

Air-Borne Mycoflora in the Schools Environment in Hofuf, Al Hassa Province of Saudi Arabia

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Abstract

This study was conducted to collect the air-borne mycoflora from the environment of Primary and Secondary schools during the period from 1st of April till the end of May 2007. A total number of 13 fungal genera were isolated. Genus *Aspergillus* was the most predominant and showed the highest number of cfu/m³ of air followed by *Penicillium*, *Cladosporium*, *Fusarium*, *Rhodotorula*, *Mucor*, *Alternaria*, *Acremonium*, *Curvularia*, *Stachybotrys*, *Rhizopus*, *Drechslera* and *Ulocladium* in the descending order. Generally, environment of primary schools yielded greater number of fungal cfu compared to secondary schools in all the localities of Hofuf city. This is the first record of airborne fungi from schools environment in Hofuf city, Saudi Arabia.

Key words: Airborne, mycoflora, schools, environment.

Introduction

Due to extensive use of air-conditioning especially during summer in the Modern schools where ventilation reduced significantly to provide cooling, causes a most suitable environment for fungal flora to flourish and this becomes more worse for the children health when these fungi coincide with pollen grains and dust resulting in allergenic disease like asthma, rhinitis, nasal eosinophilia and also dermatitis, especially in children (Bokhary and Parvez, 1995; Bokhary and Parvez, 1999; Krillis, *et al.*, 1985; Al-Fryah, *et al.*, 1989; Rafii, 1990). Each fungal species has a unique array of antigenic and allergenic components, but sometimes different fungal species or even genera exhibit cross-reacting components (Agarwal, *et al.*, 1982). These airborne fungal flora, so called opportunistic fungi, changes the spectrum of fungal diseases (Singh, 2001). Recent reports indicate that these environmental fungi previously considered as non-pathogenic saprophytes, are increasingly encountered as causing life threatening invasive infections (Ayedini, *et al.*, 2007; Ceylon, *et al.*, 2006; Chakrabarti, 2007; Zaoutis, *et al.*, 2007; Hedayati, *et al.*, 2007). These fungi also causing skin, nail, ear, and hair along with the conventional dermatophytes with similar symptoms (Bakhshwain, *et al.*, 2008).

Although various reports have been published regarding the air-borne household and school environment from different parts of Saudi Arabia. (Bokhary and Parvez, 1995; Bahkali and Parvez, 1999; AlSwain, *et al.*, 1999; Abdel Hafez and Shoreit, 1985; Al-Falih, 2001) but no reports so far been published regarding the air flora of school environment from Hofuf city. Therefore the aim of this study was to explore the air-borne fungal flora present in the school environments of Hofuf city, Saudi Arabia.

Materials And Methods

Sample Collection

Samples were collected from first of April till the end of May 2007. Study includes 32 schools distributed equally between localities in Al-hofuf city, the main city in Al-ahsa region of Saudi Arabia. These localities were north, south, east and west. Fungi were isolated using a portable volumetric air sampler (Miliport Air Tester (M Air T), USA). The M Air T sampler is a six-stage impactor air sampler so that the air was impacted in appropriate Petri dishes, which design for equipment use (Cassetts M Air T), containing the appropriate culture media. During the above collection, the air sampler was positioned vertically

about one meter above floor level. Each sample collected with the impactor M air T was processed with an air volume of 500 liters according to the manufacturer's instructions. All the collection patterns (time period of air impaction, culture medium, agar concentration, and collection site inside the class room) have been determined previously and kept consistent through out the whole study.

Culture media, isolation and identification of fungi

For inoculation through air sample impactation, the culture medium used was Rose Bengal Chloramphenicol Agar Base (CM0549, Oxoid, UK) with the addition of 100 mg/l of chloramphenicol selective supplement (SR0078E, Oxoid, UK) after dissolving in 6 ml of ethanol prior to autoclaving. Following sample collection, dishes were incubated for 5 days at 28°C. The initial number of fungal colonies was assessed in third and fourth day of incubation, and the number of Colony Forming Units (CFU/m³) was determined in per m³ of air in the fifth day. Next, the colonies that morphologically distinct were isolated

and photographed. Due to slow or poor growth of some fungal strains during initial conditions of cultivation, these strains were subcultured in different culture media such as Sabouraud Dextrose agar (Oxoid, UK), Czapek-Dox agar (Oxoid, UK) and/or Potato Dextrose agar (Oxoic, UK) and incubated at 28°C for 10 days. Fungi were identified according to the following literature: Ellis (1976); Ramirez (1982); Raper and Fennell (1965); Carmichael *et. al.* (1980), Zycha *et. al.* (1969); Nelson *et. al.* (1983); Pitt (1979). Confirmation of the identification was done by Sarwat Parvez, Mycologist, RMH, Riyadh, Saudi Arabia.

Result and Discussion

A total number of thirteen fungal genera *viz.* *Acremonium*, *Alternaria*, *Aspergillus*, *Cladosporium*, *Curvularia*, *Drecheslera*, *Fusarium*, *Mucor*, *Penicillium*, *Rhizopus*, *Rhodotorula*, and *Stachybotrys* were isolated by air sampler method from different schools located in different localities in the Hofuf city. These results are summarized in (Fig. 1 and Fig. 2). The air dust samples

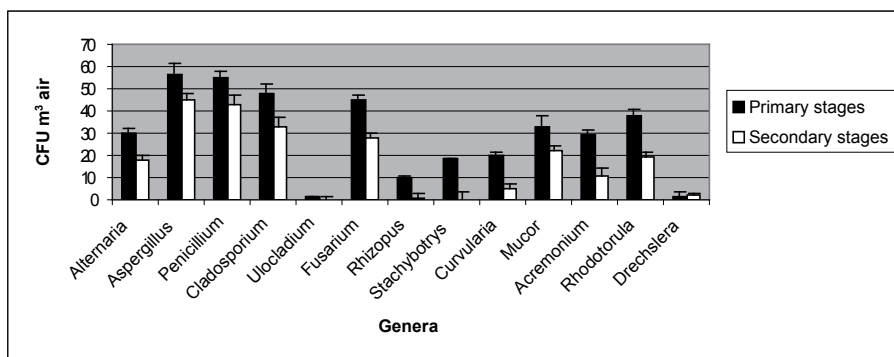


Fig. 1 : Total fungal CFU/m³ isolated from the air of schools at different places in Hofuf city.

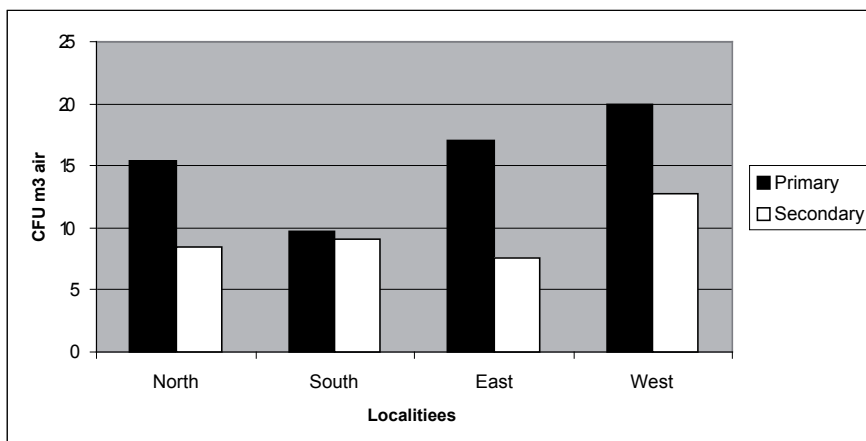


Fig. 2. Percentage of total fungal CFU/m³ air collected from schools at different localities of Hofuf city.

were collected from First of April when schools re-opened after vacation till the end of May 2007.

Two fungal genera were detected solely in primary stages including, *Stacybotrys* and *Ulocladium*. Furthermore, the number of CFU/m³ was higher in primary schools than in secondary schools. This might be due to the density of classrooms in primary stages, which was in an average of 38 students per classroom compared to 21 students per classrooms in secondary stages. Similar observations was reported previously by (Al-Falih, 2001). Although, in their study the highest number of colonies per plate was in general higher in secondary stages which had more students present in classrooms than in primary stages. However, results from the two studies are not directly comparable due to the different experimental systems used to collect the air samples from the classrooms. Most of the previous studies performed in Saudi Arabia did not use a six-stages air sampler (Al-Falih, 2001; Bokhary and Parvez, 1995; Bahkali and Parvez, 1999; Abdel-Hafez, 1984). In most of these studies a plate-settled method was applied thus, the amount of air volume contacted the surface of the agar plate cannot be determined and consequently the comparison between schools might be biased statically. In contrast to previous studies (Al-Falih, 2001; Bokhary and Parvez, 1995; Bahkali and Parvez, 1999), in this study a defined amount of air volume was impacted in the same way for all samples (M Air T, USA). Thus, the amount of fungal genera detected should be more accurately comparable for different sites. The percentage of total fungal CFU/m³ in schools at different localities in Al-hofuf City did not vary much between different localities. However, schools at the south location of Al-hofuf City yielded less number of total fungal CFU/m³ this might be due to total number of students presented in these schools which was less compared to other schools. In general, the most common genera isolated from the air of schools covered in this study were *Aspergillus*, *Penicillium* and *Cladosporium* respectively. This observation agree with previously reported studies about indoor common fungal genera in Saudi Arabia, however, *Cladosporium* genus was reported previously to be isolated from dust samples in schools in Riyadh city, but not from air samples. This could be due to two reasons, first, dust storms much more common in Al-hofuf city than in other cities in Saudi Arabia where similar studies have been done. Second, the amount of air volume that was impacted in Petri dishes by the use of air sampler which was 500 liters, which is equivalent to 17.7 cubic feet (M Air T, USA).

Acknowledgements

I am thankful to King Faisal University for financial

support of this project (Project # 7053). The author would like to acknowledge Dr. Sarwat Parvez, Mycologist, Riyadh Military Hospital for conformation of the identification of fungi.

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الجراثيم الفطرية في بيئة الفصول الدراسية المغلقة في مدارس مدينة الهفوف بمحافظة الأحساء بالمملكة العربية السعودية

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المخلص

شملت هذه الدراسة الفصول الدراسية التابعة لـ ٣٢ مدرسة موزعة بالتساوي بين المرحلتين الابتدائية والثانوية خلال الفترة من ١ ابريل وحتى نهاية شهر مايو للسنة الملاحية ٢٠٠٧. تم التعرف علي ١٣ جنس من الفطريات في العينات الهوائية المؤخوذة من مختلف الفصول الدراسية. كانت اكثر المستعمرات الفطرية ظهورا في المتر المكعب للهواء تابعة للجنس اسبرجلس ثم البنسيليوم, كلودوسوريم, فيزاريوم, رودوتيللا, ميوكرا, الترناريا, اكريمونيم, كيورفولارا, ستاكي بوتيريس, ريزويس, دريكسلايرا ثم يولوكلاديم تدريجيا من الأعلى الي الأقل. يمكن القول بشكل عام ان عدد المستعمرات الفطرية في فصول المراحل الابتدائية اكبر واكثر تنوعا مقارنة بفصول المراحل الثانوية في العينات التي شملتها الدراسة. تعتبر هذه هي الدراسة الأولى التي شملت هذا العدد من المدارس في مدينة الهفوف بمنطقة الأحساء بالمملكة العربية السعودية.
