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# Occurrence of micromycetes in indoor environment

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Investigation of micromycete occurrence in the basements as well as on the ground and the first floors of new and old buildings has been carried out in 1996–2000. The mycological state of 87 premises was investigated; 3000 inoculations were sown. Premises where academic studies take place, as well as those under reconstruction and renovated were chosen. Micromycetes were found to evolve more intensively in the premises with humidity surplus. From 3 up to 960 micromycete precursors were isolated from the air and walls (the quantity per Petri dish). The largest amount and generic variety of micromycete precursors were fixed in the premises of the building under reconstruction, where construction works took place and micromycete precursors could get from the environment (soil, plants and other objects). Micromycetes of the genera *Cladosporium*, *Alternaria*, *Trichoderma*, *Penicillium*, *Aspergillus* predominated in all basement premises. *Aspergillus* (52% of the total number of isolated precursors) and *Penicillium* (20%) predominated in academic premises. The mycological state of the premises depended upon the building's construction peculiarities, care of the premises and the activity that took place in the premises.

**Key words:** fungus, micromycetes, premises, mycological state

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## INTRODUCTION

Microorganisms, and especially micromycetes, are active biodestructors of materials of different chemical composition. Due to their flexible enzymic system, active biochemical reactions and other functional peculiarities, micromycetes may remain viable and may start to grow even under extreme environmental conditions. Lots of micromycetes and their precursors constantly exist in the human environment. They spread with air-streams and, having settled on the surface of different objects of the environment, germinate and start to function. Recently, occurrence of micromycetes in the dwelling and working premises has become a serious sanitary-hygienic problem. Micromycetes grow more intensively in badly ventilated, humid and dusty premises. "Plaster fungus" – a species of the genus *Cladosporium* – very often occurs on dampish walls. Separate strains of these fungi can be pathogenic and may cause *Cladosporium* diseases. Species of the genera *Aspergillus*, *Alternaria*, *Mucor*, *Rhizopus*, *Penicillium*, *Trichoderma* often occur in working and dwelling premises. Large numbers of micromycete precursors in the premises may be related to such human diseases as bronchitis, asthma, rhinitis and allergy. The number of micromycete precursors in the air is an important index while evaluating the mycological state

of the premises [1–4]. Employees of the Laboratory of Hygiene and Sanitation investigate the occurrence of micromycetes in the premises. However, most often such investigations are carried out when the sanitary state of the premises has already worsened. Unfortunately, detailed investigations of micromycete occurrence and the evaluation of the microbiological state of premises used for different purposes are irregular. Recently, a more specified investigation of the functional peculiarities of the micromycetes spread indoor and their generic variety has been started in Lithuania [2, 4]. Occurrence of micromycetes is investigated in the working premises which are intended for different purposes, where various numbers of people work or stay. Thus, while investigating the occurrence of micromycetes, it is important to investigate premises of a similar purpose (production shops of factories, libraries, class-rooms, lecture-halls, etc.). We aimed to fix and compare the amount of micromycete precursors in old and new premises located in the basement, on the ground and the first floors; to investigate and evaluate the microbiological state of the premises.

## METHODS

Investigation of microscopic fungi (micromycetes) has been carried out within the period from 1996 till 2000.

Premises of the buildings located in the city of Vilnius have been chosen for investigation: (1) premises of a building under reconstruction in Vilnius (the Old Town), where construction works were going on and part of walls had been ruined. Precursors of micromycetes could be brought into the premises by air-streams, together with construction equipment and tools, from the soil, plants growing in the surroundings, and other sources; 57 premises have been investigated; (2) premises of an old but renovated building, where no activity has been carried out after final repair works. There was no furniture in the premises; 11 premises have been investigated; (3) academic premises in an old building (lecture-halls, laboratories, class-rooms, etc.); 7 premises have been investigated; (4) academic premises in a new building (lecture-halls, laboratories, class-rooms, etc.); 12 premises have been investigated. Micromycetes have been isolated from the premises located on the ground and the first floors and in the basement. 3000 inoculations were totally sown in 89 premises. Precursors of micromycetes were isolated directly from the walls and air by the method of gravitation, *i.e.* sedimentation of micromycetes into a Petri dish together with full agarosed nutrient medium. The duration of exposition was 15 minutes. The composition of medium, grams:  $\text{NaNO}_3$  – 2.0;  $\text{KH}_2\text{PO}_4$  – 0.7;  $\text{K}_2\text{HPO}_4$  – 0.3;  $\text{KCl}$  – 0.5;  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  – 0.5;  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  – 0.01; glucose – 30; agar – 20; distilled water – 1000 ml. Cultures were grown in a thermostat for 5–7 days at a temperature of  $25^\circ \pm \pm 2^\circ\text{C}$ . The grown micromycete colonies were calculated on the fifth day. The cultures of micromycetes are purified and the grown colonies identified in accordance with their morphological character.

## RESULTS

The number of micromycete precursors was different in various premises. From 3 to 960 precursors have been isolated per Petri dish. The largest number of micromycete precursors was fixed in the premises of the old building under reconstruction. Having investigated 57 premises of the basement, on the ground and the first floors, 96 up to 960 precursors of micromycetes were singled out in a Petri dish. Walls of all the premises were dampish. A smell of must was typical of most of the premises. While evaluating visually the state of walls, seats of micromycete growth were noticed. They occurred on the walls at a different height. Upon sowing direct inoculations from the walls, it was revealed that mostly yeast as well as *Cladosporium*, *Alternaria*, *Ulocladium*, *Stemphylium*, *Trichoderma*, *Aspergillus*, *Penicillium* micromycete genera evolved in such places. The walls were most humid in the basement. Not only micromycetes, but also algae were present on the walls. From 96 up to

960 precursors of micromycetes were found in 24 premises on the ground floor. The walls were dampish. Micromycetes intensively evolved on the walls at a height of approximately 1 meter from the floor. Eighteen premises were investigated on the first floor. The walls of these premises were drier than the walls of the premises in the basement or on the ground floor. However, humidity surplus was observed in all the premises. Streaks and salt excretion could be noticed even on the walls of the buildings that had been constructed and plastered not long ago. From 196 up to 586 precursors of micromycetes grew in seedings. The micromycetes of 35 genera were isolated in the premises of this building. Micromycetes of the genera *Aspergillus*, *Cladosporium*, *Mucor*, *Penicillium*, *Trichoderma* predominated in the seedings.

The mycological investigation was carried out in a building located in Vilnius (the Old Town), where the premises had been just renovated. The number of micromycete precursors in the air was not large (3–11). However, significantly more micromycetes grew in the seedings sown on scraps. There were up to 105 micromycetes in the samples taken from dampish places. Micromycetes of the genera *Cladosporium*, *Penicillium*, *Aspergillus*, *Mucor* predominated in these seedings. A larger diversity of micromycetes was found in the premises of the basement. Walls of the basement become dampish because of poor isolation of the foundation. Humidity rises upwards. Micromycetes of the family *Dematiaceae* (*Cladosporium*, *Alternaria*, *Stemphylium*) predominated in the premises of the basement. Micromycetes of the genera *Trichoderma*, *Mucor* and yeast grew in large quantities. *Aspergillus* and *Penicillium* micromycetes were found in the air as well as in the wall scraps.

The mycological state of academic premises was investigated in old and new buildings. While investigating 19 premises, from 5 up to 290 precursors of micromycetes were singled out per Petri dish. Micromycete species of the genus *Alternaria*, which made 37% of all isolated precursors of micromycetes predominated in the premises of the basement. From 30 up to 280 precursors of micromycetes were isolated in the lecture-halls where lectures took place constantly and approximately 50 people worked simultaneously. Micromycete species of the genera *Aspergillus* and *Penicillium* predominated in the air of the lecture-halls both in the old and the new buildings. However, poorer ventilation of the premises in the old building as well as its long-term exploitation predetermined a larger number of micromycete precursors. The occurrence of micromycetes in the premises was directly dependent on the occupation of premises. From 112 to 285 precursors of micromycetes were isolated in the lecture-halls where academic studies constantly take place and 5–8 precursors of micro-

mycetes in rarely used academic premises. It was noticed that the character of activity also influenced the number of micromycete precursors: more precursors of micromycetes and their larger specific variety were revealed in the air of the laboratories where certain activities with plants, seeds and microscopic fungi was carried out. This fact explains the difference of micromycete occurrence in the same lecture-halls but at different time. Micromycetes of the genera *Aspergillus*, *Penicillium*, *Alternaria*, *Cladosporium*, *Ulocladium*, *Mucor* and *Trichoderma* predominated in the academic premises. Fungi of *Aspergillus fumigatus* group, which stunted the growth of other micromycetes in the seedings, were isolated from the air in certain premises. The role of these fungi in the etiology of mycoses is proven. The premises were cleaned, disinfected and ventilated. The repeated investigation revealed no *Aspergillus fumigatus*. In the course of investigation it was revealed that when construction works were taking place in the premises the conditions were favorable for micromycetes to get into the premises from the environment. When people start to utilize such premises, these micromycetes may start their active functioning and worsen the sanitary conditions of the premises. Thus, while carrying out construction and renovation works it is necessary to isolate the sources of humidity and to use fungicides. Regular investigations of the mycological state of academic premises where a lot of people work and there is constant movement are obligatory.

## CONCLUSIONS

1. While investigating the mycological state of 87 premises, from 3 up to 960 precursors of micromycetes were isolated in a Petri dish. The number of micromycete precursors depended upon the state of the premises, ventilation, humidity, the host of people and the character of activities.

2. The largest occurrence of micromycete precursors and their widest variety were typical of the premi-

ses under reconstruction. From 96 up to 960 precursors of micromycetes were isolated. The genera *Cladosporium*, *Alternaria*, *Ulocladium*, *Stemphylium*, *Trichoderma*, *Aspergillus*, *Penicillium* predominated.

3. Micromycetes of the genera *Cladosporium*, *Alternaria*, *Stemphylium*, *Trichoderma* grew in the most plentiful quantities on dampish walls.

4. Micromycetes of the genera *Aspergillus* and *Penicillium* predominated in the academic premises. The microbiological state should be one of important criteria while evaluating the quality of the premises.

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## MIKROMICETŲ PAPLITIMAS PATALPOSE

### S a n t r a u k a

Atlikus mikologinės būklės tyrimus 89 patalpose, Petri lėkštelėje buvo išskirta nuo 3 iki 960 mikromicetų pradų. Šis skaičius priklausė nuo patalpų būklės, ventiliacijos, drėgmės, žmonių kiekio ir veiklos pobūdžio. Gausiausiai mikromicetų pradais paplitę ir didžiausia rūšių įvairovė rasta rekonstruojamo seno pastato patalpose – nuo 96 iki 960 mikromicetų pradų. Vyravo *Cladosporium*, *Alternaria*, *Ulocladium*, *Stemphylium*, *Trichoderma*, *Aspergillus*, *Penicillium* gentys. Ant drėgnų sienų gausiausiai augo *Cladosporium*, *Alternaria*, *Stemphylium*, *Trichoderma*. Mokyklos patalpose daugiausia aptikta *Aspergillus* ir *Penicillium*. Taigi vienas kriterijų vertinant patalpų kokybę turėtų būti jų mikrobiologinė būklė.