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THE OCCURRENCE OF FUNGAL MICROFLORA IN ATMOSPHERIC AIR IN THE AREA OF THE CITY OF OLSZTYN

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ABSTRACT

Mycological analyses were carried out on air samples collected with the sedimentation and impactor methods. Fungi were assayed in atmospheric air sampled in the city centre of Olsztyn and in the forest at Lake Kortowskie. The experiment aimed at evaluating the contamination of atmospheric air with fungal microflora in the city centre of Olsztyn (3 stations) and in the forest at Lake Kortowskie (one station), collected with the sedimentation and impactor methods. Differentiated population numbers of fungi, reported in the atmospheric air of the city of Olsztyn, appeared to depend, to a great extent, on meteorological conditions.

Key words: filamentous fungi, yeast fungi, atmospheric air.

INTRODUCTION

Increasing industrialization is accompanied by a growing number of factors enhancing the occurrence of fungal infections and an increased incidence of allergic diseases. This has resulted from the pollution of the natural human habitat and from decreased cellular resistance upon the frequent use of steroids, antibiotics or intentional immunosupression (organ grafts) [9]. One of key factors contributing to the increased incidence of allergic diseases is the appearance of allergens, which until recently have been played mainly an infectious role. The infections have been mainly caused by fungi, with the most significant ones being: *Candida tropicalis, Candida albicans, Candida glabrata,* and *Candida krusei*. A typical feature of fungi, both saprophytic and pathogenic, is their occurrence in nearly all latitudes [6]. Fungi pathogenic to humans appear in the biosphere of different climatic zones. They have been isolated, among others, from air [3, 10], soil, fresh and sea waters, fish, various plant organisms (mainly fruits and seeds) and plant juices. Their habitats may include skin and internal organs as well [1, 2]. In general, mycoses of the respiratory tract are induced by saprophytes occurring in high numbers in the environments of waste dumps and

waste materials, which become pathogenic mainly after penetration into a weakened organism. It has been demonstrated that in some individuals the inhalation of fungal aerosol may induce environmental asthma [7] or other ailments, including: allergic rhinitis, cough, shortened respiration, etc.

The aim of the experiment was to evaluate the contamination of atmospheric air (sampled with sedimentation and impactor methods) with fungal microflora in the centre of the city of Olsztyn and in the forest at Kortowskie Lake.

MATERIALS AND METHODS

Collection of samples. Samples of atmospheric air, to be used for mycological quantitative analyses, were collected at selected measuring stations from April to August 2002 in monthly intervals as well as in October 2002 and February 2003, each time in three measuring series. The air samples were collected with two methods: the sedimentation method following the recommendations of the Polish Norm [8], and the impactor method with a microbiological air sampler MAS 100 Eco TM by MERCK [12].

Measuring stations. Three measuring stations were selected in the centre of the city of Olsztyn (fig. 1) and one in a district of Olsztyn – Kortowo: station 1 – a square by the "Dukat" mall; station 2 – a square by the Regional and District Court of Law; station 3 – a square at the crossing by the City Hall; station 4 – in the forest at Kortowskie Lake (Olsztyn's District – Kortowo).

Fig. 1. Sampling sites situated in the centre of Olsztyn

Mycological analyses. A quantitative determination was carried out for the number of fungi (including filamentous and yeast fungi) incubated in the Sabouraud's medium, at a temperature of 26°C for 6 days. Results were confirmed with microscopic analyses.

While collecting air samples for analyses, results of meteorological observations concerning temperature, atmospheric pressure, relative air humidity, direction and speed of wind, and insulation were recorded.

RESULTS

The total number of fungi in the atmospheric air determined with the sedimentation method ranged from 80 cfu/m3 in February (station 3) to 3300 cfu/m3 in July (station 3). The highest mean contamination was recorded at the station 4 located in the forest, whereas the lowest was at station 1 situated at the square by the "Ducat" mall (tab. 1). The examined group of fungi was predominated by filamentous forms, the percentage of which ranged from 15% in February to 99% in August. Yeast forms were observed to appear at lower percentage values, fluctuating from 1% in August to 85% in February (fig. 2 a).

Table 1. Mean numbers of fungi per 1 m^3 of air at stations located in the city centre and recreation sites of the city of Olsztyn determined with the sedimentation and impactor methods

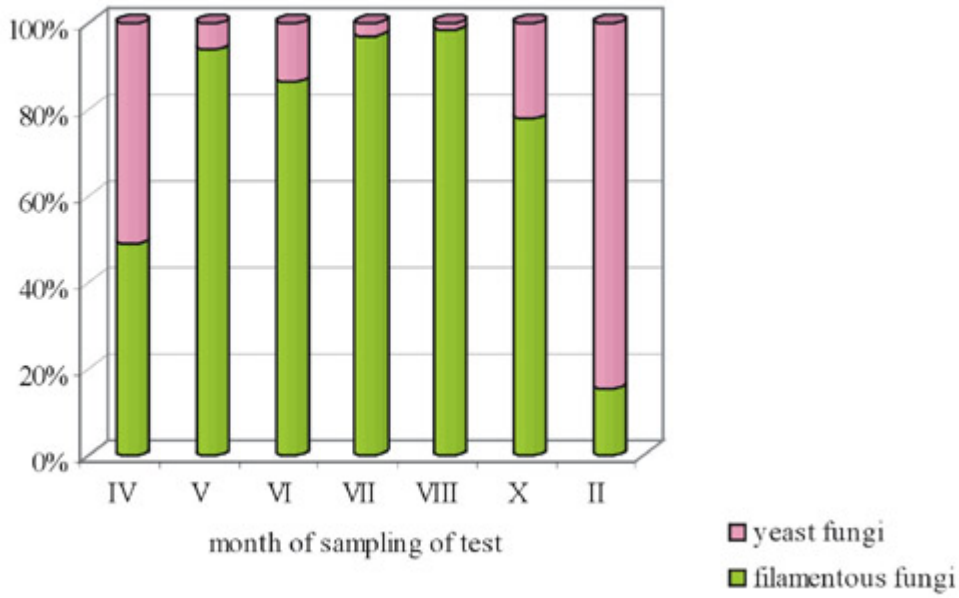
Month of sampling of test	Method of sampling									
	sedimentation					impactor				
	Number of sampling site									
	1	2	3	4	geom. mean	1	2	3	4	geom. mean
	Numbers of fungi									
IV	200	320	470	480	367	950	750	950	1940	1147
V	430	710	900	2630	1167	1550	3200	0	350	1275
VI	1690	940	1340	2710	1670	2260	2430	2000	4090	2695
VII	2670	2790	3300	2870	2907	1850	2400	2130	4630	2752
VIII	1220	1770	2630	2590	2052	1550	2450	3100	3280	2595
X	160	280	470	710	405	300	580	270	400	387
II	160	160	80	120	130	40	0	50	110	50
geom. mean	933	996	1313	1730	-	1214	1687	1214	2114	-
standard deviation	971	963	1211	1225	-	817	1054	1305	1901	-

The total number of fungi in the air collected with the impactor method ranged from 0 cfu/m3 in May (station 3) and February (station 2) to 4630 cfu/m3 in July (station 4). The highest mean numbers of fungi in the atmospheric air were observed at station 4 located in the forest and the lowest ones – at the station 1 situated at the square by the "Ducat" mall (tab. 1). The analysed group of bacteria was predominated by filamentous fungi whose percentage fluctuated from 3% in February to 96% in October. The yeast forms constituted from 4% in October to 98% in February of the total fungi count (fig. 2 b).

The statistical analysis of the results with the ANOVA test of Kruskal-Wallis ranks [9] demonstrated that the numbers of the fungi investigated are affected, to the greatest extent, by the sampling period. Statistically significant differences were reported between numbers of fungi determined with the sedimentation and the impactor methods and dates of sample collection (fig. 3). However, no significant correlations were observed between fungi numbers and location of particular measuring stations (thus those results were not included herein).

Fig. 2. The percentage of filamentous and yeast forms in fungal microflora in 1 m^3 of atmospheric air from the city centre (1, 2, 3) and from a district of Olsztyn – (4), determined with a) sedimentation method b) impactor method

a)



b)

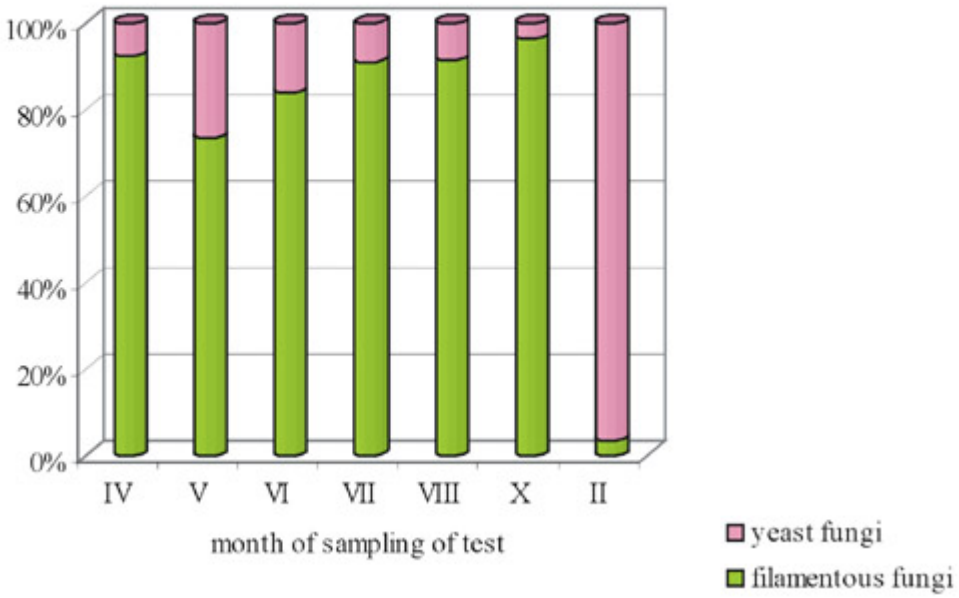
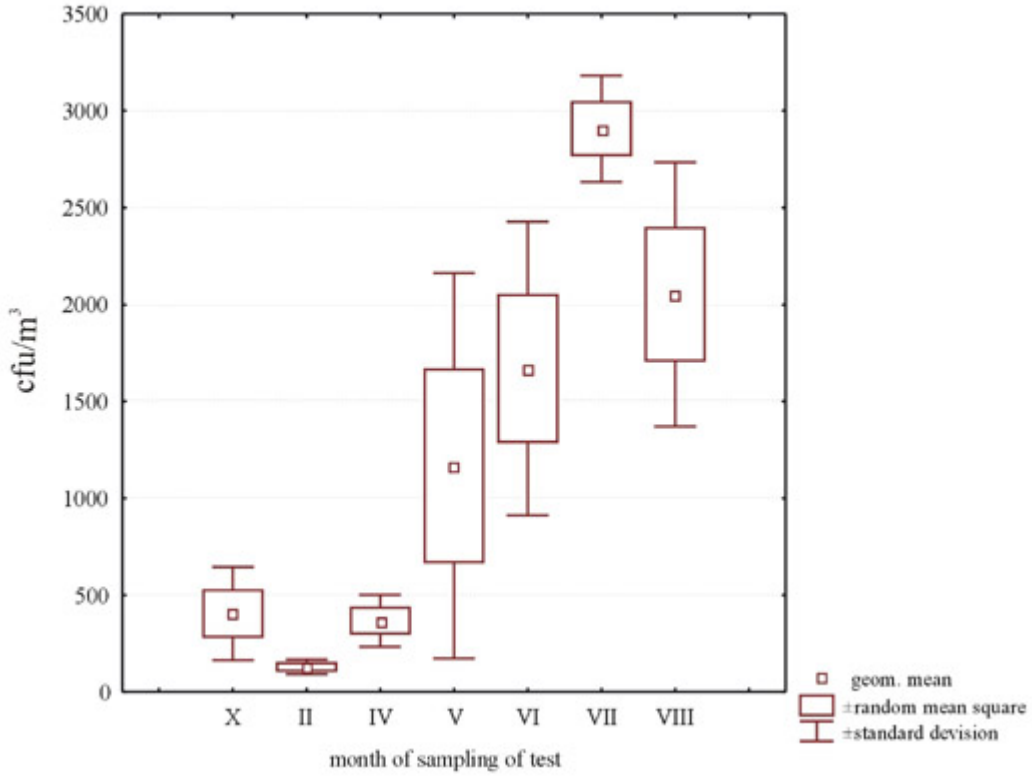
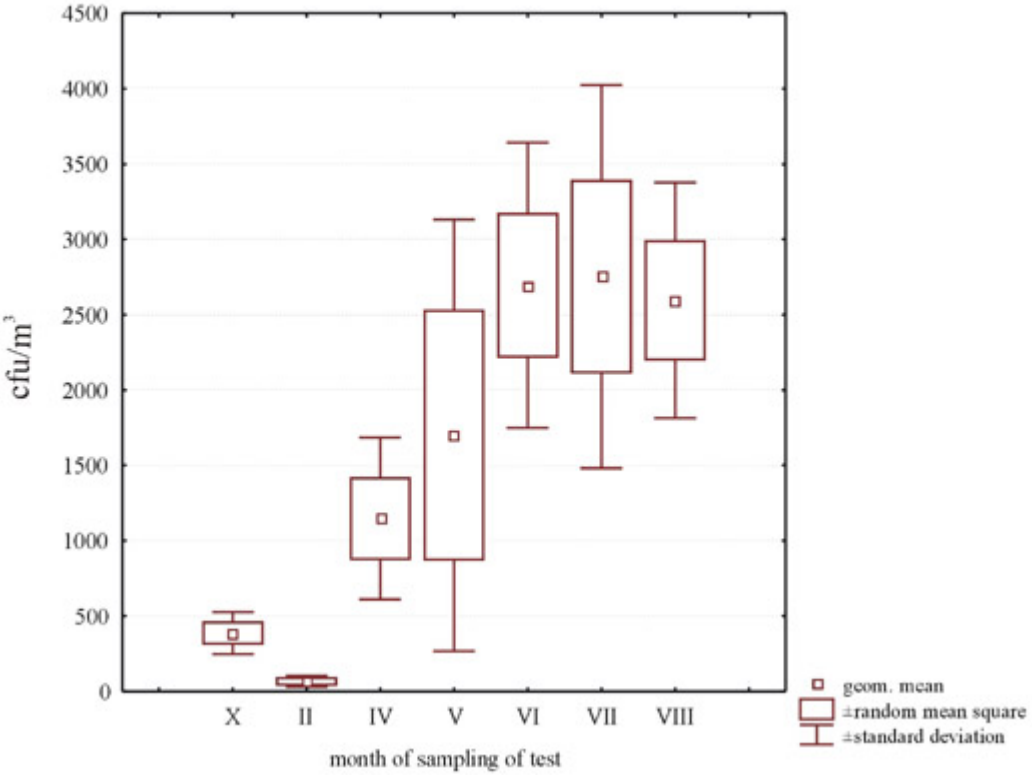


Fig. 3. Results of a statistical analysis with ANOVA test of Kruskal-Wallis ranks at a significance level of α = 0.05. Evaluation of the effect of sampling period on fungi determined with a) sedimentation method, b) impactor method

a)



b)



The results of meteorological measurements were compiled in table 2.

Table 2. The results of the meteorological observations

Month of sampling of test	Temperature °C	Relative humidity %	Atmospherical pressure hPa	Wind direction and speed m/s	Insolation
IV	8	72	1016	1.0-3.0 NE	total cloudiness, without falls
V	11.5	72	1018	2.7-3.8 SW	sunny, day earlier storm
VI	23	42	1018	moderate SW	partial cloudiness, without falls
VII	19	55	1004	moderate SW	changing cloudiness
VIII	22	67	1011	moderate N	sunny
X	8	68	1011	strength S	total cloudiness
II	0	62	1028	0.1-1.0 SW	sunny, cloudless sky

DISCUSSION OF THE RESULTS

The numbers of fungi recorded in the experiment were often similar, at both methods of air sample collection. Over the entire experimental period, the percentage of yeast fungi was lower than that of the filamentous fungi, except for February when the percentage of the yeast forms accounted for ca. 100% of the total fungi count, at both methods of air sample collection. It should be remembered, however, that the majority of yeast fungi occurring in the air belong to saprophytic forms. Nevertheless, regular contact with those bacteria leads to chronic and acute allergic conditions. The distribution of fungal microflora concentration in the air examined indicates some seasonal regularity, namely in the winter season when the number of fungal spores decreased substantially, compared to the other seasons. Reference data indicate that the maximal numbers of fungal spores in the temperate climatic zones are reported in the summer season [4]. Such correlations were observed in Olsztyn, where the highest numbers of these bacteria were recoded in July, at sampling with both the sedimentation and impactor methods. The comparable mean number of fungi in July was also reported in the air samples from the city of Kutno [4], collected with the sedimentation method. A similar seasonality in the quantitative distribution of fungi was observed by other authors [5, 6]. The highest mean air contamination, at both sampling methods, was recorded at the station 4 located in the forest, whereas the lowest one – at the station 1 situated at the square by the “Dukat” mall. In both cases, filamentous fungi were predominant. It should be emphasized that the numbers of fungal microflora in the atmospheric air examined in different seasons were negligible, which points to air purity. According to the regulations of the Polish Norm [8], such air can be referred to as non-contaminated with fungal microflora.

CONCLUSION

1. Quantitative differentiation of the fungi observed in the atmospheric air of the city of Olsztyn appeared to depend, to a great extent, on the meteorological conditions.
2. Higher numbers of the examined groups of fungi were usually reported in the summer season, compared to the other experimental months.
3. In general, higher numbers of fungi were reported at the collection of air samples with the impactor method than with the sedimentation method.
4. The mean population numbers of the fungi analysed were higher at the station located in the forest than at those located in the city centre.
5. According to the Polish Norm PN-89 Z-04111/03, over the entire experimental period, the air at the stations examined should be considered as non-contaminated with fungal microflora.

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