Dumlupınar Üniversitesi Fen Bilimleri Enstitüsü Dergisi
Sayı: 6 Ekim 2004



# A STUDY ON MICROFUNGI FLORA OF ERZURUM'S OUTDOOR AIR

**Ç. EFE* & İ. HASENEKOĞLU****

Abstarct

By using "Petri- Plate method" based on gravitation the microfungi flora of outdoor air in Erzurum city was studied. In this research 92 microfungi species and varieties were isolated from 288 samples taken monthly from 4 different areas of Erzurum's outdoor air between January 1993- December 1994. Among the species, 83 belonged to Moniliales, 7 to Mucorales, 2 to Sphaeropsidales. 88 sterile microfungi colonies were also found.

Excess colony numbers were *Penicillium, Cladosporium Alternaria* and *Trichoderma*. The most common species were *Cladosporium herbarum*, *Penicillium brevicompactum*, *Penicillium verrucosum var. verrucosum*, *Alternaria alternata*, *Penicillium fagi* and *Penicillium paxilli*. In four stations which we have taken samples, the most excessive colonies were found was Sanayi station and the least colony numbers were countered in Şehitler station. Air pollution has been perceived very much in Sanayi and Gürcükapı stations. This pattern seems to be correlated to the human population and activities, the vegetation areas and environmental conditions.

## 1. Introduction

Fungal spores are a normal component of air and cosmopolitan distribution of fungi has been attributed to the fact that fungi occupy micro-environments which occur in various ecosystems and geographical areas [1 ]

Recently, attention to air pollution, not just by chemical and physical pollutants but also by fungi propagules, has increased. McCartney [ 2 ] suggests that air is the primary way for microorganisms of many species to spread. Investigations on atmosphere aerosols, their composition, and impact of their components upon certain groups of microorganisms and their viability, as well as possibilities of microorganisms' adaptation to atmospheric conditions have been performed. Knowledge about the survival of microorganisms under extreme conditions of ambient air when their cells are affected by a profusion of chemical and physical factors is being accumulated [3,4 ].

Anahtar Kelimeler: Erzurum, Havadan gelen Mikrofunguslar, kirlilik, şehir havası

Atmospheric aerosols consist of biological and non-biological components. Bioaerosols of ambient air consist of various particles of organic origin: bacteria, their endospores, micromycete spores,conidia, and hyphal fragments, metabolites excreted by microorganisms, viruses, hair and skin particles of mammals, as well as many other organic wastes and decaying products. Toxines, excreted by microorganisms and other live organisms, are important elements of bioaerosols. Moubasher [ 1] supposed that airborne spores are basically a contribution from vegetation rather than soil. On the other hand, Burge [5] reports that dead grasses, leaves, fallen fruits, tree bark, dead wood and soil particles as well as animal and bird dropping and remains, provide adequate substrate materials for a wide variety of fungi in natural outdoor environments.

Although an individual habitat is seldom uniform, different parts may differ in their micro- climate, nutrient availability and susceptibility to microbial colonization, therefore changes in the environmental cause differs in diversity. Also, weather conditions such as rain, wind speed and direction, humidity, temperature, and flora and fauna are among the major factors that affect the collection of data [ 6 ]

Propagules of micromycetes can travel far and on their way contaminate various substrata of the environment. Micromycetes can therefore affect the activities of people and can cause diseases of plants, animals and people [ 7,8,9 ]. Airborne microorganisms may cause ill effects in humans ranging from mild irritation to disease. Examples of infections which may result from the presence of microorganisms in the air, are tuberculosis, measles, legionellosis, histoplasmosis, various mycoses, and toxicosis [ 8 ]. Therefore, recently the evaluation of airborne microorganisms has gained increasing importance.

Outdoor fungal airspora have extensively been studied in many cities in Turkey [ 10,11,12,13 ]. However, little is known about the fungal airspora in Erzurum city. Thus, this investigation was conducted to throw light mainly on the airborne fungal spores in the city, which has extremely bad air conditions and air pollution.

## 2. Material and Method

### 2.1 Geographical Location and Climate of the research area.

Erzurum is the highest city in Turkey (latitude 39° 55′ longitude 41° 16′, altitude 1800-2000m). And also it is one of the least temperature average cities in Turkey. Climate is continental. Rainy springs, hot and dry summers, cold and severe winters of long duration prevail in this area. So, vegetation period takes a short time.

According to measurements of the Ministry of Health, Erzurum is the most polluted province in the Eastern Anatolia Region. The main reasons for air pollution are

limited knowledge of the people on burning techniques and use of low quality coal. Apart from those factors, topographical situation of the city, irregular urbanization and increasing number of motor vehicles are also affective on the increase in pollution [14].

Meteorological conditions, high pressure, mountains around the city, and often-repeated inversion of events prevent effective measures for reducing air pollution in the city. Pollutants become so dense that it can be seen by naked eyes. Concentrations of nitrogen oxide ($NO_x$), sulphur dioxide ($SO_2$) and particle respectively 245 $\mu g/m^3$, 307 $\mu g/m^3$ and 221 $\mu g/m^3$ (the average of last five years) have been detected. Whereas the standards of WHO are: $SO_2$ = 150 $\mu g/m^3$, NOx = 250 $\mu g/m^3$, Particle= 75 $\mu g/m^3$ [ 15 ].

The area of the "Sanayi" is located at 1750 m, "Gürcükapı" is located at 1900m."Yenişehir" is located at 2000 m and "Şehitler" is located at 1950 m altitudes. The four areas are under the same meteorological conditions (temperature around to 11-5 ºC,humidity of 61% and about 2.500 mm of annual rainfalls. These areas were selected because of different location and different concentrations of people. According to the last census, the populations of the areas are: Sanayi 70.000, Gürcükapı 75.000, Yenişehir 60.000, and Şehitler 15.000 [16]

### 2.2. Sampling and identification of fungi

The "Gravitational Settle Plate Method" [ 17,18 ] was used to trap the fungal airspora mainly from 4 different urban areas located in Erzurum. This method is easy and available to all researchers. This study was started in January 1993 and lasted until December 1993. Peptone-dextrose Agar was used to catch the fungal spores and to eliminate bacteria and Actinomycetes and to retard the development of rapidly growing fungal colonies, 30 ml/ l streptomycin and 30 ml/l rose Bengal were added to the medium. The samples were caught 1 m from the ground and the plates were exposed for 45′ and brought to the laboratory. The plates were incubated at 25° for 10-15 days and examined periodically. At the end of incubation, colonies appeared on the agar surface were counted, and by examining under low magnification, the Penicillium and Aspergillus species were transferred to the Czapek solution Agar for identification and the species belonging to other generation Malt Agar for further evaluations. The identification of fungi was based on the macro and microscopic features following the keys of Morton & Smith [ 19 ], Apinis [ 20 ], Raper & Fennel [ 21 ], Zycha *et al*. [ 22 ], Booth [ 23 ], Ellis & Hesltine [ 24 ], Samson *et al*. [ 25 ], Pitt [ 26], Hasenekoğlu [ 27 ], Schipper [ 28 ], and Samson & Pitt [ 29 ].In the preparations of microscopic slides, the Butler and Mann's [ 30 ] cellulose band method was used in addition to the traditional standard methods.

### 2.3. Statistical analysis

Qualitative and quantitative results were compared by area, season and month. Seasons were defined as winter (December, January, February), spring ( March, April, May), Summer (June, July, August) and autumn ( September, October, November). The frequency ( %) of occurrence was calculated for each fungal species

## 3. Result and Discussion

The airborne fungi of Erzurum's outdoor air from 4 different areas (Sanayi, Gürcükapı, Şehitler, and Yenişehir) were studied. We found 92 species and varieties. The dominant family (in terms of the number of species) was Moniliales. 83 fungi species belong to this family, which constitutes 96.8% of the total colony number. (Table I).

According to our findings the most common fungi were the members of Penicillium (45,9%), Cladosporium (19,4%), Aspergillus (5,3%) and Alternaria (5,1%). Similar studies have reported that these species are cosmopolite species and appear everywhere[ 31,32 ]. The most common species were Cladosporium herbarum (17%), The most common species were Cladosporium herbarum (17%), Penicillium brevicompactum (12,9%), Penicillium verrucosum var. verrucosum (12,7%), Alternaria alternata (4,2%), Penicillium fagi (3,8%) and Penicillium paxilli (3,6%).

Among four locations, it was Sanayi where the most excessive colonies were found (33,3%) and the least colony numbers were encountered in Şehitler (19%). This possibly occurred due to less concentration of people than the others. Furthermore, three areas (Sanayi, Gürcükapı and Yenişehir) have busy streets and construction fields. There is considerable concern in environmental health circles about chemical and physical contaminants being emitted by road transport. Epidemiological studies are consistently reporting an association between fine particulate pollution and health [33]. Motor vehicle emissions are considered to be the main source of fine particles in ambient air of cities. Vehicle movement creates local turbulence, which promotes aerosolization of fungal spores from surrounding buildings, trees, and soil. Therefore, concentrations of fungal spores can be considerably increased near busy streets. In the construction field, demolition of old buildings may release concentrations of fungi high into the surrounding air.

The highest colony number of species were isolated in autumn (38,8%), and the least colony number in winter (9%) while in spring - 21.67%, in summer - 29.2%. Therefore, summer and autumn in Erzurum can be characterised by increasing numbers of the most frequently isolated species that may produce a negative impact

upon the health of people. Such rises in the concentrations in summer and autumn could be explained by the increase of the sources of airborne fungi, as well as meteorological factors forming favourable conditions for the accumulation of pollutants.

According to monthly dispersion; the most excessive colony numbers are on October, and then on September and on April. The least colony numbers are encountered on February (Table I).

However, it is rather complicated to compare the data on the concentrations of micromycetes and species composition obtained in our research with that of other authors because investigators use different devices for collecting fungal propagules, different media, and cultivating conditions. Although the geographic conditions and air polution is not similar to Erzurum city, some authors have presented similar data. Ayata and Ekmekçi [13 ] were found the highest spore level in autumn in İzmir (Turkey).

The airborne fungi of Natal, State of Rio Grande do Norte, Brazil were studied during one-year period. One hundred and twenty Petri dishes with culture medium were exposed at five different locations in the city of the thirty one genera identified The most frequent were: Aspergillus (78%), Penicillium (60%), Fusarium (42%), Cladosporium (21%), Curvularia (19%), Rhizopus (17%) and Rhodotorula (13%) [ 32 ].

In Wadi Qena during of one-year 83 species and 2 varieties representing 31 genera were collected. And Alternaria, Aspergillus, Claodosporium, Curvularia, Dreshlera, Epicoccum, Penicillium, Stemphlium and Ulocladium were isolated [ 34 ].

In the works of other researchers the following results have been presented; In the ambient air of the city of Turin (Italy), an area of temperate, suboceanic climate, the majority of detected fungi species belonged to Mitosporic fungi; micromycetes of the Penicillium (62.8%) and Aspergillus (23.3%) genera dominated. [ 35 ].

Comparison of our research results with those presented in the literature shows that the fungi species most frequently isolated from the air in Erzurum city are cosmopolitan, spread in different climatic zones.

According to Dix and Webster [36] some features of the fungi may contribute to explain their occurrence in polluted sites. For instance, the occurrence of the species of Trichoderma has been linked to the lack of carbon sources, and in the special case of T. harzianum, to low content of nitrogen compounds in the soil. In our study 55 colonies T. harzianum were found in four areas.

Giving some support to the suggestion of Purchio *et al*. [37] of using non-sporulating fungi as indicators of air pollution. 750 (10,9%) non-sporulating fungi were obtained in our study. The data confirm this idea.

Finally, it is a noticeable tendency that the frequency of conditionally pathogenic micromycete species is high in the air of Erzurum city. (Table II - Table III ).

Table I. Monthly airborne fungi receved from the air of Erzurum's urban air

| MONTH | NC | % | MONTH | NC | % |
|---|---|---|---|---|---|
| January | 246 | 3.59 | July | 673 | 9.82 |
| February | 162 | 2.36 | August | 737 | 10.76 |
| March | 185 | 2.70 | September | 879 | 13.90 |
| April | 872 | 12.73 | October | 1411 | 20.60 |
| May | 424 | 6.19 | November | 370 | 5.40 |
| June | 595 | 8.68 | December | 220 | 3.21 |
| Total NC = 6847 | | | | | |

NC : Number of colony

Table II. The Number of Fungal Colonies In Gürcükapı, Şehitler, Sanayi and Yenişehir ( urban air of Erzurum city/Turkey) from Jan/1993 to Dec/1993 and frequency of each taxon

| **İsolite Name** | **G** | **Ş** | **S** | **Y** | **Total** | **freq** |
|---|---|---|---|---|---|---|
| | NC | NC | NC | NC | NC | % |
| MUCORALES | | | | | | |
| *Absidia repens* Van Tieghem 1876 | 1 | 2 | 1 | | 4 | 0,05 |
| *Actinomucor elegans* Hessletin 1957 | 3 | | 4 | | 7 | 0,10 |
| *Mucor circinelloides* Schipper 1957 | 5 | | | | 5 | 0,07 |
| *Mucor hiemalis* Wehmer 1903 | 8 | 3 | 8 | 4 | 23 | 0,33 |
| *Mucor plumbeus* Bonord 1876 | | | 8 | | 8 | 0,11 |
| *Mucor ramosissimus* Samutsevitsch 1929 | | 2 | | | 2 | 0,02 |
| *Rhizopus oryzae* Went & Prinsen Geerlings 1875 | 11 | 20 | 106 | 26 | 163 | 2,38 |
| SPHAEROPSİDALES | | | | | | |
| *Endothiella sp.* | | | | 1 | 1 | 0,01 |
| *Phoma sp.* | | 5 | | | 5 | 0,07 |
| MONİLİALES | | | | | | |
| *Acremonium furcatum* Gams 1970 | 2 | | | 1 | 3 | 0,04 |
| *Acremonium sp.* | 3 | 19 | 9 | 2 | 33 | 0,48 |
| *Alternaria alternata* Keissler 1912 | 36 | 21 | 156 | 80 | 293 | 4,27 |
| *Alternaria brasicicola* Wiltsihre 1947 | 1 | 1 | 6 | 2 | 10 | 0,14 |

| Table II. continue | | | | | | |
|---|---|---|---|---|---|---|
| *Alternaria pluriseptata* Jorstad 1945 | | | 21 | | 21 | 0,30 |
| *Alternaria radicina* Dreshler & Eddy 1922 | | | 5 | 22 | 27 | 0,39 |
| *Alternaria raphani* Grpves & Skolko 1944 | | | 4 | | 4 | 0,05 |
| *Arthrinium urticae* Ellis 1971 | | 1 | | | 1 | 0,01 |
| *Aspergillus clavatus* Desm. 1834 | 15 | | | | 15 | 0,21 |
| *Aspergillus chevalieri* Thom & Church 1926 | 1 | | | | 1 | 0,01 |
| *Aspergillus kanagavaensis* Nehira 1951 | | | | 20 | 20 | 0,29 |
| *Aspergillus fumigatus* Fresenius 1863 | 1 | 12 | | 4 | 17 | 0,24 |
| *Aspergillus ochraceus* Wilhelm 1877 | 5 | | | 4 | 6 | 0,08 |
| *Aspergillus auricomus* Saito 1939 | 3 | | | 1 | 3 | 0,04 |
| *Aspergillus ficuum* Hennings 1895 | 18 | 5 | 4 | | 27 | 0,39 |
| *Aspergillus niger* Van Tieghem 1867 | 10 | 5 | 49 | 1 | 65 | 0,94 |
| *Aspergillus candidus* link 1824 | | | 1 | | 1 | 0,01 |
| *Aspergillus flavus* Link ex Gray 1821 | 1 | 8 | 5 | | 14 | 0,20 |
| *Aspergillus coremiformis* Rambelli et. al. 1979 | 1 | 4 | | | 5 | 0,07 |
| *Aspergillus terricola var. americana* Marchal 1971 | | | 1 | | 1 | 0,01 |
| *Aspergillus wentii* Wehmer 1896 | 10 | | | 1 | 11 | 0,16 |
| *Aspergillus versicolor* Trabschi 1926 | 11 | 9 | 14 | 49 | 83 | 1,21 |
| *Aspergillus nidulans* Winter 1884 | 5 | 51 | | 2 | 58 | 0,84 |
| *Aspergillus ustus* Thom & Church 1926 | 14 | 24 | | | 38 | 0,55 |
| *Aspergillus carneus* Blochvitz 1945 | | | | | 1 | 0,01 |
| *Aspergillus citrisporus* Raper, Fennel & Tresner1953 | | | | 1 | 1 | 0,01 |
| *Botrytis cinerea* Nocca & Balb 1871 | | | | 6 | 6 | 0,08 |
| *Botriyotricum sp.* | | 3 | 1 | 1 | 5 | 0,07 |
| *Cladosporium cladosporioides* De Vires 1952 | 39 | 37 | | 91 | 167 | 2,43 |
| *Cladosporium herbarum*(Pers) Linnk ex S.F. Gray 1821 | 454 | 131 | 506 | 73 | 1164 | 17 |
| *Cladosporium sp.* | | 1 | | | 1 | 0,01 |
| *Coccidioides immitis* Stiles & Gilchrst 1896 | | | 11 | | 11 | 0,16 |
| *Doratomyces microsporus* Morton & Smith 1963 | | | | 1 | 1 | 0,01 |
| *Dreshlera ravenelli* Subram & Jain 1966 | | | | 1 | 1 | 0,01 |
| *Embellisia chlamydospora* Simmons 1971 | 1 | 8 | 1 | | 10 | 0,14 |
| *Fusarium solani* Snyder & Hensen 1941 | | 6 | 6 | 4 | 16 | 0,23 |
| *Fusarium sp.* | | 3 | 3 | 38 | 44 | 0,64 |
| *Humicola grisea* Traen 1914 | | 1 | | | 1 | 0,01 |
| *Mortierella antarctica* Lineman 1969 | 3 | | 2 | 4 | 9 | 0,13 |
| *Nectria inventa* Pethybr 1919 | 36 | 12 | | 11 | 61 | 0,89 |
| *Penicillium spinulosum* Thom 1910 | | | | 1 | 1 | 0,01 |
| *Penicillium multicolor* Grigorieva- Manoilova 1915 | | 2 | 20 | | 22 | 0,32 |
| *Penicillium chermesinium* Biourge 1923 | | 3 | 5 | 12 | 20 | 0,29 |
| *Penicillium cyaneum* Biourge 1923 | | | 56 | | 56 | 0,81 |
| *Penicillium humuli* Van Beyma 1939 | 108 | 17 | 13 | 2 | 140 | 2,04 |
| *Penicillium jantinellum* Biourge 1923 | 2 | | | 1 | 3 | 0,04 |
| *Penicillium simplicissimum* Thom 1930 | | | 12 | | 20 | 0,29 |
| *Penicillium godlewskii* Zaleski 1927 | 11 | 10 | 6 | 12 | 39 | 0,56 |
| *Penicillium canescens* Sapp 1912 | 4 | | 1 | 3 | 8 | 0,11 |
| *Penicillium jensenii* Zaleski 1927 | 52 | 5 | | 13 | 70 | 1,02 |
| *Penicillium atro- sanquineum* Dong 1973 | 2 | | | | 2 | 0,02 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Penicillium citrinum* Thom 1910 | 43 | 21 | 18 | | 82 | 1,19 |
| *Penicillium corylophylum* Dierck 1901 | 1 | | | | 31 | 0,45 |
| *Penicillium steckii* Zaleski 1927 | 4 | 27 | 30 | | 31 | 0,45 |
| *Penicillium paxilli* Bainer 1907 | 16 | 40 | 190 | 1 | 247 | 3,60 |
| *Penicillium chrysogenum* Thom 1910 | 3 | 24 | 18 | 7 | 52 | 0,75 |
| *Penicillium roqueforti* Thom 1906 | | 3 | 27 | | 30 | 0,43 |
| *Penicillium fagi Martinez & Ramirez 1978* | 150 | 82 | | 32 | 264 | 3,85 |
| *Penicillium farinosum* Novobranova 1974 | | 1 | | | 1 | 0,01 |
| *Penicillium brevicompactum* Diercx 1901 | 173 | 291 | 170 | 255 | 889 | 12,9 |
| *Penicillium stoloniferum* Thom 1910 | | 1 | | | 1 | 0,01 |
| *Penicillium verrucosum* Diercx *var. verrucosum* Samson, Stolk & Hadlok 1976 | 194 | 61 | 266 | 349 | 870 | 12,7 |
| *Penicillium verrucosum* Diercx *var. Corymbiferum* Samson, Stolk & Hadlok 1976 | | | 97 | 2 | 99 | 1,44 |
| *Penicillium verrucosum* Diercx *var. Melanochlorum* Samson, Stolk & Hadlok 1976 | | | | 11 | 11 | 0,16 |
| *Penicillium expansum* Link ex Gray 1871 | 43 | 8 | 11 | 22 | 84 | 1,22 |
| *Penicillium italicum* Wehmer *var. italicum* Samson, stolk & Hadlok 1976 | | 2 | | 5 | 7 | 0,10 |
| *Penicillium granulatum* Bainer 1905 | 25 | | 16 | 18 | 59 | 0,86 |
| *Phialophora sp.* | 6 | 4 | | | 10 | 0,14 |
| *Scopulariopsis brevicaulis* Bainer 1907 | | 2 | 7 | 2 | 11 | 0,16 |
| *Sepedonium chrysospermum* Bull 1832 | | 6 | 21 | | 27 | 0,39 |
| *Trichoderma aureoviride* Rifai 1969 | 20 | 4 | 16 | 6 | 46 | 0,67 |
| *Trichoderma hamatum* Bain 1906 | | | | | 1 | 0,01 |
| *Trichoderma harzianum* Rifai 1969 | 16 | 14 | 19 | 6 | 55 | 0,80 |
| *Trichoderma koningi* Oud 1902 | 11 | | 1 | 1 | 13 | 0,18 |
| *Trichotecium roseum* Link ex Gray 1821 | 1 | 40 | 11 | 21 | 73 | 1,06 |
| *Ulocladium atrum* Preus 1852 | 1 | 1 | 11 | | 13 | 0,18 |
| *Ulocladium tuberculatum* Simmons 1967 | 9 | 13 | 12 | 22 | 56 | 0,81 |
| Non sporulating fungi | 188 | 188 | 197 | 177 | 750 | 10,9 |
| **TOTAL** | **1804** | **1306** | **2286** | **1451** | **6847** | |

G: Gürcükapı S: Sanayi
Ş: Şehitler Y: Yenişehir T: Total

Table III. Selected Important Pathogen Fungi from urban air of Erzurum city centre acording to scienfic literature [ 38,39]

| **Fungal Species** | **Effects** | **Potential Health Effect** |
|---|---|---|
| Acremonium sp. | Allergen | İnfection of cornea and nails |
| Alternaria alternata | Allergen<br>Toxic | Asthma,pulmonary emhysema<br>Nephrotoxic,hepatotoxic, hemorragic |
| Aspergillus clvatus | Allergen | Allergic alveolitis |
| Aspergillus candidus | Toksic | Diseases in humans |
| Aspergillus carneus | Pathogen | Diseasens in humans |
| Aspergillus flavus | Toxic,<br>Carsinogen<br>Teratogen<br>Mutagen<br>Allergen | Poisonous to human by ingestion, occupational disease via inhalation<br>Aspergillosis, infections, |
| Aspergillus fumigatus | Allergen<br>Pathogen | Aspergillosis, asthma, rhinits, hypersensiticit pneumonitis |
| Aspergillus nidulans | Toksic | Aspergilosis |
| Aspergillus niger | Pathogen | Aspergillosis, skin and pulmonary infections |
| Aspergillus ochraceus | Allergen | Allergic alveolitis |
| Aspergillus ustus | Pathogenic | Disease in humans |
| Aspergillus versicolor | Toxic<br>Carcinogen | Diarrhea and up set stomach, kidney and liver carcinogen |
| Botrytis cinerea | Allergen | Allergic alveolitis |
| Cladosporium cladosporioides | Alergen | Chromoblastomycisis |
| Cladosporium herbarum | Allargen | Chromoblastomycisis |
| Fusarium solani | Toxic | Trichothecene toxins which may be associated with disease in humans |
| Fusarium sp. | Toksic<br>Allergen | Alimentary toxic aleukia<br>hemorragic sendrome,<br>eye,skin,nail infections |
| Geotrichum candidum | Alergen | Secondary<br>İnfection, geotrichosis |
| Mucor circinelloides | Allergen | Zygomycosis |
| Mucor hiemalis | Pathogen | Diseasens in humans |
| Mucor plumbeus | Allergen | Mucorosis, brain, eye, skin infections |
| Paecilomyces sp. | Allergen | Pneumonia |
| Penicillium brevicompactum | Allergen | Allergic alveolitis |
| Penicillium chrysogenum | Allergen | Allergic alveolitis |
| Penicillium citrinum | Pathogen | Diseasens in humans |
| Penicillium corylophylum | Allergen | Allergic alveolitis |
| Penicillium expansum | Allergen<br>Toxic | Allergicalveolitis,<br>Neurotoxic |
| Phoma | Allergen | Phaeohyphomycosis |
| Scopulariopsis brevicaulis. | Allergen | Allergy |
| Trichoderma harzianum | Toksic<br>Allergen | İnhibition by trichothecenes, allergy |
| Trichotecium roseum | Toxic<br>Allergen | Associated disease in humans |

## 4. REFERENCES

[ 1] Moubasher A. H.1993. Soil fungi of Qatar and other Arab countries. The scientific and Applied Research Centre, University of Qatar, Doha, Qatar, 566.

[ 2] McCartney H.1994. Dispersal of spores and pollen from crops. Grana, 33, 76- 80.

[ 3] Nevalainen A.,Willeke K., Liebhaber F., Pastuszka J., Burge H., Henningson E.1993. Bioaerosol Sampling. In: Willeke K, Baron PA (Eds.): Aerosol Measurement, Principles, Techniques and Applications, New York, 471-492.

[ 4] Willeke K, Baron PA.1993. Bridging Science and Application in AerosolMeasurement. In: Willeke K, Baron PA (Eds.): Aerosol Measurements. Principles, Techniques and Applications, Van Nostrand Reinhold, New York.3-7.

[ 5] Burge H.A.1985. Fungus allergens. Clinical Review of Allergy 3: 319-329.

[ 6] Lynch J.M. and Hobbie J.E.1988. Aeral dispersal and development of microbial communities. Blackwell Sci. Publ., 207-237 pp.

[ 7] Isaac S.1996. To what extent do airborne fungal spores contribute to respiratory disease and allergic reactions in humans? Mycol Res, 96: 535-541.

[ 8] Li D, Kendrick B.1995. A year round comparison of fungal spores in indoor and outdoor air. Mycologia, 87: 190-195.

[ 9] Lacey J., Crook B.1988. Fungal and actinomycete spores as pollutants of the workplace and occupational allergens. Ann Occup Hyg, 32: 515-533.

[ 10] Ulutan F., Çopur S., Koçoğlu T. 1985. Çarşamba Kızılot Sağlık Ocağına Bağlı Köylerde Havanın Fungal Florası. Mikrobiyoloji Bülteni, 19: 139-143.

[ 11] Özyaral O., Germayan H., Johanson C.B. 1988. İstanbul'da Ev Tozu Küfleri Üzerine Çalışmalar I. Yatak Tozu Küf Florasının Saptanması. Mikrobiyoloji Bülteni 22: 51- 5.

[ 12] Güneşer S., Köksal F., Yaman A., Özkoyuncu F.1989. Adana'nın Çeşitli Bölgelerindeki Ev Tozlarında Görülen Mantar Sporlarının Araştırılması. XXIV. Türk Mikrobiyoloji Kongresi.12-18 Mayıs 1990.Özet Kitabı, 28.

[ 13] Ayata C., Ekmekçi S. 1992. İzmir İlinin Çeşitli Semtlerindeki Ev İçi ve ev Dışı Havanın Fungal Florası. Fırat Üniversitesi XI. Ulusal Biyoloji Kongresi, Elazığ. 24- 27 Haziran 1992.

[ 14] Boncukcuoğlu, R., Kocakerim M., Bayhan Y.K., 1991. Isıtmada Kullanılan Kalitesiz Linyitlerden Kaynaklanan Hava Kirliliği. Yanma ve Hava Kontrolü. 1. National Semposium, Article Book. p: 533-544. 10-2, June, Ankara.

[ 15] Topçu N. 1991. Fosil Yakıtların Erzurum Hava Kirliliğine Katkısı. Atatürk Üni ZF.Dergisi. Erzurum. 2:36-40,

[ 16] Vural M. 1993. Erzurum, Yakutiye Yayıncılık ve Bilgi İşlem Merkezi. Erzurum. 41-51.

[ 17] Yoshida K, Ando M, Sakata T, Araki S.1988. Environmental mycological studies on the causative agent of summer- type hypersensitivity pneumonitis. J.Allergy Clin Immunol, 81: 475-83.

[ 18] Güneser S., Atici A., Köksal, Yaman A.1994. Mold allergy in Adana, Turkey. Allergol Immunopathol, 22-52-4.

[ 19] Morton, F.J., and Smith, G., 1963, The Genera Scopulariopsis, Microascus and Doratomyces Mycological Papers, No: 8,1- 96 pp.

[ 20] Apinis, E. E. 1964. Revision of British Gymnoacaceae Mycological Papers, No: 96: 1-57

[ 21] Raper K.B and Fennel D.I.1965. The genus Aspergillus. Baltimore. 685 pp.

[ 22] Zycha H., Siepmann R., Linneman G.1969. Mucorales. Lehre. 1355 pp.

[ 23] Boot C. 1971. The Genus Fusarium. Commonwealth Mycological Institue, Kew, Surrey, England, 273 pp.

[ 24] Ellis, J.J and Hesseltine, C. V.1965. The genus Absidia: Globose- spored species, Mycologia, 57: 223-235 pp.

[ 25] Samson R.A., Stolk A.C., Hadlok R.1976. Revision of subjection Fasciculata of Penicillium and some allied species. Mycology. 2: 1-47.

[ 26] Pitt J.1979. The Genus Penicillium. Academic Press. London, New York,Toronto, Sydney, San Fransisco. 200-201 pp.

[ 27] Hasenekoğlu, İ.1991.Toprak Mikrofungusları. Atatürk Üniversitesi. K.K. Eğt. Fak. Yay., Erzurum.

[ 28] Schipper M.A.A.1984. A revision of genus Rhizopus. Stud.Mycol. 25: 1-34.

[ 29] Samson R:A., Pitt J.I. (Eds.)1985. Adverces in Penicillium and Aspergillus Systematics. Plenium Press. New York and London. 483 pp.

[ 30] Butler, E. E and Mann, M.P.1959.Use of cellophane tape for mounting and photographing phytopathogenic fungi. Phytopath. 49: 231-232

[ 31] Pasanen AL, Niinine M, Kalliokoski P, Nevalainen A, Jantunen M.J.1992.Airborne Cladosporium and other fungi in damp versus reference residences. Atmospheric Environ, 26B, 121-124.

[ 32] Braz, R.F and Ribeiro,M.A.1993. Airborne Fungi Isolatd from Natal, State of Rio Grande Norte- Brazil Rev- Microbiology, Vol, 24 No: 3 pp 198 - 202, ıssn 0001-3714 En. En, Algology Mygology Protozoology.23: 48

[ 33] D'Amato G. 2000.Urbain air pollution and plant derived respiratory allergy. Clin Exp Allergy, 30, 628-636.

[ 34] Abdel - Hafez S.I.I. and El-Saida.H.M. 1989. Seasonal variations of airborne fungi in Wadi Qena, Eastern Desert, Egypt. Grana 28: 193-203.

[ 35] Marchisio VF, Nosenzo C, Caramiello R.1992. Preliminary survey of airborne fungal propagules in Turin, Italy. Mycol Res, 96, 535-541.

[ 36] Dix, N.J.; Webster, J. 1995. Fungal Ecology. Cambridge, University Press, 549p.

[ 37] Purchio, A., Gambale., W., Paula, C.R., Ugoline, C., Remie, C.A.1984. Airborne fungi of Baixada Santista, State of São Paulo, Brazil. Rev.Microbiol.,15:258-265,.

[ 38] Burge HA. 1989. Airborne allergenic fungi. Classification, nomenclature, anddistribution. Immunol Allergy Clin N Am, 9:307-19, Miller JD. Fungi as contaminants in indoor air. Athmospheric Environ, 26A:2163-72,1992

[ 39] Yang, C.S. 1994. Toxic Effects of Some Common Indoor Fungi. Enviros: The Healthy Building Newsletter. Sept.

# ERZURUM'UN EV DIŞI HAVASININ MİKROFUNGUS FLORASI ÜZERİNE BİR ARAŞTIRMA

**Ç. EFE* & İ. HASENEKOĞLU****

Özet

Yeçekimine dayalı Petri- Plak metodu kullanılarak Erzurum şehrinin ev dışı havasının mikrofungus florası çalışılmıştır. Bu araştırmada, ocak1993- aralık 1994 yılları arasında Erzurum'un dört farklı bölgesinin ev dışı havasından 92 mikrofungus tür ve varyetesi izole edilmiştir. 83 tür Moniliales'e, 7si Mucorales'e 2 si Sphaeropsidales'e aittir. Ayrıca 88 steril mikrofungus kolonisi bulunmuştur.

En fazla koloni sayısı Penicillium, Cladosporium Alternaria ve Trichodermaya aittir. En yaygın türler Cladosporium herbarum, Penicillium verucosum var. verrucosum, Alternaria altenata ve Penicillium fagidir.Örnek alınan dört istasyon içinde en fazla koloni sayısı Sanayi istasyonunda en az koloni sayısı Şehitler istasyonunda bulunmuştur. Bunun insan populasyonu ve aktivitesi, vejetasyon alanı ve çevre koşulları ile ilgili olduğunu söyleyebiliriz.

**Key Words:** Airborne microfungi, Erzurum, Pollution,Urban air

* Şehit Ömer Budak Cad. Alapaslan Gazi Mah. Ağaçlı Sitesi. F Blok, No:3 Dadaşkent, Erzurum chefe49@hotmail.com

** Atatürk Üniversitesi Fen ve Matematik Alanları Eğitimi Anabilim Dalı Biyoloji Eğitimi Bölümü, Erzurum ihasenek@hotmail.com.