

Identification and Prevalence of Culturable Mesophilic Microfungi in House Dust from 100 Danish Homes

Comparison between Airborne and Dust-Bound Fungi

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In order to encircle possible allergen sources, fungi from house dust were cultivated and identified. Dust from vacuum cleaners was inoculated on Petri dishes containing V-8 agar with addition of penicillin and streptomycin to eliminate the bacterial flora. The number of genera identified were for the most part consistent with the genera trapped from the air. However, presumably owing to their dispersal biology, it was demonstrated that members of *Mucorales* were much more frequently represented in the samples obtained by this method compared with gravimetric and volumetric measurements. The method is recommended as a simple way to demonstrate and identify the mould contents in house dust and as a tool for the identification of some of the real allergenic sources in house dust.

Key words: allergen sources; fungi; house dust; moulds.

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Allergy to house dust is well known, but not clearly defined (12, 13, 19) with the exception of the allergenic role of the house dust mites *Dermatophagoides pteronyssinus*, *D. farinae* and animal dander (3, 15). Efforts are being made to detect the single organisms and components in this poorly defined ecosystem: house dust, consisting of textile fibres, human dander, fungi, animal hair and dandruff, pollen, mites, bacteria and degradation products of all these components.

The ecological role of fungi in house dust is insufficiently explained, although a certain association with *Dermatophagoides* spp. and other mites is suggested (1, 15). *Trichoderma viride* and *Chaetomium* spp., two microfungi with strong cellulose decomposing ability (5, 16), possibly play a role in the degradation of textile fibres in dust. Other possible

relationships: mites eating the fungal spores (easily observed in the gastrointestinal tract through the microscope), and moulds (*Mucorales*) with chitinolytic ability decomposing the skeleton of the dead mites.

Analyses of commercially available house dust extract (Allergologisk Laboratorium, Copenhagen) have recently been performed by means of crossed immunoelectrophoresis (2). Several of the above mentioned components have been demonstrated and five different moulds have been identified. However, greater sensitivity in the detection of the fungal components can be achieved by cultivation, identification and—if technically possible—quantitation.

Microscopic examination of fungi, cultivated from house dust, dust in mattresses and furniture, has been performed in different geographical locations

(4, 10, 11, 19). This method is suitable and detailed enough to demonstrate the occurrence of viable fungi in dust.

Fungal particles liberated to the air from different growth foci will be dispersed outdoors as well as indoors and will sediment with different velocity according to Stoke's Law: $V \cong 3.10^{-8} \cdot \zeta \cdot d^2$, where v is terminal velocity, ζ is density (kg/m^3) and d^2 is diameter in μm . Small, light spores remain in the air for a long time, while large heavy spores quickly sediment on both horizontal and vertical surfaces (9) together with other dust particles.

A fact which causes much discomfort to many allergic patients is that the dust particles are redispersed into the air owing to local indoor turbulence and currents created by temperature difference, movement of persons, vacuum cleaning and other house cleaning.

To further elucidate indoor allergen sources this study was done to demonstrate and identify the content of viable fungus spores in Danish house dust, to examine whether the sedimentation rate had any

influence on the fungal composition in the dust and to compare the prevalence of moulds found in house dust with airborne microfungi recorded inside Danish homes during 1971-72 (6).

MATERIAL AND METHODS

Samples of house dust from 100 different homes, some of them inhabited by allergic patients, were investigated. A total of 30 mg house dust was collected from vacuum cleaner paperbags sent to the Laboratory. The dust was inoculated on Petri dishes with V-8 agar with added antibiotics to prevent bacterial growth. The first microscopic examination took place after 3-4 days of incubation at room temperature.

About 10 days after incubation most of the sporulation was finished and perfect fruit-bodies were formed from members of the Ascomycetes such as *Chaetomium* spp. and *Sordaria fimicola*. No dilution method was used because of the overgrowing effect of *Mucor* and *Rhizopus* which are abundantly represented in the samples. Rose Bengal agar

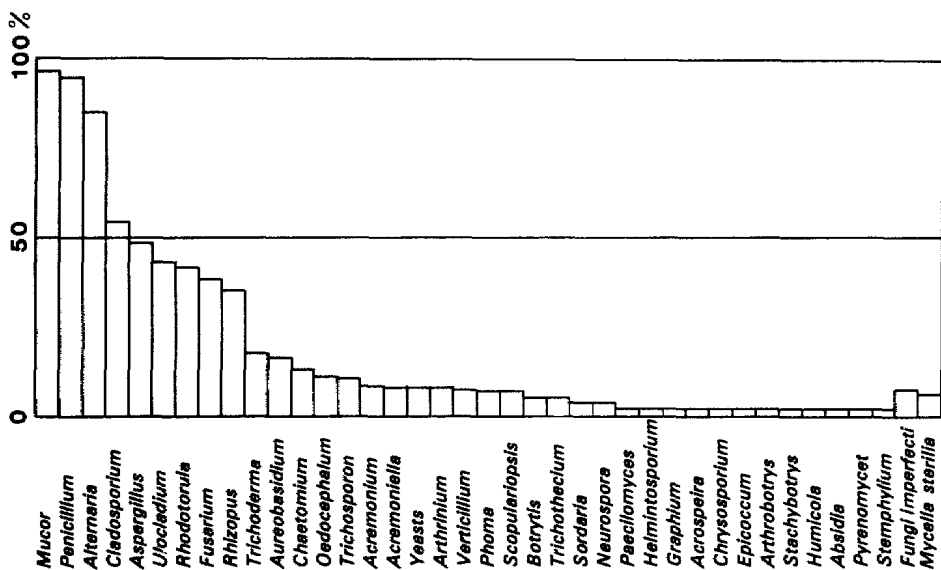


Fig. 1. Prevalence of microfungi cultivated on V-8 agar from dust samples collected in 100 Danish homes.

was tried without success and consequently no quantitative estimation was performed.

RESULTS AND DISCUSSION

As seen from Fig. 1 members of the Mucorales (*Mucor spinosus*, *M. racemosus*, *M. spp.* and *Rhizopus nigricans*) predominated the dust samples, followed by species of *Penicillium*, *Alternaria*, *Cladosporium* and *Aspergillus*. The following species from dominating genera were identified: *Mucor racemosus*, *M. spinosus*, *Cladosporium herbarum*, *C. cladosporioides*, *C. macrocarpum*, *Aspergillus fumigatus*, *A. niger* and *A. ochraceus*.

Compared with the frequency of microfungi recorded from the air inside Danish homes (Fig. 2), the most significant feature was the domination of *Mucor* in the dust samples. *Penicillium*, the ubiquitous year-round mould, is demonstrated as no. 2 in frequency both from air and dust. It is

remarkable that *Cladosporium* which was recorded 100% in the air samplings only occurred in 53% of the dust samples, while *Ulocladium* (closely related to *Stemphylium*) was found only in 10% of the air recordings but was represented in 43% of the house dust.

Fig. 3 shows the terminal velocity of some of the moulds represented in house dust.

A certain correlation between spore size and sedimentation rate was expected but a general tendency seems difficult to demonstrate.

The overall representation of *Mucor* could be explained by the fact that spores from different *Mucor* species are rather sticky because of their liberation from the sporangium in a mucilaginous droplet (7, 8). This is in accordance with an earlier study (19) in which dust is separated into two different types: fine dust, found for example on smooth surfaces, where *Mucor* is seldom encountered, and crude floor dust where

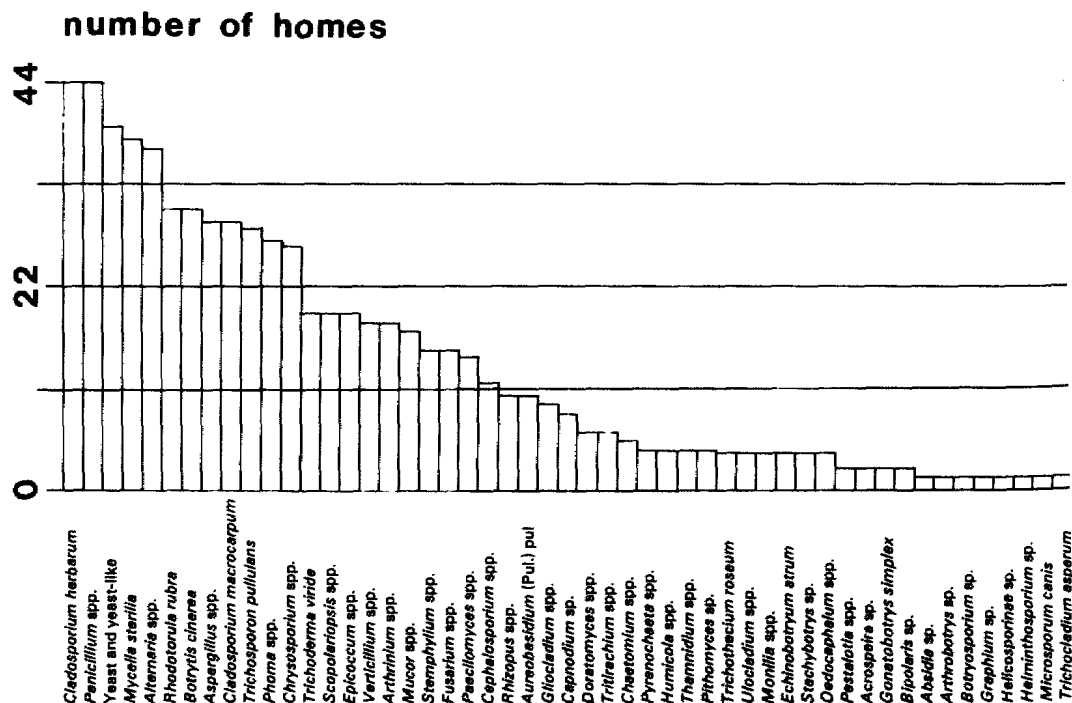


Fig. 2. Frequency of microfungi recorded monthly during 1 year from the air in 44 Danish homes.

Estimated density 1.1 g/cm ³	Shape	Size μ m	Terminal velocity cm/sec
<i>Mucor spinosus</i>		4–7.5	0.21–0.75
<i>Mucor racemosus</i>		6 x 9	0.65
<i>Penicillium, Aspergillus</i>		3–5	0.12–0.33
<i>Alternaria</i>		9 x 20/18 x 63	2.38–15.02
<i>Cladosporium</i>		5 x 9/13 x 28	1.20–2.44
<i>Helminthosporium</i>		7 x 24/11 x 85	2.23–12.39
<i>Acremoniella</i>		15 x 20/25 x 30	3.97–9.93

Fig. 3. Calculated sedimentation rates based on Stoke's Law.

Seldom recorded from indoor analyses:	{ <i>Helminthosporium</i> <i>Acremoniella</i>
Found in 96% of dust analyses:	{ <i>Mucor</i> <i>Mucor</i>
Frequent in both dust and air analyses:	{ <i>Penicillium</i> <i>Aspergillus</i> <i>Alternaria</i>
Most often recorded from indoor air analyses:	{ <i>Cladosporium</i>

Mucor is always present. The latter type will be the one mainly represented in this study.

Helminthosporium and *Acremoniella*, two heavily spored moulds seldom recorded from indoor air, are demonstrated in Danish house dust.

The reason why *Cladosporium* compared with *Penicillium* and *Aspergillus* is so sparsely represented is difficult to explain. It depends perhaps on their mutual competition during growth. This competition ability between fungi is one of the factors which make a quantitative estimation of the dust-bound fungi dubious.

With this in mind, we regard dust analysis of the stationary moulds as a supplement to

the 20-min gravitation measurements of spore concentration of indoor air, giving us a momentary picture influenced by variable parameters in the room. It should be mentioned, however, that the prevalence of moulds differs from one country to another, depending on the season, the macroclimate and outdoor vegetation, the indoor microclimate, the standard of the house, as well as the sampling methods (14, 17).

The role of microfungi as an allergen source is well established. We recommend environmental analysis of suspected homes, partly to identify the allergen sources and partly to let the moulds serve as a bio-indicator for elimination treatment.

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