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MESOPHILIC ACTINOMYCETES - THE REAL INDOOR AIR PROBLEM?

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Airborne fungal spore and bacterial levels and flora in 50 problem sites were compared to those without any complaints about the indoor air quality. A distinctive difference was found in the bacterial flora. Actinomycete colonies were found in 70% of the air samples taken on bacterial medium from the problem rooms but in only sporadically in the controls. Although the levels of actinomycete spores were not high, 2-240 cfu/m^3, their occurrence seems to indicate unusual microbial situation in the building in subarctic climate. These soil bacteria have very intense, earthy odor which may greatly contribute to the development of indoor air quality problems.

INTRODUCTION

Microbial aerosols are found everywhere. The main source of indoor air fungi is outdoor air. The dominant sources for indoor air bacteria are human beings. Other microbial sources include moldy food, contaminated humidifiers, and microbial growth in the construction materials. The subarctic climate of Scandinavia requires long heating periods (up to 8 months/year) and efficient insulation practice, therefore indoor air and the building frames are generally dry. Moisture and associated microbial problems may, however, be caused by

water damages, leakages or improper moisture insulation.

Microbial growth in houses is associated with various health problems, including nausea and respiratory symptoms (1). There is, however, no exact information about the etiology of these symptoms. The indoor air flora is poorly characterized, and it is not known whether the health problems are based on excess counts of spores and viable cells in indoor air or whether there are abnormalities in the genera of indoor air microbes.

The results of our earlier study on the airborne flora of homes with and without microbial problems showed that certain bacteria, i.e. actinomycetes, are an indication of microbial growth in the house (2). To confirm this preliminary observation, we investigated a larger set of problematic buildings. The aim of this work was to compare bioaerosol levels and flora in "normal indoor air" and in problem houses.

MATERIALS & METHODS

Bioaerosol samples were taken in the fall, winter or early spring when the soil was frozen and/or snow-covered and the outdoor levels of bioaerosols were low.

The 50 problem sites consisted of homes, schools, offices and day-care centers. The tenants or personnel had contacted health authorities about annoying odor and visible or suspected mold growth in the construction. In most cases there was a suspected association between health problems and indoor air. As controls we used combined data from our earlier surveys, 107 homes, offices and day-care centers in all.

Bioaerosols were sampled with six-stage impactors using malt extract based agar for fungi and tryptone-yeast-glucose agar for bacteria. Samples were taken near the site of observed or suspected mold growth. The plates were incubated in the dark at 20°C...23°C for 5-7 days. Fungi were identified to genus level by morphology in light microscope; among bacterial colonies the dry colonies with aerial mycelium (actinomycete type) were counted separately.

RESULTS & DISCUSSION

In the problem houses, the geometric mean (GM) of fungal spore levels was somewhat higher (GM 180 cfu/m^3, range 10-2 300) than in controls (GM 90 cfu/m^3, range <10-5 600). However, the range is wider in the control data and these values can be considered normal in our climate. Thus the small differences cannot explain the complaints or the presence of respiratory symptoms. The main groups of fungi were Penicillium, sterile

mycelia, yeasts and Cladosporium, which belong to the common airborne fungal flora.

Total levels of bacteria were also somewhat higher in the problem sites (600 cfu/m^3, range 10-12 200) than in controls (GM 380 cfu/m^3, range 10-8 500). Airborne bacteria mainly indicate presence of humans, and their excessive levels are due to insufficient ventilation or overcrowding and may contribute to complaints of indoor air quality. However, because most bacteria results were within the normal range (3), evaluation of total bacteria concentrations did not give an explanation for the complaints.

A distinctive difference between the problem and control sites was found when bacterial flora was analyzed. Colonies of streptomycetes, which are mesophilic actinomycetes, were found in 70% of the bacterial samples of the problem sites but in less than 10% of the controls. While the source of most indoor air bacteria is human skin, streptomycetes are clearly of other origin. They are typical genera of soil, and they are capable to utilize any carbon-containing material for their growth even in presence of negligible amounts of water. They may be opportunists that attack to moistened construction materials. Although the levels of streptomycete spores in indoor air were not high, up to 240 cfu/m^3, their occurrence seems to be a qualitative indicator of microbial growth in the building. However, this conclusion concerns only urban areas with no specific actinomycete sources, such as hay and straw in farming areas.

Streptomycetes have an intense, earthy odor that often is characterized as "moldy". The annoying odor which often is a reason for indoor air quality complaints, may originate from streptomycete growth in the construction.

Some actinomycete species, such as Faenia rectivirgula (former Micropolyspora faeni) and Thermoactinomyces candidus (former Thermoactinomyces vulgaris) are known to be associated with occupational health hazards, e.g. farmer's lung disease. These species, however, are thermophilic microbes that easily grow at temperatures around 55°C. The species isolated in our study belong to the mesophilic strains of the genus Streptomyces (optimum growth at 25°C). In the medical literature there is no information concerning possible health effects of airborne mesophilic actinomycetes. Thus the present importance of our finding is its indicator value in indoor air hygiene.

CONCLUSIONS & RECOMMENDATIONS

In subarctic climate, mesophilic streptomycete spores do not belong to the normal wintertime flora of urban indoor air, and

their presence indicates microbial growth in the building construction. Therefore, their occurrence should lead to identifying and elimination of the moisture damage site. Unless repaired, microbial growth may proceed to health hazards or to growth of rot fungi.

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