Osmotolerant And Osmophilic Fungi From House Dust, Riyadh, Saudi Arabia

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Abstract. House dust samples collected from filters of vacuum cleaners and air-conditioners filters of different houses in the different localities of Riyadh city were screened for osmotolerant and osmophilic fungi present in the household environment. A total number of 78 fungal species belonging to 31 genera were isolated. Out of these 57 species of 24 genera of fungi were found to grow on M40 (Malt Extract + 40% sucrose) medium (Osmophilic fungi). The total number of fungi per gram of house dust was found to be higher during summer season than in winter. *Aspergillus* was the predominant genus among the 27 species. It was predominant both in summer and winter season and also on M20 and M40 medium, since this genus exihibit more number of species compared to other genera in all the cases. The occurrence of *Aspergillus* was followed by the genera *Eurotium* (7 species) and *Penicillium* (6 species).

Key Word: Fungi, Osmotolerant, Osmophilic, House dust, Saudi Arabia.

Introduction

Modern houses provide a new ecological niche for fungi as a result of reduced ventilation and extensive use of air-conditioning, specially during summer time. Fungi along with mites pose great health hazzards to the residents of these houses (Schoeber, 1988; Rijckaert, 1981; Bokhary and Parvez, 1995). These fungal components, mites and pollen grains cause several allergic diseases like asthma, rhinitis, nasal eosinophilia and dermatitis (Krillis *et al.*, 1985; Chirila *et al.*, 1984; Al-Fryah *et al.*, 1989). Childrens are more susceptible to these diseases than adults (Mori *et al.*, 1985; Bronswijk *et al.*, 1986). Common molds, usually saprophytic and organisms like *Alternaria, Aspergillus, Penicillium* , *Mucor, Drechslera* and *Cladosporium* found in almost every type of environments are reported to cause allergic asthma (Krillis *et al.* 1985; Al-Doory and Dommson, 1984).

Hamada and Yamada (1991) have recorded *Aspergillus restrictus, Eurotium* spp. and *Wellemia sebi* as the most abundant xerophilic (osmophilic) fungal flora of house dust unlike the outdoor air-borne fungal flora. Bokhary (1998) has reported *Aspergillus* to be the predominant genus as osmotolerant and osmophilic fungus from sand dunes. Seasonal

fluctuations in the outdoor mycoflora was first studied in Riyadh by Ali *et al.* (1977). Fungi inhabiting household environment in different localities of Riyadh has been reported by Bokhary and Parvez (1995). Fungi were also reported earlier from floor and air-conditioner dust of houses in Riyadh (Saad and El-Gindy 1990). However, no work has so far been reported about osmophilic and osmotolerant fungi from house dust. Therefore, the aim of present study was to investigate the fungi that can survive under extreme condition of low moisture availability or those that are xerophytic in nature (osmotolerant and osmophilic fungi).

Materials and Methods

Samples of house dust were collected monthly from filters of vacuum cleaners and from filters of air-conditioners in the houses in different localities of Riyadh during the period from January to December 1997. For isolation of fungi, dilution plate method was adopted as earlier (Bokhary and Parvez, 1995). Media used for isolation were M20 (malt extract + 20% sucrose) and M40 (Malt extract + 40% sucrose) for osmotolerant and osmophilic fungi respectively as adopted earlier (Bokhary, 1998). Purification of fungi was carried out every day after 3 days of incubation upto a total of 25 days of incubation. Fungi were identified according to keys cited earlier (Bokhary and Parvez, 1995).

Results and Discussion

Seasonal fluctuations in the mycoflora of house dust collected from vacuum cleaners are given in Table 1. A total number of 78 fungal species belonging to 31 genera were isolated on M20 (osmotolerant) and M40 (osmophilic) media during different seasons of the year. The highest number of fungal species (71 species) were isolated on M20 medium during May to August period, followed by isolation on M40 medium (55 species) during the same period. The period between September to December yielded second highest numbers of fungi (35 species on M20 medium and 26 species on M40 medium), followed by the period between January to April (29 species on M20 and 23 species on M40 medium). This may be due to the extensive use of air-conditions during the summer (May to August) and also due to less ventilation of houses. *Aspergillus* was the predominant genus and represented by 27 species. *Aspergillus* species were also predominant on M40 medium as most of these could grow on 40% sucrose, hence were able to tolerate high sugar concentrations (osmophilic) or high osmotic potential. Therefore these fungi can survive even at very low humidity condition. Genus *Aspergillus* was followed by genus *Eurotium* with 7 species. *Eurotium* is the ascomycetes phase (perfect state) of *Aspergillus* with visible sclerotia present in the medium. *Penicillium* with 6 species ranked third in dominance. *Penicillium* also could grow well on M40

Table 1. Seasonal fluctuation in the mycoflora of house dust collected from vacuum clearners.

Fungi	No. of colonies per gram of house dust					
	A		B		C	
	M20	M40	M20	M40	M20	M40
Acremonium strictum W Gams	-	-	12±3	-	-	-
Alternaria alternata Fr.:Fr. Keissler	26±4	20±3	36±5	32±6	25±3	20±4
A. chlamydospora Mouchaca	35±5	26±4	42±6	39±5	20±3	18±3
A. solani Sorauer	-	-	16±3	20±5	-	-
A. tenuissima (Kunze:Pers) Wiltshire	-	-	15±3	-	-	-
Aspergillus candidus Link: Fr.	-	-	23±4	15±3	16±4	-
A. carbonarius (Bain.) Thom	16±3	20±4	39±5	35±4	20±4	16±3
A. carneus (van Tieg.) Blochwitz	-	-	26±4	16±3	-	-
A. chevalieri (Margin) Thom & Church	12±2	-	-	-	-	-
A. conicus Blochwitz	-	-	16±2	12±2	18±3	15±3
A. flavus Link	43±4	36±3	59±7	46±5	49±5	36±5
A. floriformis Samson & Mouchaea	-	-	-	-	11±2	-
A. foetidus Thom & Raper	-	-	-	-	8±3	-
A. fresenii Subram.	8±2	-	9±3	-	12±3	-
A. fumigatus Fresenius	49±8	42±6	58±6	43±5	63±4	49±5
A. japonicus Saito	-	-	20±4	16±3	-	-
A. niger van Tieghem	68±6	57±5	76±8	68±7	63±4	60±5
A. nutans Mclennan & Ducker	-	-	12±2	-	-	-
A. niveus Blochwitz	-	-	16±3	10±2	-	-
A. ochraceus Wilhelm	-	-	15±3	12±2	-	-
A. oryzae (Ahlb.) Cohn	12±3	8±2	18±4	12±4	-	-
A. parasiticus Speare	-	-	12±4	-	-	-
A. penicilloides Spegazzini	-	-	18±2	16±3	-	-
A. phoenicis (Corda) Thom	-	-	16±3	-	8±2	-
A. pseudoglaucus Ohtsuki	-	-	8±3	-	6±2	-
A. restrictus G. Smith	8±3	6±2	16±3	12±2	-	-
A. tamarii Kitta	11±3	12±3	19±4	16±4	-	-
A. terreus Thom.	-	-	23±4	16±5	-	-
A. umbrosus Bainier & Sartory	-	-	15±3	15±3	-	-
A. ustus (Bain) Thom et Church	8±3	8±2	18±3	17±3	-	-
A. versicolor (Vuill.) Tiraboschi	-	-	22±4	20±4	16±3	10±2
A. wentii Wehmer	-	-	19±4	24±5	-	-
Aureobasidium pullulans (de Bary) Arnaud	-	-	12±2	15±3	-	-
Bahusaganda sp.	-	-	18±3	16±4	-	-
Basidiobolus haptosporus Drechsler	8±3	-	12±3	-	-	-
Botryotrichum atrogriseum Van Beyma	-	-	18±4	12±3	16±2	14±2
Cephalosporium sp.	-	-	22±3	16±4	-	-
Chaetomium globosum	-	-	16±3	16±4	12±3	10±3
Chalara sp.	-	-	12±3	12±3	-	-
Circinella muscae (Sorok.) Berl. et de Toni	13±2	10±2	18±3	16±2	-	-
Cladosporium cladosporiodes (Fres.) De Vries	20±3	18±3	25±5	20±3	29±3	26±4
C. herbarum (Pers: Fr.) Link	-	-	16±3	12±5	-	-
C. sphaerospermum Penzig	-	-	12±3	8±4	19±3	14±3
Cochliobolus spicifer Nelson	-	-	16±3	15±3	-	-
Drechslera sp.	-	-	-	-	8±3	-
Chlamydomyces sp.	13±3	-	18±3	-	-	-
Emericella nidulans (Eidam) Vuill.	-	-	14±3	18±3	8±3	8±2

Table 1 cont.

E. rugulosa (Thom et Raper) Benjamin	-	-	12±3	16±2	-	-
Embellisia chlamydospora (Hoes & al.) Sin.	-	-	18±3	-	-	-
Eurotium amstelodami Mangin	14±2	26±4	20±3	32±4	25±4	20±4
E. chevalieri Mangin	16±3	32±3	29±4	32±4	33±3	39±4
E. halophilicum Delacr.	13±2	18±3	22±4	31±3	16±2	26±3
E. montevidensis Talice et Macknnon	-	-	16±3	18±2	-	-
E. repens de Bary	-	-	-	-	16±4	19±3
E. rubrum (Konig, spieck., & Brem.) Thom & Church.	20±4	29±4	30±3	42±5	-	-
E. tonophilum Ohtsuki	-	-	23±4	25±5	-	-
Fusarium oxysporum Shelecht	24±3	29±4	32±4	39±3	20±3	16±2
Hyphomyces chrysospermum Tul.	-	-	12±3	14±4	-	-
Monodictys castaneae (Walter.) Hughes	-	-	11±4	-	-	-
Mucor hiemalis Wehmer	14±3	-	26±3	-	12±2	-
Mycelia sterilia	-	-	10±2	12±4	-	-
Penicillium aurantiogriseum Dierckx	-	-	-	-	14±2	16±3
P. chrysogenum Thom	36±3	25±4	69±7	63±5	52±3	41±5
P. citrinum Thom	18±2	10±2	21±3	16±2	-	-
P. funiculosum Thom	-	-	15±3	14±3	29±3	20±3
P. oxalicum Currie et Thom	-	-	10±3	12±4	-	-
P. sclerotiorum Van Beyma	-	-	24±4	-	-	-
Pleospora herbarum (Fr.) Rabenh. ex les et de Not	-	-	-	-	13±3	12±3
Rhizopus stolonifer Ehrenb.	18±3	-	29±4	-	16±3	-
Scopulariopsis brevicaulis (Sacc.) Bainer	11±2	15±3	22±5	20±5	-	-
S. brumptii Salvanet - Duval	-	-	15±3	12±4	-	-
Stachybotrys atra Corda	26±4	20±4	39±5	35±5	30±3	25±4
Torula caligans (Batista & Upadhyay) M.B. Ellis	-	-	10±2	-	-	-
T. herbarum Link: Fr.	-	-	19±3	12±2	-	-
Ulocladium atrum Preuss.	18±2	16±2	30±5	30±3	12±3	10±3
U. chlamydosporum Mouchaca	-	-	16±3	15±3	29±2	26±3
U. tuberculatum Simmons	-	-	18±2	-	-	-
Wellemia sebi (Fr.) v. Arx	16±2	18±2	26±3	39±4	22±2	31±4
Total no. of species 78	29	23	71	55	35	26

A : Jan. to April
B : May to Aug.
C : Sept to Dec.
± : Standard deviation.

medium although with lesser number of colonies as compared to its growth on M20 medium, However genus *Eurotium* showed higher number of colonies per gram dust on M40 medium as compared to M20 medium, and therefore could be termed as true osmophilic. *Wellemia sebi* also showed an increased number of colonies per gram of house dust on M40 medium in comparison to M20 medium. Other genera isolated were *Acremonium, Alternaria, Aureobasidium, Bahusaganda, Basidiobolus, Botryotrichum, Cephalosporium, Chaetomium, Chalara, Circinella, Cladosporium, Cochliobolus, Drechslera, Chlamydomyces, Emericella, Embellisia, Fusarium, Hyphomyces, Monodictys, Mucor, Pleospora, Rhizopus, Scopulariopsis, Stachybotrys, Torula* and *Ulocladium.*

The fungal species which were found on both the medium and during all the seasons included *Alternaria alternata, A. chlamydospora, Aspergillus carbonarius, A. flavus, A. fumigatus, A. niger, Cladosporium cladosporioides, Eurotium amstelodami, E. chevalieri, E. halophilicum, Fusariium oxysporum, Penicillium chrysogenum, Stachybotrys atra, Ulocladium atrum* and *Wellamia sebi.* Out of 78 fungal species isolated, 57 species were found to grow on M40 medium.

Seasonal fluctuations in the mycoflora of house dust collected from air-conditioners dust are given in Table 2. A total number of 44 fungal species were isolated. The highest number of species were recorded on M20 medium (41 species) during the period May to August followed by growth on M40 medium (36 species) during the same period. During the period of September to December 24 species were recorded on M20 medium and 21 species on M40 medium. The least number of species were recorded during the period of January to April. This may be due to the lesser use of air-conditioner during this period and more house ventilation as compared to other periods. *Aspergillus* was again the predominant genus exhibiting the highest number of species (12 species) followed by *Eurotium* with six species. *Alternaria alternata, A. chlamydospora, Aspergillus flavus, A. fumigatus, A. niger, Eurotium halophilicum, E. rubrum, Penicillium chrysogenum, Stachybotrys atra* and *Ulocladium atrum* are the species which were recorded on both media and also during all seasons. Other genera isolated were *Aureobasidium, Botryotrichum, Cephalosporium, Circinella, Cladosporium, Cochliobolus, Emericella, Embellisia, Fusarium, Pleospora, Rhizopus, Torula,* and *Wellemia.*

Aspergillus which yielded the highest number of species and the 3rd ranking *Penicillium* were also recorded as the most prevalent genera of house-hold environment and air-conditioner dust of Riyadh (Bokhary and Parvez, 1995; Baggy and Gohar, 1988). However the 2nd ranking genus *Eurotium* was not recorded earlier by the same authors. This may be due to the fact that they used normal media for fungal isolation and these *Eurotium* and *Wellemia* species are usually missed because of slow

Table 2. Seasonal fluctuation in the mycoflora of house dust collected from air-conditioner dust.

Fungi	No. of colonies per gram of house dust					
	A		B		C	
	M20	M40	M20	M40	M20	M40
Alternaria alternata Fr. :Fr. Keissler	13±3	12±2	42±5	35±5	20±4	18±3
A. chlamydospora Mouchaca	16±3	15±3	49±4	45±3	33±3	25±4
Aspergillus candidus Link: Fr.	-	-	32±4	14±2	-	-
A. carbonarius (Bain.) Thom	-	-	36±3	32±4	-	-
A. flavus Link.	36±5	30±5	69±7	60±6	42±3	36±4
A. fumigatus Fresenius	33±5	26±4	58±5	52±5	69±3	68±5
A. niger Van Tieghem	48±3	45±5	76±7	70±5	56±4	42±6
A. ochraceus Wilhelm	-	-	28±4	25±5	-	-
A. oryzae (Ahlb.) Cohn	-	-	18±3	16±3	10±2	8±3
A. penicilloides Spegazzini	-	-	29±4	25±5	16±3	12±4
A. restrictus G. Smith	6±2	5±2	25±4	21±3	-	-
A. tamarii Kitta	-	-	26±4	25±4	-	-
A. terreus Thom.	-	-	16±2	15±3	12±2	10±2
A. ustus (Bain) Thom et Church.	-	-	16±3	16±4	-	-
Aureobasidium pullulans (de Bary) Arnaud	-	-	18±3	16±3	-	-
Botryotrichum atrogriseum Van Beyma	-	-	16±2	15±2	10±2	10±2
Cephalosporium sp.		-	26±5	22±-	-	-
Circinella muscae (Sorok.) Berl. et de Toni	-	-	16±2	14±3	-	-
Cladosporium cladosporioides (Fres.) De Varies	40	-	29±4	26±4	16±3	14±3
C. sphaerospermum Penzig	-	-	10±2	6±2	-	-
Cochliobolus spicifer Nelson	-	-	18±3	12±2	-	-
Emericella nidulans (Eidam) Vuill.	-	-	16±2	14±2	-	-
Embellisia chlamydospora (Hoes & al.) Sin	-	-	16±3	-	-	-
Eurotium amstelodami Mangin	-	-	26±4	34±3	15±3	26±4
E. chevalieri Mangin	-	-	36±5	40±5	22±3	26±3
E. halophilicum Dalacr.	10±2	8±2	34±3	35±4	18±2	16±2
E. repens de Bary.	-	-	-	-	10±2	12±3
E. rubrum (Konig, Spieck, & Brem.) Thom & Church	12±2	25±3	36±5	46±4	22±3	32±4
E. tonophilum Ohtsuki	-	-	18±3	16±5	-	-
Fusarium oxysporum Shelecht	-	-	26±3	22±4	16±3	15±4
Mucor hiemalis Wehmer	-	-	26±3	-	29±4	-
Mycelia sterilia	-	-	16±3	14±3	-	-
Penicillium aurantiogriseum Dierckx	-	-	-	-	18±2	-
P. chrysogenum Thom	26±4	25±4	73±5	70±5	56±5	50±4
P. funiculosum Thom.	-	-	18±4	16±3	-	-
P. oxalicum Currie et Thom	-	-	18±3	16±4	-	-
Pleospora herbarum (Ar.) Rabenh. ex les et de Not.	-	-	-	-	8±2	8±3
Rhizopus stolonifer Ehrenb.	14±2	-	32±4	-	15±3	-
Stachybotrys atra Corda	16±2	14±2	29±3	26±4	20±2	18±3
Torula caligans (Batista & Upadhyay) M.B. Ellis.	-	-	16±3	-	-	-
Ulocladium atrum Preuss.	20±3	18±3	36±5	32±5	10±2	10±4
U. chlamydosporum Mouchaca	-	-	22±3	16±2	18±3	16±3
Wellemia sebi (Fr.) v. Arx	-	-	39±4	46±5		-
Total no. of species 44	12	11	41	36	24	21

A : Jan. to April
B : May to Aug.
C : Sept. to Dec.
± : Standard deviation.

growth on normal media which are covered by fast growing molds (Hamada and Yamada, 1991). Ali *et al.*, (1977) reported *Cladosporium* as a most prevalent genus as out door air-borne mould flora followed by *Aspergillus, Fusarium,* and *Hormodendron,* However this order was not found in the indoorenvironment during the present study and earlier studies (Bokhary and Parvez 1995; Baggy and Gohar, 1988). Common mold genera isolated here like *Aspergillus, Penicillium, Alternaria, Cladosporium, Fusarium, Ulocladium, Mucor,* which are prevelent fungi in house dust, were also common in different types of environments and dusts (Palmgren *et al.*, 1983; Robert *et al.*, 1984; Abdel-Hafez and Shroeit, 1985; Hamada and Yamada, 1986). The fungal species reported here on M20 and M40 medium were also earlier recorded to grow on high sugar concentrations (Bokhary, 1998; Abdel-Hafez, 1982) and to grow even at 50% sucrose concentration (Abdel-Hafez *et al.*, 1990; Hamada and Yamada, 1991). Most of the fungal genera found here were also reported from floor dust of schools (Ali-Shatayel and Arda, 1989; Mercantini *et al.*, 1985; Mercantini *et al.*, 1983). These household inhalant were found to induce positive skin test more frequently than other common allergens. House dust mites are associated with house dust allergens and fungi may stimulate the population growth of the house-dust mites (Samson and Lustgraaf, 1978).

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فطريات غبار المنازل المتحملة والمحبة للضغوط الازموزية العالية بمدينة الرياض بالمملكة العربية السعودية

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قسم النبات والأحياء الدقيقة ــ كلية العلوم ــ جامعة الملك سعود
ص.ب ٢٤٥٥ الرياض ١١٤٥١ المملكة العربية السعودية

تم تجميع عينات غبار من مرشحات مكانس الشفط ومن مرشحات هواء المكيفات من منازل مختلفة بمدينة الرياض تم فحصها للفطريات المتحملة والمحبة للضغوط الازموزية العالية وقد كان العدد الكلي لهذه الفطريات المعزولة هو ٧٨ فطراً تنتمي إلى ٣١ جنساً . وقد وجد من بينها ٥٧ نوعاً تابعة لـ ٢٤ جنس تنمو على بيئة أم ــ ٤٠ (مستخلص الشعير + ٤٠ % سكروز) الخاصة بالفطريات المحبة للضغوط الازموزية العالية وقد وجد أن العدد الكلي للفطريات لكل جرام من غبار المنازل يكون أعلى أثناء موسم الصيف عنه من موسم الشتاء وان كان الاسبرجيلس هو الجنس السائد من بين ٢٧ نوع ــ كما كان سائداً في كلا موسمي الصيف والشتاء وكذلك على وسطي أم ٢٠ وأم ٤٠ حيث أظهر جنس اسبرجيلس وجنس إيروشام (٧ أنواع) وجنس بنسليم (٦ أنواع) .