Presence of Thermophilic Actinomycetes in Residential Heating Systems

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Thermophilic actinomycetes, associated with a hypersensitivity pneumonitis, may be found in compost but also have been detected in heating systems of office buildings. This study was designed to determine whether these organisms were present in residential heating systems. Furnace dust or humidifier water of 12 of 20 homes contained thermophilic actinomycetes, indicating that the organisms may be found in areas other than specific decomposing organic dusts.

There has been recent interest in the thermophilic actinomycetes, particularly in those belonging to the genera Micropolyspora and Thermoaclitomycetes, because inhalation of their spores has been associated with the development of a hypersensitivity reaction manifested by recurrent chills, fever, or dyspnea (8, 9), which may lead to irreversible pulmonary damage (6). Thermophilic actinomycetes grow best at temperatures between 40 and 56 C (14). These organisms have been reported to proliferate in decaying organic material such as hay, bagasse, or mushroom compost (8, 9) where conditions for their growth are favorable because of the heat generated in the decomposing materials.

Recently we reported the occurrence of a hypersensitivity pneumonitis resembling farmer’s lung in which the source of the offending thermophile could be traced to a contaminated heating system in the patient’s working environment (2). Although actinomycetes are ubiquitous in distribution and members of the genera Streptomyces and Micromonospora capable of growing below 37 C have been isolated from the air of houses and outdoors (5), no information is available about possible contamination of forced-air heating systems by thermophilic actinomycetes growing at higher temperatures. It was therefore decided to investigate whether these organisms also could be detected in heating systems of residential dwellings.

Samples of dust from furnace ducts, filters from cold air returns, and water from humidifiers were obtained from 20 homes. Portions of each sample were incubated in peptone-soy, V-8, nutrient, Casamino Acid, and yeast extract agar and broth. Colonies of a thermophilic species, which appeared to be identical on the basis of gross colonial and microscopic morphology, could be readily grown from 12 samples of humidifier water and from one of the dust samples. The latter sample was obtained from one of the homes in which the humidifier was also contaminated. Subcultures of the thermophilic isolates in all 13 samples revealed growth on all media at 45, 49, and 55 C with rapid growth at 55 C. Only occasional plates showed slow growth at 37 C. Slight differences in colony morphology were noted with different media, but on peptone-yeast and yeast extract agar growth was profuse. Slightly raised yellowish colonies with abundant velvety-white to greyish aerial mycelium, developing initially around their outer edges, were first noted at 24 hr. The substrate mycelium was yellow with some brownish areas. Stained, thin-layer slide cultures revealed short sporophores along straight hyphae. Most of the attached spores were monosporas, but some chains, primarily of 2 and 3 spores, were noted on the substrate and aerial mycelium. Occasional intercalary spores were also seen, primarily on the substrate mycelium. The substrate was narrower and more hyaline than aerial mycelium, and on slide cultures was partially obscured by large collections of unattached spores at the point of inoculation. Electron micrographs of aerial mycelium spores showed them to be round to globose and approximately 0.8 μm in diameter.

Cell wall hydrolysates, prepared by the method of Becker, Lechevalier, and Lechevalier (3), were
analyzed for amino acids and amino sugars, both by descending paper chromatography (10) and in a modified Technicon amino acid analyzer (4). Cell wall sugars also were analyzed by the method of Becker, Lechevalier and Lechevalier (3). These analyses of our isolates revealed the presence of glutamic acid, alanine, glucosamine, muramic acid, and the meso isomer of diaminopimelic acid as major cell wall amino acid and amino sugar constituents. Of the sugars only a trace amount of galactose was detected. This composition conforms essentially to the Type III cell wall aerobic actinomycete pattern (12). The gross colonial morphology, growth properties, microscopic spore characteristics, and chromatographic pattern indicated that our current isolates likely belong to the genus Thermoactinomyces. Although these characteristics approximate those of Thermoactinomyces vulgaris (13), the gross morphology of our isolates and that of known T. vulgaris isolates (1, 11) appear to be different. Until further definitive studies are performed, our currently described heating system isolates are best classified as Thermoactinomyces sp.

The results of this study indicate that thermophilic actinomycetes, previously shown to cause a hypersensitivity pneumonitis in man (2), may be cultured from the heating and humidification systems of homes. The importance of this source of actinomycete antigen in the production of non-occupational hypersensitivity chest disease remains to be elucidated.

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LITERATURE CITED