregnated with toxic chemicals. On entering into the breathing tubes of human beings these act as allergens and trigger allergic reactions. The allergic reactions are manifested as itching, swelling on nose accompanied with wheezing and nasal drops. An examination of records on skin and respiratory diseases from the hospitals of Karachi City would show that allergic diseases are on the increase day by day. The microbiological propagules present in the indoor environment are known for causing many dermal and respiratory diseases in human beings (Al-Doory, 1984; Sanches *et al.*, 1999; Chapman, 1999; Anon., 1998a; Simmeray, 1995). When the allergens land on mucous membrane lining the nose, a chain of reaction occurs to release histamine and other chemicals. These chemicals react with cells and blood vessels in nose resulting in nasal congestion (Anon., 1998b). According to a United Nations report published in the daily newspaper (The News, November 2002) an estimated 18,000 people die every year due to air pollution in Pakistan. Of these air pollutants affecting the health of Karachi City dwellers, identification of fungal propagules present in the indoor environment was considered important for the benefit of medical practitioners involved in the treatment of skin and respiratory diseases.

MATERIALS AND METHODS

Microbiological propagules present on rugs and carpets in two different types of human habitation, one comparatively less polluted than the other were collected from the indoor environment of Karachi city during 2000-2001. The samples were collected in spring, summer, autumn and winter seasons during which a distinct range of temperature and humidity form four distinct seasons. For the collection of microbial propagules, a series of glass slides with a drop of sterilized distilled water (1 ml) placed in the middle were kept on rugs and carpets in a tray for 6 h following the method of Agashe and Alfadil (1989). Collections were made from time to time from a overpopulated locality (Saddar) and from a comparatively less populated and polluted locality (Gulzar-e-Hijri). The trapped propagules were brought to the laboratory for cultivation of microbes. One ml of the collected sample containing microbial propagules was mixed with 10 ml of a melted cooled agar medium. In this way a series

of the samples were mixed either with PDA (potato dextrose agar) or CDA (Czapek Dox agar) media and incubated at 25°C for 7 days or were mixed with SDA (Sabourd dextrose agar) media and incubated at 37°C for 10 days. The somatic and reproductive structures of the fungal colonies growing on the three media were studied in detail and identified up to the species level. The trapped microbial propagules in different seasons developing into colony forming units (CFU) on the culture media were identified and the average number of colony forming unit (CFU) was calculated on percent basis of the total occurrence. For the study of the bacterial colonies arising on the media, only morphological features and Gram reaction (Soc. of Am. Bacteriologists) was carried out. For the study and identification of fungi, standard mycological literature (Barnett and Hunter, 1972; Ellis, 1971; Gilman, 1957; Raper and Thom, 1949; Thom and Raper, 1945; Subramanian, 1983) were consulted.

RESULTS AND DISCUSSION

Altogether 56 species of fungi belonging to 19 genera were trapped and identified along with a number of bacterial isolations from the indoor environment of Karachi City (Table I). Of the various media for cultivating fungi, PDA and CDA media were found suitable for the growth of trapped fungal propagules and a selective medium SDA for the growth of dermatophytic fungi during 2000-2001. Hirst (1952) devised a volumetric method for trapping microbial propagules from atmosphere and Gregory (1973) has given an account of the microbiology of air but for the sake of simplicity and convenience the method devised by Agashe and Afadil (1989) was followed for collecting spores from the indoor environment of Karachi city. The data on the occurrence of fungal spores show that qualitatively and quantitatively more fungi grew on PDA than CDA medium at 25°C whereas the selective medium SDA supported the growth of a few fungi and bacteria at 37°C. The weather in Karachi city from March to October of any year remain hot and humid which is conducive for the growth and multiplication of microbes (fungi and bacteria) and the temperature and relative humidity remain low from November to February. During the course of this work it was noted that samples collected from March to October yielded more fungal colonies on growth media than during November to February. The percentage of occurrence of fungal colonies collected from indoor environment was found to be higher in samples collected from over populated and polluted part of the city (Saddar) than the part of city with a lesser population and pollution (Gulzar-e-Hijri) as is evident from the data presented in Table I. A few bacterial cells in the form of rods and spheres and thin radiating mycelial cells grew on selective SDA medium at 37°C.

The study and identity of indoor microflora revealed that in addition to very many species of fungi, species of *Alternaria*, *Aspergillus*, *Penicillium* and *Cladosporium* were present which are reported as atmospheric fungi from other countries (Tilak, 1990; Valeria *et al*., 1992; Thom *et al*., 1992; Ebner *et al*., 1992; Pasanen *et al*., 1991; Kumar, 1952; Sanches *et al*., 1999) and are said to cause allergic reactions. Simeray *et al*., (1995) reported 40 genera of fungi from the vicinity of bake houses from Milano some of which are ascribed to be allergenic. Marchisio *et al*., (1992) isolated 77 species of fungi from Turin of which 26 species are known to cause allergenic reactions in human beings. The over population, excessive pollution and presence of a large number of microbiological propagules in the living environment of Karachi city can be related to be the cause for increase in the incidence of asthma and skin diseases. Fungi and other microbes grow, multiply and get disseminated through aerobiological pathways to enter into indoor environment. The factors responsible for the growth and multiplication of fungi in an open environment can be done away with proper management of discarded organic matters and hospital wastes strewn in open and vacant places in the city. Similarly the degradation and deterioration of city environment caused by the breakdown of sewerage system resulting in the overflowing of gutters, leakage in pipes supplying drinking water and thus contaminating it with waterborne diseases and emission of poisonous smoke from vehicles and toxic chemical fumes released from industrial complex in the city of Karachi should be rectified forthwith. As a matter of fact most of the cities in the developing countries are confronted with a similar situation and is in need of rectification and upgradation of the environment. Safe disposal of organic waste, repair of the sewerage system and water pipe linings and use of environment friendly CNG for vehicular traffic are necessary for a better environment. Planting of trees in parks, by the side of playgrounds and roads should be popularised for combating air pollution. Such remedial measures are likely to reduce the incidence of respiratory and skin diseases.

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Table 1. Fungi occurring in the indoor environment of Karachi.

Fungal species	Samples from ⇨	Polluted area (Saddar)			Non polluted area (Gulzar-e-Hijri)		
	Growing on ⇨	PDA	CDA	SDA	PDA	CDA	SDA
Alternaria alternata (Fr.) Keissler		4.6	3.8	1.6	3.8	2.7	0.0
A. chrysanthemi Sim. & Crosier		2.0	0.2	0.0	2.1	3.2	0.2
A. brassicola (Schw.) Wiltshire		1.0	1.7	0.0	1.1	2.2	0.0
A. citri (Ellis & Piercepud) Pierce		4.1	3.4	1.2	2.3	1.4	0.5
A. solani Soroner		5.1	4.5	2.5	3.3	2.3	0.7
A. tenissima (Kunz ex pers.) Wiltshire		4.9	3.0	1.5	1.2	2.1	0.0
Aspergillus candidus (Link) Thom & Church		1.4	0.2	0.0	1.2	0.8	0.0
A. flavus Link		5.2	3.9	1.8	3.2	2.5	0.1
A. *fumigatus* Fries		4.4	3.4	1.6	3.7	2.8	0.2
A. glaucus Link		0.2	0.2	0.0	0.3	0.2	0.0
A. nidulans (Eidum) Went.		0.5	0.4	0.0	0.4	0.2	0.0
A. niger Van Tiegh		7.6	5.1	1.9	5.1	3.2	0.5
A. niveus (Var) Blochwitz		0.2	1.0	0.3	1.3	1.4	0.2
A. ochraceous Wilhelm		0.2	0.2	0.0	0.3	0.1	0.0
A. sulphurus (Fres) Thom and Church		0.7	0.2	0.0	0.3	0.4	0.0
A. sydowi (Bain and Sart) Thom and Church		0.5	0.3	0.0	0.1	0.2	0.0
A. terreus Thom		1.4	0.4	0.4	0.8	0.5	0.0
A. versicolor Tirchoschi		1.8	1.9	0.0	1.2	1.8	0.0
Aspergillus spp.		1.2	1.5	0.2	0.5	0.4	0.3
Aureobasidium pullulans (deBary) Arnaud		1.8	1.2	0.8	1.3	1.7	0.2
Chaetomium indicum Corda.		1.3	1.2	0.1	0.9	0.7	0.1
C. globosum Kunze ex Fries.		1.2	1.8	0.7	0.9	0.6	0.0
Cladosporium cladosporiodes deVires		2.0	1.5	0.4	1.2	1.0	0.0
Cladosporium herbarum Pers Link ex Gray		1.5	1.8	1.6	1.3	1.4	0.0
C. oxysporum Burk and Curd		1.7	1.2	0.8	1.4	1.2	0.0
C. sphaerospermum Penz		1.8	1.7	1.4	1.5	1.3	0.0
Curvularia clavata Jain		2.6	2.5	1.2	1.7	1.4	0.0
C. lunata (Wakker) Baedign		0.8	2.7	0.8	0.8	0.6	0.0
Drechslera dematioidea Subram & Jain		0.8	0.4	0.0	0.7	0.1	0.0
D. *hawaiiensis* Subram & Jain		2.5	0.9	0.0	1.3	1.1	0.1
D. sorokiniana Subram & Jain		2.9	1.7	1.2	1.3	1.4	0.0
Drechslera halodes Subram & Jain		2.8	2.3	0.4	2.1	2.3	0.0
Fusarium culmorum (Smith) Sacc.		0.8	0.3	0.0	0.7	0.6	0.1
F. equiseti (Corda) Sacc.		0.7	0.5	0.8	0.9	0.7	0.2
F. roseum Link		0.6	0.2	0.0	0.8	0.9	0.0
F. oxysporum Schlecht emend Snyd and Hans		0.9	0.5	0.0	0.7	0.6	0.0
F. semitectum Berk and Rav.		0.8	0.7	0.0	0.9	0.3	0.0
F. solani (Mart) emend Snyd and Hans		0.5	1.5	0.5	1.1	1.3	0.0
Mucor mucedo Michelo ex Fries		0.8	0.3	0.0	0.3	0.2	0.0
Mucor hiemalis Wehmer		1.1	0.4	0.0	0.5	0.3	0.0
Mycelia sterilia		1.9	1.1	0.4	1.7	1.3	0.2
Penicillium digitatum Sacc.		1.8	1.3	0.0	1.2	1.1	0.0
P. notatum Westling		2.8	1.0	1.2	1.3	1.4	0.0
P. brefeldianum Dodge		1.7	1.2	1.9	1.6	1.5	0.0
P. citrinum Thom		0.7	0.6	0.0	0.5	0.4	0.0
Penicillium spp.		0.9	0.7	0.2	0.3	0.2	0.3
Phoma eupyrena Sacc.		0.8	0.2	0.0	0.5	0.3	0.0
Puccinia recondita		1.1	1.5	0.4	0.9	0.7	0.0
Rhizopus nigricans Ehrenb		2.0	0.2	0.0	1.5	0.9	0.0
R. stolonifer (Ehrenberg ex Fries) Vuillemen		1.4	1.3	0.0	1.3	1.4	0.0
Saccharomyces cerevisae Meyer		1.7	1.9	0.0	1.2	1.3	0.5
Scopulariopsis brevicaulis (Sacc.) Bain		0.8	1.0	0.0	0.6	0.4	0.0
Stemphylium solani Weber		1.1	0.2	0.0	0.8	0.6	0.0
Syncephalastrum racemosum Cohn ex Schroter		0.8	1.0	0.0	0.7	0.5	0.0
Trichoderma viride Pers		0.5	0.8	0.0	0.3	0.1	0.0
Ulocladium atrum Preuss		0.2	0.6	0.0	0.4	0.2	0.0
Eubacteriales	Rods :	3.1	4.2	0.3	2.1	1.5	0.0
	Spheres:	2.1	1.5	0.2	1.3	1.8	0.3
Actinomycetales		0.5	0.5	0.1	0.3	0.2	0.2

The colony forming unit (CFU) arising out of 1 ml. Str. dist. water exposed indoor then mixed and cultivated in PDA and CDA media at 25°C and on SDA at 37°C. The identified CFU were calculated on percent basis of the total colonies.

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