



ISSN: 0976-3031

Available Online at <http://www.recentscientific.com>

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research  
Vol. 8, Issue, 5, pp. 16912-16916, May, 2017

**International Journal of  
Recent Scientific  
Research**

DOI: 10.24327/IJRSR

## Research Article

### IMPACT OF INDOOR ALLERGENIC FUNGAL SPORES IN SAUDI ARABIA

\*Hasnain, SM<sup>1.</sup>, Al-Qassim, A<sup>1.</sup>, Alsini, H<sup>1.</sup>, Alsobhi, A<sup>1.</sup>, Al-Mohanna, F<sup>1.</sup>,  
Al-Frayh, A<sup>2</sup> and Al-Sedairy S<sup>1</sup>

<sup>1</sup>Department of Cell Biology, King Faisal Specialist Hospital and Research Centre, Riyadh

<sup>2</sup>Department of Pediatrics, King Saud University, Riyadh, Saudi Arabia

DOI: <http://dx.doi.org/10.24327/ijrsr.2017.0805.0243>

#### ARTICLE INFO

##### Article History:

Received 15<sup>th</sup> February, 2017  
Received in revised form 25<sup>th</sup>  
March, 2017  
Accepted 23<sup>rd</sup> March, 2017  
Published online 28<sup>th</sup> May, 2017

##### Key Words:

Fungi; allergic diseases; asthma;  
allergens; house dust samples

#### ABSTRACT

The fungal flora contains diverse organisms including a large number of fungi, molds, mushrooms, yeasts, rusts, and smuts etc. Airborne fungi are important source of indoor allergens and studies confirm their role in the development of allergic diseases. In order to identify indoor fungal allergens, 539 house dust samples were collected from different regions in Saudi Arabia. Samples were analyzed by culture employing Sabouraud Dextrose and Potato Dextrose Agar. The cultivated plates were incubated at 25°C up to 5 days. Colony forming units (CFU) were enumerated and identified.

Various fungal species were identified from the samples. The majority of fungi identified belonged to the allergenic genera. *Aspergillus niger* constituted 38.5%, *A. fumigatus* 15.5%, *Rhizopus* spp 14.5%, *Penicillium* spp 8%, *Aspergillus* spp 7.1%, *Alternaria* spp 4.4%, Yeast 4%, *Mucor* 3%, *Cladosporium* spp 2%, *Fusarium* spp. 1%, and other minor type include *A. flavus* 2%. The non-coastal cities (n=455) showed a higher percentages than coastal cities (n=84) because of difference in sample collection.

Public places, primarily mosque, was included in the study. Out of 104 samples, *Aspergillus niger* constituted 39%, *Rhizopus* spp 14%, *Aspergillus fumigatus* 12%, *Alternaria* spp 10%, *Fusarium* sp. 8%, *Penicillium* spp 6%, *Aspergillus* spp 6%, *Ulocladium*, *Bipolaris* and Yeast 2%, *Mucor*, *Cladosporium* spp and *Drechslera* spp. 1%.

Exposure to certain fungal species cause sensitization and allergic reactions and may increase severity of asthma symptoms. Therefore, proper avoidance strategy need to be adopted with a regular cleaning of storage area and humidity control measures, if possible.

Copyright © Hasnain, SM *et al.*, 2017, this is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

#### INTRODUCTION

Allergic diseases are considered to be one of the major diseases of the twentieth century, estimated to affect more than 30% of the population with increasing incidence (Cramer, *et al.* 2014). The ambient atmosphere is dominated along with many others, pollen and spores, which trigger allergic reactions and diseases (Ezike, *et al.* 2016). Fungi are among the most important aeroallergens (Abu-Dieyeh, *et al.* 2010) and well known to cause allergic diseases (Hasnain, *et al.* 2012). They are present in some outdoor and indoor environment. Many research confirmed the relationships between environmental fungal exposures and human health effects (Baxi, *et al.* 2016).

Exposures to several fungal spores are also associated with the risk of child and adolescent asthma which is a significant public health problem (Tham, *et al.* 2016; Sharpe, *et al.* 2015).

Allergenic fungal components from indoor environment also play an important role in patients with allergic rhinitis, bronchial asthma, allergic conjunctivitis and allergic bronchopulmonary aspergillosis (ABPA) (Zukiewicz-Sobczak, 2013; Bush, 2008). Indoor environments play important role in human health and most indoor pollutant comes from biological particles such as fungi (Haleem Khan, 2012).

*Aspergillus* species is known to be one of the important fungal type causing allergic reactions among various groups of fungi (Patterson & Strek, 2010). *Aspergillus fumigatus* is one of the most frequent species in the genus and play an important role in the patients who have allergic immune response to *Aspergillus* (Pasqualotto, 2009); Inhalation of their spores can affect the respiratory tract and cause Allergic Broncho-Pulmonary Aspergillosis (ABPA) (Shah & Panjabi, 2016). *Aspergillus niger*, *Aspergillus fumigatus*, *Aspergillus flavus* are

\*Corresponding author: Hasnain, SM

Department of Cell Biology, King Faisal Specialist Hospital and Research Centre, Riyadh

some of the important allergenic species (Bhetariya, et al. 2011). In addition, *Alternaria*, *Cladosporium*, *Penicillium* and some other type of fungi are also found to be an important species affecting human health (Erkara, et al. 2008).

Many studies have been conducted worldwide showing a high prevalence of outdoor and indoor fungi (Tham, et al. 2016; Beezhold, et al. 2008). In the Middle East, documentation is poor in all countries other than Iran and KSA (Goronfolah, 2016). The airborne fungi identified as the most common allergen in Iran (Soleimani, et al. 2013) and Saudi Arabia (Hasnain, et al. 2004; Alwakeel & Nasser, 2011). However, some studies conducted in Saudi Arabia showed a high prevalence of sensitization to aeroallergens are outdoor studies. Limited data are available on indoor allergens in general, as very rare studies conducted on indoor fungi (Almogren, 2009).

## MATERIALS AND METHODS

### Sampling cities

The samples were collected from different cities throughout Saudi Arabia, with different geographical conditions. Non-coastal areas which are hot and dry in summer, cold in winter. Summer temperatures sometimes exceed 45°C, while in winter the temperature falls to 5°C or lower. The coastal area is renowned for its humidity, with summer temperatures rising to >40°C.

### Cities descriptions

**Riyadh:** the capital city as well as the most populous city of the Kingdom of Saudi Arabia, lies in the Central Region, It has a very dry climate and rainfall, the weather is dry and hot in the summer and cold in the winter.

**Qassim:** an agricultural area situated in central of Saudi Arabia, the weather in Qassim is very hot in summer and rainy and cold in winter.

**Jeddah:** a coastal city laying on the red sea, located on the western region of the Kingdom, it has a high temperature and humidity during the summer.

**Makkah:** a mountain and valleys area in the western region of the Kingdom, the climate is generally high temperature, in winter; it is between 20-25°C while in summer it could go up to 47°C.

**Abha:** a mountain area located on the south-west region of the Kingdom, it has a generally moderate climate, moderate temperature and climate all year round and heavy rainfall.

**Jizan:** a coastal area lying on the red sea and located in the southwestern region, the weather is hot in the summer and mild in the winter.

**Arar:** situated in northern region of Saudi Arabia, is considered to have a desert climate.

**Jouf:** located in the northwestern part of Saudi Arabia and considered to have a desert climate.

**Dammam:** lies in the Eastern region and important seaport, it has a hot and humid climate in summer and mild temperature in winter.

**Al-wajh:** is a small city on the northern Red Sea coast of Saudi Arabia, has a high temperatures and humidity during the summer.

### Collection of Samples from homes/public places

Samples were collected in sterile plastic (ziplock) bag, by vacuuming carpet in the bedroom, living rooms, mattresses, sofas and other non-synthetic furniture. In some cases, a holder attachment device or connector (MODEL ALK) especially designed were used for this purpose. Individuals using their own vacuum cleaners were advised to use a new vacuuming bag and transfer the dust in a plastic (ziplock) bag (provided to them). Collected samples on the filter dishes were sealed, labeled and transported safely to the laboratory.

### Processing of House Dust Samples

All collected house samples were cleaned in the laminar flow cabinet, separating the bigger particles and sieving the samples. All information such as collection date, name, address, location, contact person, telephone, and email address are recorded in the database for each sample.

### Dust Culture for Allergenic and Toxic Fungi

Dust samples collected from homes and public places were also used for identification of various dry-spore fungi, known to cause respiratory allergies.

100 ml of diluted dust were poured on two petri dishes containing two different culture Medias:

- a) PDA (Potato Dextrose Agar)
- b) SDA (Sabouraud Dextrose Agar).

These plates were incubated at temperatures 25°C for 5-7 days for identification.

With a maximum incubation of 7 days, molds colonies were identified in almost all samples.

## RESULTS

Colony Forming Unit (CFU) of 16 fungal taxa were isolated from 539 indoor dust samples. These samples came from 11 cities around the Kingdom as indicated in Figure 1. The identified species were, in descending order, *Aspergillus niger* 39%, *Aspergillus umigatus* 15.5%, *Rhizopus* spp 14.5%, *Penicillium*spp 8%, *Aspergillus* spp 7.1%, *Alternaria* spp 4.4%, Yeast 4%, *Mucor* 3%, *Cladosporium* spp 2%, *Fusarium* spp. 1%, and other minor types 2%. The minor types included: *A. flavus*, *A. rugulosus*, *A. tamari*, *Aureobasidium pullulans*, *Arthrinium* sp, and *Drechslera* sp.

- At a look 3 species of allergenic fungi constituted 62.3% in coastal regions compare to the same 3 species constituting 61% in non-coastal regions. However, it must be noted the 62.3% of *Aspergillus* species resulted from a total of 84 samples compared to 455 samples from non-coastal regions.
- Out of 455 samples collected from the non-coastal regions, 104 were collected from public places (mosques) in the Riyadh region.

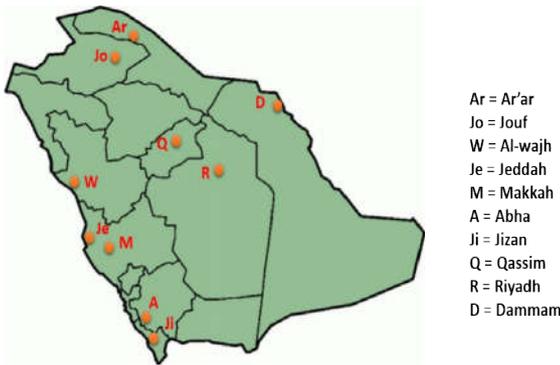


Figure 1 The Kingdom of Saudi Arabia

Percentages of Fungi (CFU) in House dust samples

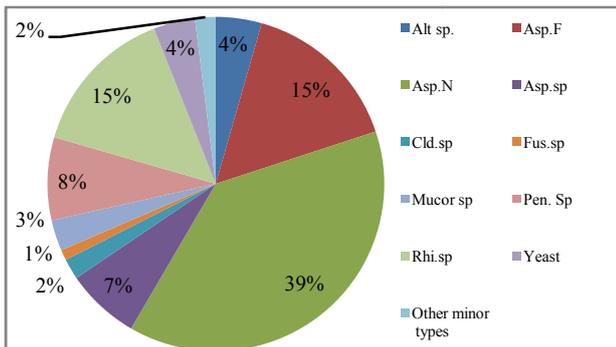


Figure 2A Percentages of All Fungi (CFU) in House dust samples from different cities

Individual fungal type in non-coastal cities against the total fungi

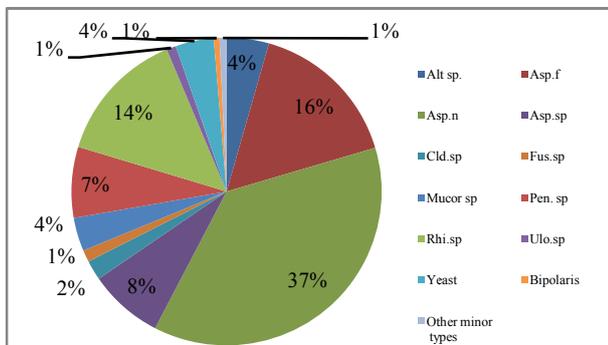


Figure 2B Percentages of Fungi (CFU) in House dust samples in Non-Coastal Cities

Individual Fungal Type Against The Total Fungi In Coastal Cities

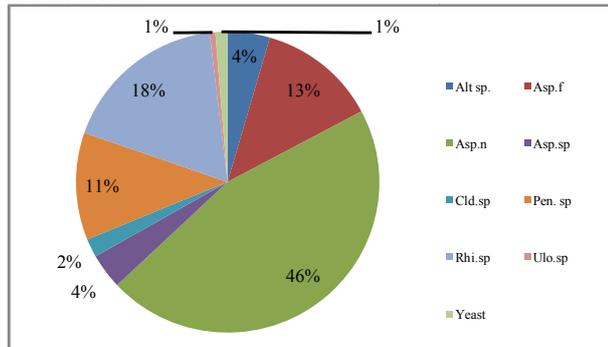


Figure 2C Percentages of Fungi (CFU) in House dust samples in Coastal Cities

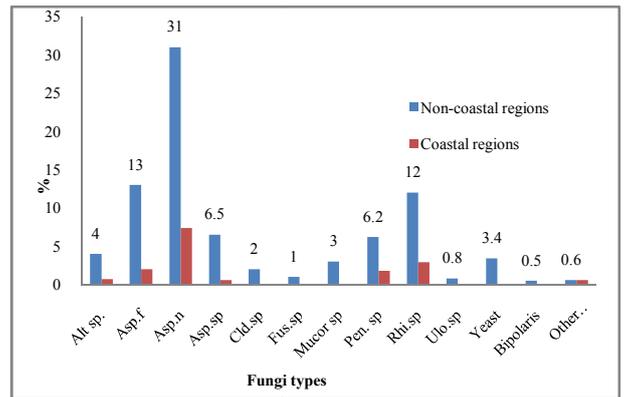


Figure 3 Percentages of Fungi (CFU) in House dust samples fungi in Coastal cities against Non-coastal cities

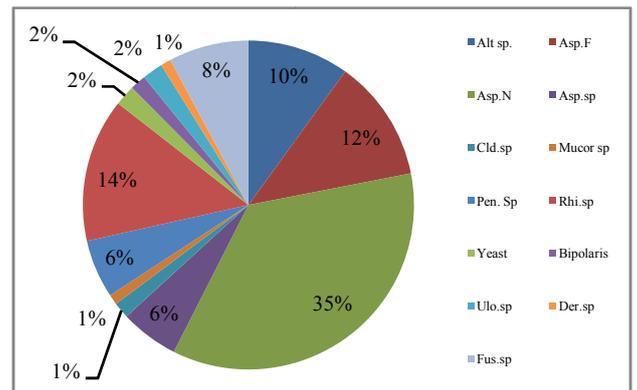


Figure 4 Percentages of Fungi in Public Places (Mosques) n=104

Abbr.: Alt; *Alternaria sp.*, Asp.f; *Aspergillus fumigatus*, Asp.n; *Aspergillus niger*, Cld.sp; *Cladosporium sp.*, Pen.sp; *Penicillium sp.*, Rhi.sp; *Rhizopus*, Bip; *Bipolaris sp.*, Muc; *Mucor sp.*, Fus. sp; *Fusarium sp.*, Dre sp; *Drechslera*, Ulo. Sp; *Ulocladium*.

DISCUSSION

The study was part of a larger program to enumerate various allergenic components of indoor origins such as Cat (*Felis domesticus/ Fel d 1*), cockroach (*Blattella germanica /Bla g 1*) etc. Fungal components were handled separately by culture as only limited antibodies are available to detect fungal proteins by monoclonal antibodies using ELISA. The results finalized for 539 indoor samples that included house dust samples from homes and public places such as mosque, indicate a heavy infestation of highly allergenic group of fungi *Aspergillus* species. From the data it is clear that 4-5 species of *Aspergillus* dominated the indoor fungal flora with varying CFU. Since we experienced huge problem in getting even number of samples in order to have a clear analysis but either because of the ignorance of patients and collectors or because of logistics reasons, the collection of more samples were not possible. We however, polled the data into coastal and non-coastal cities and analyzed accordingly. Since the samples from coastal (404) regions was smaller compared to non-coastal (84) cities, therefore, an actual CFU level of fungi in the coastal region cannot be determined. However, it is well known that humidity and temperature favor the growth of fungi and as such, these two meteorological factors are available in all coastal cities of the Kingdom. Therefore, it is not inconceivable that the true

level of fungal propagules will be much higher in coastal part compared to non-coastal regions (Figure 2 and 3).

Public places, primarily mosques and because of the logistic reasons, where many people visits several times a day, were selected for collection of samples. Results finalized for 404 samples, also displayed *Aspergillus* as dominant fungi (Figure 4).

As presented in the Introduction, that fungi in general and the spores of the fungi in particular have antigenic potency and have been found responsible for the sensitization and development of allergic diseases particularly bronchial asthma. Because of the smaller size of *Aspergillus* spores (about 5 micron) they easily penetrate to the lower bronchioles of the lower respiratory tract. This phenomenon also cause infection and inflammation in non-susceptible (non-allergic individual) termed as Aspergilloma and Allergic Bronchopulmonary Aspergillosis.

The very important practical aspect of the study presents a challenge to minimize the level and prevent the onset of allergic symptoms in many patients spending their time in the indoor environment. Saudi Arabia is one of those countries where, for cultural reasons and weather conditions, many people spend their time in the indoor environment. It is therefore concluded, that non-allergic individuals in general and allergic individuals in particular, must protect themselves from exposure to fungal allergens. It is difficult for them to know what allergens maybe in their ambient environment but such studies, through the physician's clinic, allergy society or allergy nursing staff can provide the details as to what species are likely to be in their region. Proper cleaning, Hepa-filter vacuuming and removing the sources of fungal growth such as storage areas, bathroom and kitchen areas etc. must be undertaken and if required, casual use of dust mask should be adopted for individual's protection.

#### Acknowledgements

This project was supported by a grant from National Scientific and Technology Innovation Planning (NSTIP) 13-BIO814-20 and approved by the American Association for the Advancement of Science (AAAS). The authors wish to acknowledge Ms. Cheryl Mijares-Oblea, Allergy and Medical Aerobiology Research at King Faisal Specialist Hospital and Research Centre, for her typographical assistance.

#### References

- Abu-Dieyeh, M.H., Barham, R., Abu-Elteen, K. Al-Rashidi, R., Shaheen, I. (2010). Seasonal variation of fungal spore populations in the atmosphere of Zarqa area, Jordan. *Aerobiologia*, 26: 263-276. doi:10.1007/s10453-010-9162-2.
- Almogren, A. (2009). Airway allergy and skin reactivity to aeroallergens in Riyadh. *Saudi Medical Journal*, 30(3):392-6.
- Alwakeel, S. S., Nasser, L. A. (2011). Indoor Terrestrial Fungi in Household Dust Samples in Riyadh, Saudi Arabia. *Microbiology*, 1 (1): 17-24.
- Baxi, S.N., Portnoy, J. M., Larenas-Linnemann, D., Phipatanakul, W. (2016) Exposure and Health Effects of Fungi on Humans. *The Journal of Allergy and Clinical Immunology: In Practice*, 4(3):396-404.
- Beezhold, D. H., Green, B. J., Blachere, F. M., Schmechel, D., Weissman, D.N., Velickoff, D., et al. (2008). Prevalence of allergic sensitization to indoor fungi in West Virginia. *Allergy and Asthma Proceedings*, 29(1):29-34.
- Bhetariya, P.J., Madan, T., Basir, S.F., Varma, A., Usha, S.P. (2011). Allergens/Antigens, toxins and polyketides of important *Aspergillus* species. *Indian Journal of Chemical Biochemistry*, 26(2):104-19.
- Bush, R.K. (2008). Indoor allergens, environmental avoidance, and allergic respiratory disease. *Allergy and Asthma Proceedings*, 29(6):575-9.
- Cramer, R., Garbani, M., Rhyner, C., Huitema, C. (2014). Fungi: the neglected allergenic sources. *Allergy*, 69(2):176-85. doi: 10.1111/all.12325.
- Erkara, I.P., Asan, A., Yilmaz, V., Pehlivan, S., Okten, S.S. (2008). Airborne *Alternaria* and *Cladosporium* species and relationship with meteorological conditions in Eskisehir City, Turkey. *Environmental and Monitoring Assessment*, 144(1-3):31-41.
- Ezike, D.N., Nnamani, C.V., Ogundipe, O.T., Adekanmbi, O.H. (2016). Airborne pollen and fungal spores in Garki, Abuja (North-Central Nigeria). *Aerobiologia* (Bologna), 32(4):697-707.
- Goronfolah, L. (2016). Aeroallergens, atopy and allergic rhinitis in the Middle East. *European Annals of Allergy and Immunology*, 48(1):5-21.
- Haleem Khan, A.A., Mohan Karuppayil, S. (2002). Fungal pollution of indoor environments and its management. *Saudi Journal of Biological Sciences*, 19(4):405-26.
- Hasnain, S. M., Al-Frayh, A. R., Al-Suwaine, A. R., Gad-El-Rab, M. O., Fatima, K., Al-Sedairy, S. (2004). *Cladosporium* and respiratory allergy: Diagnostic implications in Saudi Arabia. *Mycopathologia*, 157 (2): 171-179.
- Hasnain, S.M., Akhter, T., Waqar, M.A. (2012). Airborne and allergenic fungal spores of the Karachi environment and their correlation with meteorological factors. *Journal of Environmental Monitoring*, 14(3):1006-13.
- Pasqualotto, A.C. (2009). Differences in pathogenicity and clinical syndromes due to *Aspergillus fumigatus* and *Aspergillus flavus*. *Medical Mycology*, 47:S261-70.
- Patterson, K., Strek, M.E. (2010). Allergic bronchopulmonary aspergillosis. *Proceedings of the American Thoracic Society*, 7(3):237-44.
- Shah, A., Panjabi, C. (2016). Allergic Bronchopulmonary Aspergillosis: A Perplexing Clinical Entity. *Allergy, Asthma and Immunology Research*, 8(4):282-97.
- Sharpe, R.A., Bearman, N., Thornton, K.H., Osborne, N.J. (2015). Indoor fungal diversity and asthma: A meta-analysis and systematic review of risk factors. *Journal of Allergy and Clinical Immunology*, 135(1):110-112.
- Soleimani, Z., Goudarzi, G., Naddafi K., Sadeghinejad, B., Latifi, S. M., Parhizgari, N., et al. (2013). Determination of culturable indoor airborne fungi during normal and dust event days in Ahvaz, Iran. *Aerobiologia*, 2013; 29 (2): 279-290.
- Tham, R., Katelaris, C. H., Vicendese, D., Dharmage, S. C., Lowe, A. J., Bowatte, G., et al (2016). The role of outdoor fungi on asthma hospital admissions in children and adolescents: A 5-year time stratified case-crossover

analysis. *Environmental Research*, 23; 154:42-49. doi: <http://dx.doi.org/10.1016/j.envres.2016.12.016>.

Tham, R., Vicendese, D., Dharmage, S.C., Hyndman, R.J., Newbigin, E., Lewis, E. *et al.* Associations between outdoor fungal spores and childhood and adolescent asthma hospitalizations. *Journal of Allergy and Clinical Immunology*, <http://dx.doi.org/10.1016/j.jaci.2016.06.046>

Żukiewicz-Sobczak, W.A. (2013). The role of fungi in allergic diseases. *Advances in Dermatology and Allergology/Postępy Dermatologii i Alergologii*, 30(1): 42-45.

**How to cite this article:**

Hasnain, SM *et al.* 2017, Impact of Indoor Allergenic Fungal Spores In Saudi Arabia. *Int J Recent Sci Res.* 8(5), pp. 16912-16916. DOI: <http://dx.doi.org/10.24327/ijrsr.2017.0805.0243>

\*\*\*\*\*