International Journal of Microbiology and Mycology | IJMM
pISSN: 2309-4796
http://www.innspub.net
Vol. 2, No. 4, p. 1-5, 2014
Open Access RESEARCH PAPER

# Microfungal contaminants on the surface of the books and the atmosphere of the library of Health Services Vocational School in Marmaris, Turkey

**Vedat Kadir Özkan**

Muğla Sıtkı Koçman University, Health Services Vocational School, 48700 Marmaris, Muğla, Turkey

**Keywords** Microfungi, library atmosphere, microfungal flora, microfungal contamination.

**Publication date: September 22, 2014**

**Abstract**

The aim of this study was to determine the microfungi which contamined the surface of the books and the atmosphere of the library in Health Services Vocational School . The samples of the library air were taken by using open petri plate method and the samples from the surface of the books were taken by swabbing with the moistened sterile swab sticks. As a result of research, 14 different microfungal species were obtained belonging to *Alternaria, Aspergillus, Chaetomium, Cladosporium* and *Penicillium* genera. The genera of microfungi the most abundant in terms of the qualitative were *Aspergillus, Penicillium* and *Cladosporium*. Quantitatively, *Aspergillus* was found as the most abundant. Maximum colony was formed by *Aspergillus niger* in the microfungal species. The microfungal species which were obtained from the atmosphere of the library and from the surface of the books show great similarity.

* Corresponding Author: Vedat Kadir Özkan ✉ vedatkozkan @mu.edu.tr

## Introduction

Microfungi which produce too many spores and can be easily transported, form the significant part of the bioaerosols in the external and internal atmosphere of the surrounding and they can contaminate all kinds of surface. The air quality of indoor and common areas have an important effect on the human health. There are 20 thousand to 2 million fungus spores in 1 $m^3$ of air and this is one of the significant causes of skin and respiratory diseases (Çeter and Pınar, 2009). One of the common areas that people use is the library where people take advantage of using it. Microfungi can be contaminated from visitors to books, other materials and other visitors. The microfungi in the library atmosphere also contaminate the books. They accelerate the corruption of the books, pages and aging process by increasing the acid formation. People, who contact the books which are contaminated by microfungi can suffer from allergy, itchy and irritated skin and if microfungi are inhalated, they can cause asthma and related diseases (Arslan and Ulaş, 2007). In some countries researches have been done about the microfungal contaminants which cause corruption on the artifacts that are kept in museums, archives and libraries and the microfungi in the internal atmosphere and the prevention methods of them (Shamsian *et al*., 2006, Zotti *et al*., 2008, Ebrahimi *et al*., 2011, Borrego *et al*., 2012, Kalwasińska *et al*., 2012, Leite *et al*., 2012, Chadeganipour *et al*., 2013). The researches about this topic is not sufficient in our country (Yücel and Kantarcıoğlu, 1998, Arslan and Ulaş 2007, Mumcu *et al*., 2010). Considering the human circulation in libraries, these kind of studies, which have a great importance in terms of public and individual health ,should be expanded. In this research it was aimed to identify the microfungal contaminants in the internal atmosphere of the Marmaris Health Services Vocational School library and on the surface of books.

## Materials and Methods

*Sampling*

In this study, samples were taken from the Marmaris Health Services Vocational School library atmosphere and the surface of 20 books. Sampling from the library atmosphere was done by using petri dishes containing Rosebengal Chloramphenicol Agar (RbCA) and it was kept open for 30 minutes (Mumcu *et al*., 2010). The samples from the books were taken by using moistened sterile swab stick from the surface and they were transferred to petri dishes containing RbCA by using surface spreading technique (Shamsian *et al*., 2006, Mumcu *et al*., 2010, Temiz A, 2010, Borrego *et al*., 2012, Leite *et al*., 2012, Chadeganipour *et al*., 2013).

*Incubation and identification*

Sampling of the petri dishes were incubated for 15 days at 27 °C. The growing microfungi colonies were counted and transferred into the tubes containing Potato Dextrose Agar (PDA) and then they were incubated for 15 days at 27 °C. After incubation , inoculation was performed from each tube for diagnostic purposes on petri dishes containing Malt Extract Agar (MEA) and Czapek Dox Agar (CzDA). After 15 days of incubation at 27°C, developing microfungi colonies were identified by examining the cultural and microscopic features and by corresponding reference books (Domsch *et al*., 1980, Hasenekoğlu 1991, Samson and Pitt, 2000, Ellis *et al*., 2007).

## Results and Discussion

*The distribution of microfungi in the atmosphere of the library and on the surface of the books*

In this research, 14 microfungi belonged to 5 genera were obtained. *Aspergillus, Penicillium* ve *Cladosporium* genera were found to be dominant in terms of qualitative aspect and *Aspergillus* was found to be dominant in terms of quantitative aspect (Table 1). Maximum colonies were formed by *Aspergillus niger* among the species of microfungi and this was followed by *Alternaria alternata* and *Cladosporium herbarum* (Table 1).

The microfungi which were found to be dominant in terms of the qualitative and quantitative aspects are widely distributed in nature. Because of spreading easily by the atmospheric movements, having a wide range of ecological tolerance and producing too many spores, they can be found in almost any environment and they can contaminate any surface (Domsch *et al*., 1980, Hasenekoğlu 1991, Asan *et al*., 2002, Yazıcıoğlu *et al*., 2002, Çeter and Pınar, 2009). Our findings are consistent with the relevant literature.

**Table 1.** Qualitative and quantitative distribution of microfungi.

| Microfungal species | Library atmosphere | Surface of books | Colony number |
|---|---|---|---|
| *Alternaria alternata* (Fr.) Keissler | 6 | 1 | 7 |
| *Aspergillus fumigatus* Fresenius | 2 | 2 | 4 |
| *Aspergillus nidulans* (Eidam) Winter | 1 | 3 | 4 |
| *Aspergillus niger* van Tieghem | 22 | 8 | 30 |
| *Aspergillus wentii* Wehmer | - | 3 | 3 |
| *Cladosporium cladosporioides* (Fresen.) Viries | 2 | 2 | 4 |
| *Cladosporium herbarum* (Pers.) Link ex Gray | 3 | 4 | 7 |
| *Cladosporium sphaerospermum* Penz. | 2 | 2 | 4 |
| *Chaetomium* Kunze ex Fries *sp. I* | 1 | 1 | 2 |
| *Chaetomium* Kunze ex Fries *sp. II* | - | 1 | 1 |
| *Penicillium brevicompactum* Dierckx | 1 | - | 1 |
| *Penicillium glabrum* (Wehmer) Westling | 1 | - | 1 |
| *Penicillium italicum* Wehmer | 1 | - | 1 |
| *Penicillium verrucosum* Dierckx var. *verrucosum* Samson,Stolk&Hadlok | - | 2 | 2 |
| Total colony number | 42 | 29 | 71 |

There are not many studies in Turkey and other countries about the microfungi that contaminate the library air and the surface of the books. A number of these studies are about the protection against microbial originated corruption of the artifacts in the libraries, archives and museums. In a study conducted in Turkey, *Alternaria, Penicillium ,Cladosporium, Aspergillus, Fusarium* and *Rhizopus* genera were isolated in the air of the library of Selimiye Mosque in Edirne (Mumcu *et al*., 2010). These findings are largely similar to the microfungi species derived from the library air in this research.

Leite Junior *et al*. (2012), have determined that the *Aspergillus* was found to be dominant in terms of quantitative and qualitative aspects in the atmosphere of the library. Borrego *et al*. (2012), have obtained *Aspergillus* and *Penicillium* genera in high frequency from the air of the archives. Chadeganipour *et al*. (2013), have isolated *Cladosporium, Penicillium, Aspergillus* and *Alternaria* extensively from the library air and the bookshelves. The results obtained from the library air, support the findings of these literature.

Mumcu *et al*. (2010), have isolated *Alternaria, Cladosporium, Aspergillus, Acremonium, Fusarium, Rhizopus* and *Chaetomium* from the samples taken from the books in the library. In this research, the microfungi isolated from the books are largely similar to these findings. Shamsain *et al*. (2006), have isolated *Aspergillus* in high frequency and it was followed by *Penicillium*. Zotti *et al*. (2008), have obtained *Penicillium* and *Aspergillus* fungi extensively on the historical artifacts. Ebrahimi *et al*. (2011), have found the *Aspergillus* and *Penicillium* genera dominant. Borrego *et al*. (2012), have isolated *Aspergillus* and *Penicillium* genera in high frequency from the historical documents. Chadeganipour *et al*. (2013), the *Penicillium, Cladosporium, Aspergillus* and *Alternaria* genera

were determined to be common. The microfungi genera we obtained from the books are largely relevant to these literature.

In this study, both the samples from the library air and the book surfaces, the *Aspergillus niger* has formed the maximum colony (Table 1). Leite *et al*. (2012) has also indicated that the most common species in their study is the *Aspergillus niger*. In this investigation, *Aspergillus wentii, Chaetomium sp.II* and *Penicillium verrucosum* var. *verrucosum* from the microfungi species were only isolated from the books (Table 1). These microfungi species could have been contaminated to the books by the readers. The microfungi isolated from the surface of the books and the air of the library are largely similar. This shows that the surface of the books are mostly contaminated by the air.

The microfungi isolated from the air and the surface of the books in the library have not been found in high levels in terms of the qualitative and quantitative aspects. The factors like the ventilation of the library, the cleaning of the floor and shelves with detergent and the surface of the books from time to time and less circulation of visitors, have a restricted effect on the microfungi species and numerical values.

In this research, it was found that the isolated microfungi like *Alternaria* species cause mycotic keratitis. *Aspergillus* species are important pathogens which can be effective on human and animals. *Chaetomium* species are rarely isolated in medical mycology laboratories. The pathogens of the *Cladosporium* species were transferred to *Cladophialophora* genus. *Penicillium* species may cause mycotic keratitis, otomycosis and endocarditis (Ellis *et al*., 2007). Besides, *Alternia, Aspergillus* and *Penicillium* species have an influence on the human health by producing mycotoxin (Tunail, 2000).

**Conclusion**

Microfungi isolated from the surface of the books and the library air can be hazardous to human health. On account of this, personal and environmental hygiene must be taken into consideration. Consequently, it would be beneficial for individual and environmental health to make further researches like this, to take measures for the improvement of air quality in the libraries and to clean the library materials steadily.

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