SURVEY OF INDOOR AIRBORNE FUNGI IN DIFFERENT EDUCATIONAL INSTITUTIONS FROM IASI, ROMÂNIA

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The aim of this investigation was to monitor the densities and distribution of indoor airborne fungal spores that can cause an allergic response in three educational institutions placed in different location of Iasi City, Romania. Areas monitored were two lecture halls and one laboratory from the university campus, one classroom from a primary school and one from high school.

Air samples from all location were taken using the Koch sedimentation method, which suppose that Petri dishes which contained potato-dextrose-agar (PDA) and peptone-glucose-agar (PGA) media in three different compositions (classic, with rose-bengal and with streptomycin) are exposed to room air for a 5-min period. Samples were collected from April to May 2009. A total of 333 microfungal colonies were counted on 90 plates. Identification of these showed 11 genera and 10 colonies of indeterminate spores from the indoor air samples. The identification of the fungi was made according to their microscopic properties and through references.

The results showed that in all three locations were differences in the distribution of fungal genera, but Penicillium, Cladosporium and Aspergillus were the most prevalent fungal genera (43.8, 22.2 and 18.0% of the total, respectively). Indoor concentration of fungal spores in the university laboratory and high school classroom were found to be higher as the international standards and has potential to develop adverse health effects to the occupants.

***Key words**: indoor air - fungal spores density - educational institution*

Fungal spores and other airborne structures are ubiquitous in the indoor environments. Some species from *Cladosporium*, *Penicillium* and *Asperigillus* fungi genera can cause extreme allergic reaction or respiratory and other related diseases in humans. The physicall condition from different building structures, such as humidity level, temperature and the presence of organic and anorganic substrates, influence the fungal concentration in their indoor air. Collection of airborne spores can provide valuable information about the indoor air quality in many types of buildings [8].

The aim of this investigation was to monitor the densities and distribution of indoor airborne fungal spores that can cause an allergic response in three educational institutions placed in different location of Iasi City, Romania.

MATERIAL AND METHOD

The fungal composition of the air from different educational institutions was investigated. Areas monitored were two lecture halls and one laboratory from the university campus, one classroom from a primary school and one from high school. Samples were collected from April to May 2009. Air samples from all location were taken using the Koch sedimentation method, which suppose that Petri dishes which contained potato-dextrose-agar (PDA) and peptone-glucose-agar (PGA) media in three different composition (classic, with rose-bengal and with streptomycin) are exposed to room air for a 5-min period. Petri plates used were incubated aerobically at 28 ° C for 5 days.

After incubation and identification, concentration of airborne fungi was calculated as colony forming units (CFU)/cm^2. Light microscope was used to determine the colonial features and the morphological structures of the fungi. The determination of the morphological structures of fungi was carried out on material mounted in lactophenol. Fungi were identified to genus level based on micromorphology and using the books by Barnett and Ellis [3, 6].

RESULTS AND DISCUSSIONS

On the basis of the analyses of the air samples collected from different educational institutions by Koch sedimentation (passive) method, the microbial contamination was determined. This method was used because of its inherent practicalities, low cost and ease of use to obtain preliminary or qualitative information regarding the air fungal spores [2, 7].

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The results showed that in all three locations were differences in the distribution of fungal genera, but *Penicillium*, *Cladosporium* and *Aspergillus* were the most prevalent with 43.8, 22.2 and 18.0% of the total, respectively. Other fungi genera included *Alternaria*, *Botrytis*, *Trichoderma*, *Verticillium*, *Fusarium*, *Stemphyllium*, *Rhizopus*, and *Mucor*. Fungi isolated from sampled air are presented in *Figure 1*.

Aspergillus and *Penicillium* spores are the most frequent and predominant aeroallergens in the world. Hu *et al.* [8] indicated that airborne *Penicillum*, *Cladosporium* and *Aspergillus* spores represent the highest average counts in school buildings. The most common indoor fungus are *Cladosporium*, *Alternaria*, *Aspergillus* and *Penicillium* species [18].These results are compatible with our findings; the above mentioned genera were found in high frequency in our work (84.0% –*fig. 1*).

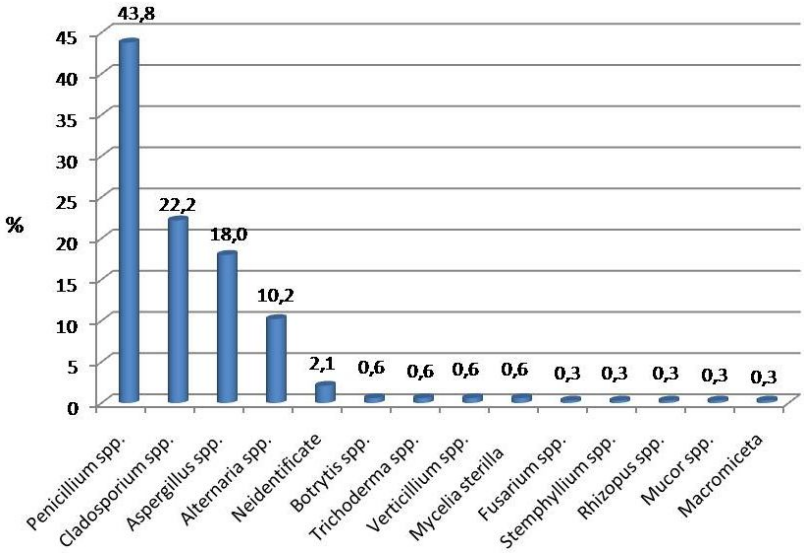

Figure 1 **Frequency of isolated fungi**

The quality of indoor air from the educational institutions depends on internal sources, such cleaning procedures, air ventilation, temperature and relative humidity. The air contamination in educational rooms was measured and the results varied from 120.8 to 862.0 CFU/m^3 (*tab. 1*).

No established guidelines are available regarding the permissible limits for exposure to airborne fungal spores to assess health impact, due to the complexity of their composition, variations in human response to exposure, and difficulties in recovering microorganisms that can pose a hazard during routine sampling [10]. However, there are some recommended concentrations for building environments. For clean areas the normal level of airborne fungi should be under 550 CFU/m^3 Rooms with airborne fungi between 550 and 700 CFU/ m^3 are regarded as contaminated, while those with CFU/m^3 greater than 700 were regarded as highly contaminated [11].

Table 1

Indoor airborne fungi concentration in different educational institutions

Sala	Genuri identificate	Concentraţie micromicete (UFC/m^3 aer)	Normele orientative pentru încărcarea fungică a aerului din încăperi
Amfiteatrul A1 al USAMV Iaşi	*Penicilium, Alternaria, Cladosporium, Botrytis, Aspergilus, Fusarium*	244,3	valori normale (< 550 UFC/m^3 aer)
Amfiteatrul A2 al USAMV Iaşi	*Penicilium, Cladosporium, Alternaria*	483,9	valori normale (< 550 UFC/m^3 aer)
Laboratorul L7 al USAMV Iaşi	*Cladosporium, Penicilium, Alternaria, Aspergilus, Stemphyllium, Rhizopus*	**718,3**	**Infestare maximă (> 700 UFC/m^3 aer)**
Clasa I-a A din Şcoala Generală "Elena Cuza" din Iaşi	*Cladosporium, Alternaria, Penicilium, Aspergillus, Mycelia sterilla*	120,8	valori normale (< 550 UFC/m^3 aer)
Clasa a XII-a E din Liceul Agricol "V.Adamachi" Iaşi	*Caladosporium, Alternaria, Aspergillus, Penicilium, Botrytis, Verticillium, Trichoderma, Mucor*	**862**	**Infestare maximă (> 700 UFC/m^3 aer)**

Indoor concentration of fungal spores in the university laboratory and high school classroom were found to be higher as the recommended concentration and has potential to develop adverse health effects to the occupants (*tab. 1*).

According to Pastuszka *et al.* [16], *Cladosporium*, *Alternaria* and *Aspergillus* are the main fungi to which children may be sensitised and to which allergic symptoms can be provoked. Exposure to the aeroallergen *Alternaria* is a risk factor for respiratory arrest in children and young adults with asthma. *Alternaria*, *Cladosporium*, *Curvularia*, *Fusarium*, *Trichoderma* and *Verticillium* may produce mycotoxicosis in humans. Moreover, Daisey *et al.* [5] reported that asthma and "sick building syndrome" symptoms are common in schools. *Aspergillus* and *Penicillium* genera produce more spores than other species.

In case of the other three location the airborne fungal spores concentration was lower as the normal level, so that no negative health effects for occupants were expected.

CONCLUSIONS

1. Indoor concentrations of fungal spores in the university laboratory and high school classroom were found to be higher as the recommended concentration (>700 CFU/m^3) and have potential to develop adverse health effects to the occupants.

2. In case of the two lecture halls and the primary school classroom the airborne fungal spores a concentration was lower that 550 CFU/m^3, so that no negative health effects for occupants were expected.

3. The maximal number of fungal genera was found in the high school classroom: *Penicillium, Cladosporium, Alternaria, Aspergillus, Botrytis, Trichoderma, Verticillium* and *Mucor*.

4. The fungal genera *Penicillium, Cladosporium* and *Aspergillus* were the most prevalent with 43.8, 22.2 and 18.0% of the total, respectively. Other fungi genera included *Alternaria, Botrytis, Trichoderma, Verticillium, Fusarium, Stemphyllium, Rhizopus,* and *Mucor*.

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