Microfungi in the aerosphere of the Arctowski Polar Station

ABSTRACT: A second mycological analysis of the air has been carried out in the vicinity of and inside heated (temp. +18°C – +22°C) and non-heated (temp. -20°C – +8°C) rooms of the Arctowski Polar Station on King George Island during stay at this station of the 21st Antarctic Expedition of Polish Academy of Sciences. Colonies of microorganisms were grown on the Sabouraud and Czapek media and were transported to Poland, where fungi strains free of bacteria were isolated. From the material obtained from the air of the rooms and compartments of the station 43 fungi strains belonging to the following genera were isolated: *Penicillium* (26 strains), *Cladosporium* (8 strains), *Alternaria* (2 strains), *Rhizoctonia* (2 strains), *Scopulariopsis* (2 strains), *Botrytis* (1 strain), *Aspergillus* (1 strain), and *Sclerotinia* (1 strain). The number of strains and their variability was significantly higher in comparison with that observed in cultures 14 years earlier during the 7th Antarctic Expedition.

Key words: Antarctica, King George Island, microfungi.

Introduction

Reports concerning fungi in Antarctica are scarce, although the presence of fungi may be expected in all parts of the biosphere, the same as in all other regions on Earth, including compartments inhabited by humans.
In 1985, during the 7th Antarctic Expedition, we have carried out a mycological analysis of the air in the permanently and temporarily inhabited rooms of the Arctowski Polar Station on King George Island, and have isolated strains of 10 genera from the classes: Ascomycetes, Zygomycetes and Deuteromycetes (Czarnecki and Białasiewicz 1987). Recently, during the 21st Antarctic Expedition, we repeated our evaluation of the degree to which the aerosphere around the Station is polluted with mould fungi. At present the number of staff living in the Arctowski Station on King George Island during wintertime is about 20 people. In the summer the Station is visited on average by 800 people, including seasonal workers and tourists. The Station receives annually several hundred tons of materials, fuel and food (Rakusa-Suszczewski 1992).

Material and methods

The degree of air pollution was analyzed in heated (+18°C – +22°C) permanently occupied rooms of the Station (dining room, first aid room, fruit storage room, incinerating plant, water intake room) and non-heated rooms (-20°C – +8°C), which serve as temporary base for field research teams (caravan, tent, habitable container). The mycological analysis also included the air in the meteorological box situated on the glacier, and in the open area a few kilometers from the Station. In the vicinity of the Station Petri dishes with agar Sabouraud and Czapek media were placed for 30–60 min. Next the dishes were incubated at room temperature till the colonies grew. Then the colonies were inoculated on Sabouraud agar slants. The obtained cultures were transported at +5°C to Poland, where the isolation of pure fungi strains and their determination were carried out in the Department of Medical Biology and Parasitology of the Medical University of Łódź. The colonies grown on Sabouraud and Czapek mediums were visually observed as to their character (colour, surface structure, ground colour, presence or absence of secretion). For microscopic investigations, microcultures were made from each distinguished fungi strain on microscopic slides covered with a thin layer of Sabouraud and Czapek agar, in order to form the characteristic organs of sexual and asexual reproduction (Raper and Thom 1949, Fassatiova 1983). Microcultures were then placed in moist chambers for 2–20 days and were monitored with a microscope at 48-hour intervals.

Results

We isolated 43 fungi strains from the air of both permanently and temporarily inhabited rooms of the Polar Station (28 strains from the heated rooms and 15 from the non-heated rooms), which mainly belonged to the Penicillium species and Cladosporium from class Deuteromycetes. Among the heated rooms, the majority
Species of fungi isolated from heated rooms and compartments of the *Arctowski* Station.

<table>
<thead>
<tr>
<th>Place of isolation</th>
<th>Species</th>
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</thead>
</table>
| Dining room        | *Cladosporium cladosporioides* (Fresn.) de Vries  
                     | *Cladosporium herbarum* (Pers.) Link ex S.F.Gray  
                     | *Penicillium waksmanii* Zalewski |
| First aid room     | *Penicillium diversum* Raper et Fennel  
                     | *Cladosporium cladosporioides* (Fresn.) de Vries  
                     | *Cladosporium herbarum* (Pers.) Link ex S.F.Gray  
                     | *Penicillium sp.* (1)* |
| Fruit storage room | *Alternaria tenuissima* (Fr.) Wiltshire  
                     | *Botrytis cinerea* Pers. ex Fr.  
                     | *Penicillium roseopuspureum* Dierckx  
                     | *Penicillium frequentans* Westling  
                     | *Penicillium chrysogenum* Thom  
                     | *Scopulariopsis brevicaulis* (Sacc.) Bainier  
                     | *Penicillium spp.* (3) |
| Water intake room  | *Alternaria tenuissima* (Fr.) Wiltshire  
                     | *Aspergillus flavus* Link  
                     | *Penicillium expansum* Link ex S.F.Gray  
                     | *Penicillium notatum* Westling  
                     | *Penicillium roseopuspureum* Dierckx  
                     | *Rhizoctonia solani* Kuhn |
| Incinerating plant | *Penicillium frequentans* Westling  
                     | *Penicillium sp.* (1)  
                     | *Penicillium expansum* Link ex S.F.Gray  
                     | *Cladosporium cladosporioides* (Fresn.) de Vries |
| Kitchen            | *Sclerotina sclerotiorum* (Libert) de Bary |
| Pantry             | *Penicillium diversum* Raper et Fennel, |

* () – number of strains

of strains were found in the fruit storage rooms (9 strains) and water intake room (6 strains). They were represented by species from the genera *Penicillium*, *Alternaria*, *Botrytis*, *Rhizoctonia* and *Scopulariopsis*. From the cultures obtained from the air in the dining room, first aid room, and incinerating plant we isolated 3–4 strains of fungi belonging mainly to the *Penicillium* and *Cladosporium* species. In the kitchen and pantry only the strains of *Sclerotinia sclerotiorum* and *Penicillium diversum* were found (Table 1).

In the air of the non-heated rooms of the Station, which were used only sporadically by the members of the Polar Expedition, we found 8 strains of fungi in the caravan, 5 in the tent, and 2 in the habitable container. The air of the caravan con-
Table 2

Species of fungi isolated from the non-heated rooms and compartments of the Arctowski Station.

<table>
<thead>
<tr>
<th>Place of isolation</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caravan</td>
<td>Cladosporium cladosporioides (Fresn.) de Vries</td>
</tr>
<tr>
<td></td>
<td>Cladosporium herbarum (Pers.) Link ex S.F.Gray</td>
</tr>
<tr>
<td></td>
<td>Penicillium brevicom pactum Dierckx</td>
</tr>
<tr>
<td></td>
<td>Penicillium diversum Raper et Fennel</td>
</tr>
<tr>
<td></td>
<td>Penicillium notatum Westling</td>
</tr>
<tr>
<td></td>
<td>Penicillium spp. (2)*</td>
</tr>
<tr>
<td></td>
<td>Scopulariopsis brevicaulis (Sacc.) Bainier</td>
</tr>
<tr>
<td>Tent</td>
<td>Cladosporium herbarum (Pers.) Link ex S.F.Gray</td>
</tr>
<tr>
<td></td>
<td>Panicillium expansum Link ex S.F.Gray</td>
</tr>
<tr>
<td></td>
<td>Penicillium spp. (2)</td>
</tr>
<tr>
<td></td>
<td>Rhizoctonia solani Kuhn</td>
</tr>
<tr>
<td>Meteorological box</td>
<td>No fungi</td>
</tr>
<tr>
<td>Habitable container</td>
<td>Penicillium spp. (2)</td>
</tr>
</tbody>
</table>

* ( ) – number of strains

itained 5 strains from the Penicillium genus, 2 strains from Cladosporium genus, and 1 strain of Scopulariopsis brevicaulis. From the habitable container and tent we isolated 7 strains in total from the Penicillium, Cladosporium, and Rhizoctonia genera (Table 2).

There were no positive cultures on Sabouraud and Czapek medium from the meteorological box and the open space in the vicinity of the Station.

Pictures 1–4 present cultures of fungi from the Penicillium, Cladosporium, Scopulariopsis, and Botrytis species. Pictures 5–8 show conidia of fungi from Penicillium, Alternaria, Aspergillus, and Cladosporium genera.

Discussion

Comparison of the data regarding air pollution with mould fungi in the Arctowski Polar Station after 14 years showed a significant increase of the number of fungi isolated from the air of both heated and non-heated rooms. The variety of isolated genera was also higher. Previously in heated and non-heated rooms there were 5 species of fungi each, while in recent studies the air of the rooms contained, respectively, 16 and 8 different species of fungi. Among them, we isolated strains not seen previously: Cladosporium cladosporioides, C. herbarum, Penicillium brevicom pactum, P. diversum, P. expansum, P. frequentans, P. roseopurpureum,
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P. waksmani, Alternaria tenuissima, Aspergillus flavus, Rhizoctonia solani, and Sclerotinia sclerotiorum.

It is possible that the soil is the source of fungi detected within the Station, as spores of fungi may be carried inside with soil. This hypothesis is confirmed by the observations of many authors studying microscopic fungi in the lithosphere of Antarctica (Vishniac 1993, Zabawski 1995), including King George Island. The authors isolated strains from the following genera of fungi from the soil: Alternaria, Aspergillus, Botrytis, Cladosporium, and Penicillium. These were also present in the rooms of the Station. However, transmission by humans from the environment outside of the Antarctica into the Station cannot be ruled out, as for example by food, clothes, or other essential materials brought to the Station. The genera of fungi detected by us are often described as food contaminators (Zalewski 1985) and air contaminators in houses (Verhoeff 1994 a, b; Krawczyk et al. 1997).

The latter hypothesis is supported by the fact that cultures from the meteorological box and open air outside the Station were negative. In such case, constant control of the aerosphere of the Station compartments for the presence of spores seems essential, in particular as the genera detected by us are potentially pathogenic, and can cause allergy, skin changes, or internal organs mycosis.

Conclusions

1. From the air of heated and non-heated rooms of the Station we isolated 43 strains of fungi from 18 species.
2. From the heated rooms more strains were isolated than from the non-heated rooms.
3. The results of our mycological study of the compartments of the Station, repeated after 14 years, show an increase in fungal pollution during this period.

References


Streszczenie

Fig. 1. *Penicillium chrysogenum* - colony on the Sabouraud agar medium.

Fig. 2. *Cladosporium herbarum* - colony on the Sabouraud agar medium.
Fig. 3. *Scopulariopsis brevicaulis* – colony on the Sabouraud agar medium.

Fig. 4. *Botrytis cinerea* – colony on the Sabouraud agar medium.
Fig. 5. *Penicillium expansum* – conidiophores; on the Sabouraud agar medium.

Fig. 6. *Alternaria tenuissima* – conidia; on the Sabouraud agar medium.
Fig. 7. *Aspergillus flavus* – conidiophores; on the Sabouraud agar medium.

Fig. 8. *Cladosporium herbarum* – conidiophore on the Sabouraud agar medium.