

Aerobiological monitoring for fungal spores in a rehabilitation hospital in Northern Italy

Antonio Meriggi^a, Stefano Ricci^{b,*}, Mariella Bruni^b, Renato Corsico^a

^aDivision of Pneumology, "Salvatore Maugeri Foundation", IRCCS Medical Centre of Rehabilitation, 27040 Montescano (PV), Italy

^bAnalysis Laboratory, "Salvatore Maugeri Foundation", IRCCS Medical Centre of Rehabilitation, 27040 Montescano (PV), Italy

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Abstract

In the setting of an aerobiological study of confined environments and environmental prevention of nosocomial infections, aerobiological monitoring of 22 areas in Montescano Medical Rehabilitation Centre (Pavia) was performed in three different months: February, May, and August, 1994. A Lanzoni 3000 spore trap was used for the monitoring. Examination of the results showed that, in the environments monitored, the indoor presence of fungi increased progressively over the three periods considered. The behaviour of individual genera of fungi differed. In the winter period *Penicillium* and *Aspergillus* were the most commonly encountered genera, *Cladosporium* was the dominant genus from the spring to the summer while the yeasts had their maximum counts in the spring morning. The use of air conditioning, combined with the low air exchange between outdoors and indoors in some of the environments certainly played a part in the low concentrations of these latter aerofungi. Copyright © 1996 Elsevier Science Ireland Ltd.

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1. Introduction

Indoor environments are characterized by simultaneously present chemical, physical and biological pollution for long periods of time, albeit not at high concentrations, capable of influencing an individual's health. (Lebowitz, 1991). From among the biological pollutants, research and identification of the fungi warrants particular attention since their spores are a potential pathogenic factor for the respiratory system as causes of immunoallergic and/or infectious diseases, (D'Amato, 1993; Peat et al., 1991) the latter being more common in debilitated and/or immunocompromised individuals. Because of their health-related importance aerobiological studies of confined environments should be performed in all Centres in

which health care functions are carried out. This study was conducted in the setting of nosocomial infection control, a field in which there is ever increasing interest. In this study it was our intention to evaluate the level of contamination by fungal aerospores in a confined environment in a hospital, the Montescano Medical Rehabilitation Centre (Pavia), characterised by the presence of subjects at risk, those in the Respiratory, Cardiology and Neurology Departments, and by heavily populated environments (gymnasia, out-patient areas, kitchens). The study was rendered of particular interest by the fact that the Medical Centre contains patients who have received organ transplants (heart and/or lungs) or are waiting for a transplant, in addition to those affected by chronic respiratory diseases, which make it mandatory to control the quality of the air carefully so as to minimize the presence of atmospheric biocontaminants.

* Corresponding author.

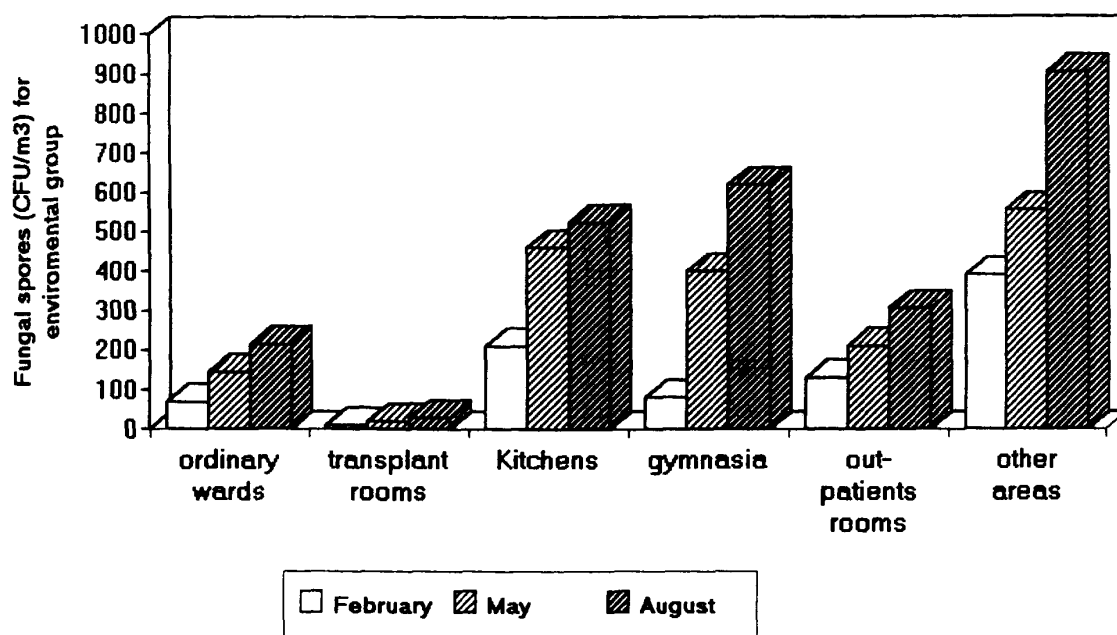


Fig. 1. Concentration (CFU/m³) of airborne fungi in nosocomial environments.

2. Materials and methods

The environmental monitoring was carried out during the period from February to August 1994. The sets of measurements were performed, respectively in the months of February, May and August. This allowed us to monitor any variation in the fungal concentration in the three periods (winter, spring and summer) in relation to the presence or absence of air conditioning. A Lanzoni 3000 volumetric spore trap, suitable for both the count and the identification of the fungi, was used for the sampling. The confined air was aspirated at flow rate of 15 l/min for 10 min and directed onto 10 cm diameter Petri dishes containing three different culture media: sabouraud dextrose agar, potato dextrose agar and corn meal agar. The dishes containing potato dextrose agar and corn meal agar were incubated at 25°C for 3–7 days, those with sabouraud dextrose agar at 37°C for 24–48 h. The fungal colonies were identified on the basis of their macroscopic characteristics and microscopic examination of their spores. Classification of the moulds was performed by transplanting the individual colonies on to czapek-dox agar medium to highlight their different sporogenous structures and thus aid identification. The 22 environments monitored were: 4 ordinary wards, 2 transplant rooms, 1 subintensive therapy unit, 4 kitchens, 3 gymnasia, 5 out-patient rooms and 3 other areas (1 coffee bar, 2 corridors) habitually frequented by both patients and their relatives as well as medical and nursing staff. An air

conditioning system was in operation during the summer period in some of the environments monitored (the 2 transplant rooms, the subintensive therapy unit containing 6 beds and all the gymnasia).

3. Results

Fig. 1 reports the mean concentrations of the fungal colonies in relation to the various groups of environments during the three sampling

At the first monitoring (February), the rooms with the transplant patients and the subintensive therapy unit registered the lowest number of fungal colonies: 10 CFU/m³. The ordinary wards, out-patients departments and gymnasia also had fairly low number of colonies with value of, respectively, 70, 130, 80 CFU/m³.

Middle values were recorded from the kitchens (210 CFU/m³), while the entrance to the Centre, the corridors and the coffee bar, reported in the graph as 'other environments' registered the highest mean: 390 CFU/m³ spores. In the second sampling period (May), the subintensive therapy unit and the transplant rooms still had the lowest number of spores 20 CFU/m³, followed by the ordinary wards 145 CFU/m³, out-patient departments 210 CFU/m³, with the highest mean again being found in the corridors and coffee bar: 555 CFU/m³ spores. Fungal spores were also present in moderation in the kitchens 460 CFU/m³ and the gymnasia 400 CFU/m³. In the last sampling period (August), yet

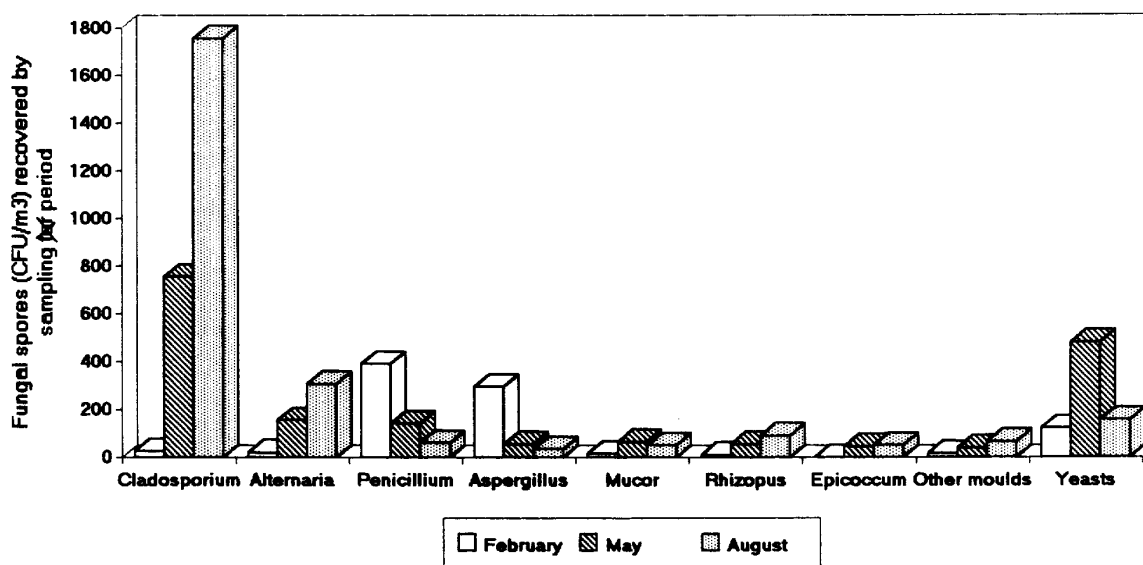


Fig. 2. Concentration (CFU/m³) of the genera of fungi recovered by sampling.

again the lowest counts of airborne fungi occurred in the transplant rooms and subintensive therapy unit with 30 CFU/m³ spores, while the highest were found in the environments having the closest contact with the outdoors (the corridors and the coffee bar) with 905 CFU/m³ spores. Despite the air conditioning in the gymnasia these suffered a substantial increase in mycetes: 620 CFU/m³ spores recovered.

In fact the total concentration of spores were 890 CFU/m³ (February), 1790 CFU/m³ (May) and 2595 CFU/m³ (August).

Fig. 2 shows the total number of fungal colonies, subdivided by genera, in the three periods of sampling.

All the poorly represented genera (*Fusarium*, *Botrytis*, *Paecilomyces* and other unidentified filamentous fungi) are reported in the graph as 'other moulds', while all the monocellular microfungi and those lacking mycelia (Endomycetales order) are generically classified as 'yeasts'. In the winter period the most commonly occurring microfungi were *Penicillium* 390 CFU/m³, *Aspergillus* 295 CFU/m³, yeasts 120 CFU/m³ with *Cladosporium* 25 CFU/m³ and *Alternaria* 20 CFU/m³ being poorly represented. In the spring period the highest counts were due to *Cladosporium* 755 CFU/m³ and yeasts 480 CFU/m³ with *Alternaria* 155 CFU/m³ and *Penicillium* 140 CFU/m³ being less common. In the summer period *Cladosporium* 1755 CFU/m³ was by far the most frequently recorded genus, followed at a distance by *Alternaria* 335 CFU/m³; the other fungal genera were recorded much less often. The data concerning the various fungal genera in the 3 monitoring periods are displayed in Figs. 3–5. In the winter period

the percentages of the three major fungal genera were: *Penicillium* (44%), *Aspergillus* (33%) and yeasts (13%).

In the spring period the aerospores of *Cladosporium* (41%) and yeasts (27%) were predominant. In the summer period there was predominance of *Cladosporium* (68%) with *Alternaria* (13%) much less evident.

4. Discussion

In recent years aerobiologic studies of indoor and outdoor environments have gained ever increasing interest because of potential repercussion on the evaluation of an individual's respiratory health (Lebowitz, 1991; Moscato et al., 1992). Among the indoor environments, particular interest has been directed towards the assessment of the interior air of health care structures (Singh et al., 1994). Special attention has been paid to the aerobiological monitoring of fungal spores (Fadel et al., 1992; Frost, 1988), which are, at present, of unclear aetiopathological importance for human diseases (D'Amato, 1993; Guerrier et al., 1989; O'Hollaren et al., 1991; Palmas et al., 1989). It has been showed, however, that fungi can cause mycoses in debilitated or immunocompromised subjects. Among them, at particular risk are the patients affected by chronic heart or lung diseases especially if hospitalized and, recently, patients receiving immunosuppressive treatment because of a heart and/or lung transplant (Maurer et al., 1992; Horvath et al., 1993). This is the reason why we performed a study evaluating the quantity and type of aerospores present in a rehabilitative hospital, characterized by an in-hospital population of subjects affected

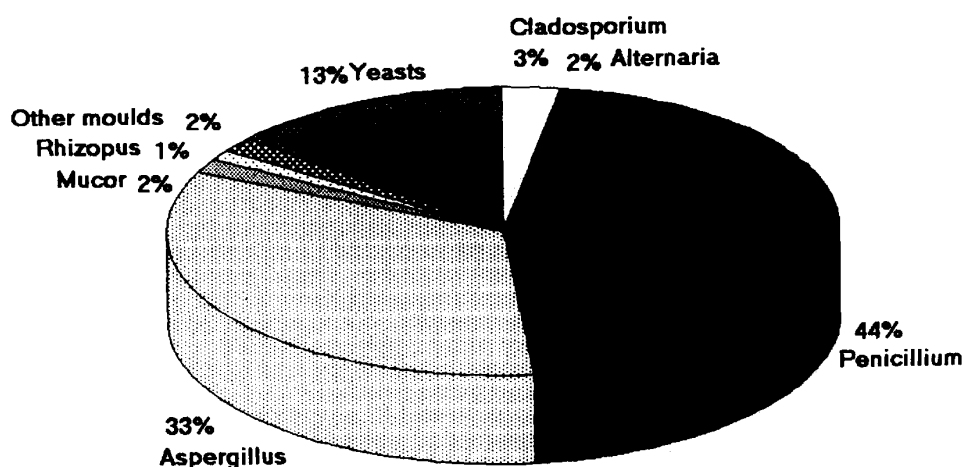


Fig. 3. Percentage subdivision of the genera of fungi recovered in winter.

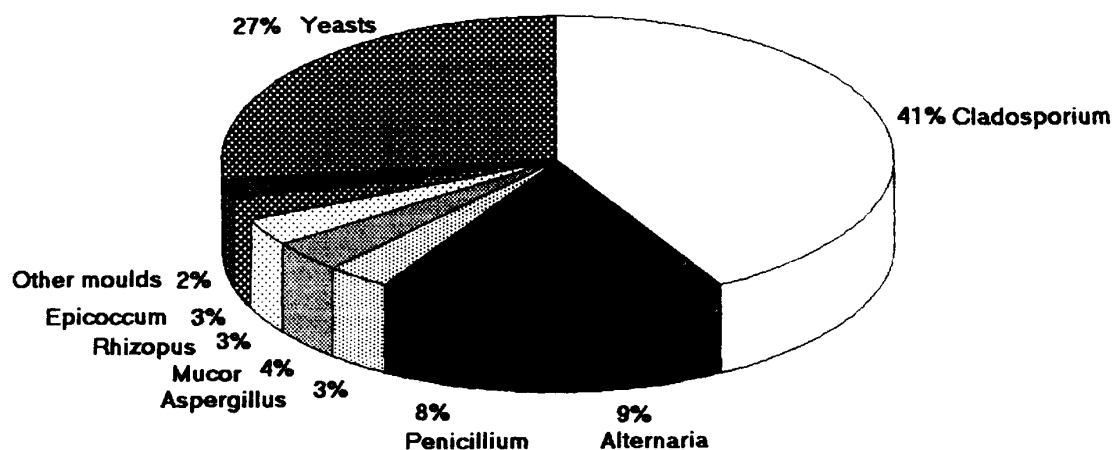


Fig. 4. Percentage subdivision of the genera of fungi recovered in spring.

by chronic cardiac, respiratory and neurological diseases of variable severity alongside patients waiting for heart and/or lung transplants and those having received such transplants. Particular attention was given to the evaluation of the rooms used by subjects having received organ transplants (heart and/or lungs) and the subintensive therapy unit, this latter being occupied by subjects affected by severe hypercapnic respiratory failure secondary to chronic lung diseases. The aerobiological monitoring was performed using a volumetric sampler which allowed a quantification of the colonies rather than using the non quantitative gravimetric method based on simple exposure of the Petri dish filled with culture medium. As regards the total number of fungal colonies, in all the areas examined there was a progressive increase in airborne fungi in the three sampling periods. This would correlate with the outdoor aerospore increase, closely linked to the variations in

climatic conditions (rain, temperature, humidity, wind speed, sunlight) from winter to summer. It should be emphasized that the number of colonies remained extremely low in the 'transplant' rooms and the subintensive therapy unit, even in the summer months, probably thanks to the greater, continuous control of the ventilatory exchange with outdoors and with the general hospital corridors, in addition to the use of air conditioning in the summer months. In contrast, the gymnasium had high spore counts in the summer months, probably due to a less than optimal exploitation of the air conditioning (window opening). Better use of the air conditioning in the summer months and its possible expansion to the rest of the hospital is desirable, in order to maintain environmental risk factors at a constant and as low as possible level (Gouyou-Beauchamps, 1990). The ordinary wards and the outpatient departments showed unexpectedly low levels of

GENERA OF FUNGI RECOVERED AUGUST 1994

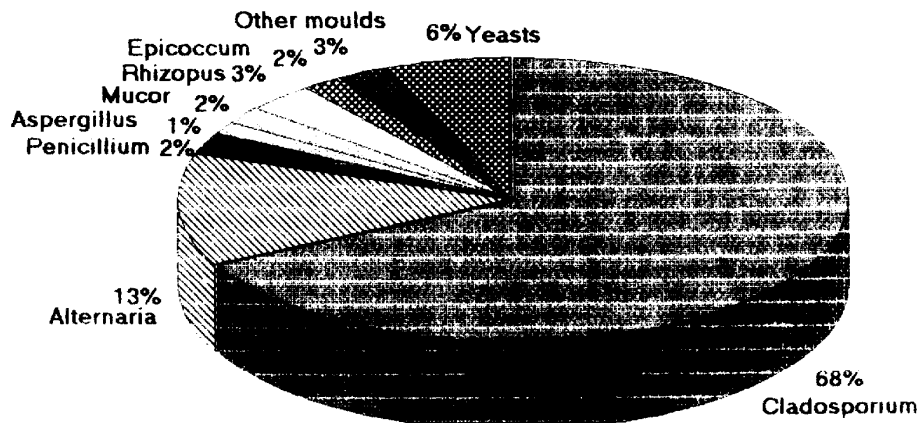


Fig. 5. Percentage subdivision of the genera of fungi recovered in summer.

fungi, probably because of limited air exchange with the outside aimed at avoiding abrupt temperature changes hazardous for the patients. Finally the kitchens, because of the type of work performed there, but above all the 'other environments', due to the greater air exchange with the exterior, contained high levels of airborne fungi. For this reason it is advisable that, for some categories of patients characterized by a deficient immune response (transplant subjects), access to areas such as the Centre's entrance and the coffee bar, and to a certain degree the gymnasium as well, should be permitted only on adoption of appropriate precautions (face-masks) and only in a stabilized clinical condition. In particular, the mask should be able to prevent the inhalation of fungal spores. Examination of the different fungal genera shows that different seasonal patterns exist for each of them. In particular, not all of them show a progressive increase in the spring-summer months compared to the winter measurements.

In fact, such a progressive increase was seen for *Cladosporium* and *Alternaria*, but not for the *Penicillium* and the *Aspergillus*, while the yeasts reached their maximum level during the spring readings (Figs. 3–5). From a quantitative point of view the genus *Cladosporium* was more abundant than the other genera with markedly higher values in the spring-summer months (extremely low in the winter samplings) with respectively 755 CFU/m³ (41%) and 1755 CFU/m³ (68%), followed by the yeasts in spring 480 CFU/m³ (27%), *Penicillium* 390 CFU/m³ (44%) and *Aspergillus* 295 CFU/m³ (33%) in the winter readings, and finally *Alternaria* 335 CFU/m³ (13%) in the summer. These data seem to indicate that in the winter months greater attention should be given to the higher risk of diseases caused by *Aspergillus*, a genus distinctly more pathogenic in immunodepressed subjects than the other fun-

gal genera. In contrast, the real pathogenic importance of *Cladosporium*, being the predominant fungal genus in the spring and summer samplings, is not yet known. It is our intention to expand our aerobiological study of the indoor hospital environment to verify, as much as possible, those factors which can influence the levels of fungi present and confirm the provenance of the fungal spores. We also wish to evaluate the effective importance of infective fungal diseases in immunosuppressed patients as complications following heart and/or lung transplantation.

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