

THE DANISH RESEARCH PROGRAMME: “MOULDS IN BUILDINGS” 1998-2001

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ABSTRACT

The research programme *Moulds in buildings, 1998-2001* is supported by a grant from the Danish Research Agency and comprises nine research projects. Additionally an information project with publication of results as peer- reviewed papers and more broadly accessible material such reports, guidelines and information material will be co-ordinated under the programme.

The three main areas of the programme deal with medical, microbiological and building-related aspects, which are closely correlated to each other. The overall aim of the programme is to combat mould growth in existing buildings and to prevent growth in future buildings by establishment of a more secure basis for decision of e.g. proportion and extent of renovation and choice of materials and constructions. Moreover, it is the aim to further elucidate the causal relation between exposure to mould growth in buildings and adverse health effects.

KEYWORDS: damp buildings, schools, fungi, exposure assessment, health effects,

INTRODUCTION

Recent studies have revealed that moulds growing on building materials produce and release substances with potentially adverse health effects such as specific inhalation allergy, non-specific hyperreactivity and toxic effects. Some of these are microfungus allergens and mycotoxins with potential dermatotoxic, immunomodulating and carcinogenic effects. Ongoing investigations deal with the health implication of exposure to both the allergens and the fungal metabolites. Some of these studies have demonstrated fungal metabolites such as *chaetoglobosins*, *satratoxins*, and *sterigmatocystins* detected from building materials with mould growth.

Knowledge on exposure measures such as allergenic moulds species, mycotoxins and other microbial components associated with water damaged building materials may be a prerequisite for further elucidation of effect measures leading to preventive strategies. Rapid and simple methods for detection of mould growth in buildings will be developed and validated. Standard methods will be elaborated as a practical tool for professionals to identify and assess mould contamination for remediation, maintenance and prevention of mould growth.

Table 1 **The research programme *Moulds in buildings, 1998-2001***

Health

Moulds and health

Effects of exposure to moulds

Microbiology

Characterization of moulds associated with damp buildings

Exposure to moulds in buildings - "From wall to nose"

Rapid methods for detection of mould infestation in buildings

Building aspects

Collection of present knowledge regarding critical and safe building constructions in relation to mould infestation

Standardized methods for inspection and assessment of mould infestation in buildings

Resistance of buildings materials to mould infestation

Decontamination and remediation of materials and building structures with mould infestation

Short description of the projects

Project 1: Moulds & health

An epidemiologically stratified cross-sectional study of 10 water-damaged schools and 10 control schools with registration of dust conditions, extent of mould growth and building related symptoms (BRS) including clinical signs of the occupants. Fungal allergen extracts from the "the damp building funga" for skin prick test and in vitro tests are produced.

The aim of the investigation is to test the following hypothesis:

A correlation between microbial infestation and presence of BRS symptoms and specific allergy and asthma among the teachers and the eldest pupils can be demonstrated.

A correlation between microbial infestation and objective tests among the teachers can be demonstrated.

Elevated frequency of allergy and asthma symptoms among children attending schools with mould infestation can be demonstrated.

Project 2: Human effects of exposure to moulds.

The project consists of three studies:

A: In vitro studies of the inflammatory reaction of exposure to moulds

Determination of induced release of cytokines and activation of mRNA for cytokines after exposure to dust and moulds from the water damaged schools dealt with in the programme.

The aim is to develop a tool for investigation of differences in reactions between persons with and without adverse health problems following exposure to moulds in buildings elucidating individual sensitivity or effects of sensitization and to investigate the inflammagenic potential of the collected dust and mould samples.

B: Double blind placebo controlled exposure to moulds

A test for correlation between a positive specific IgE test for a given fungal species - a modified histamine release -test - and symptoms after dose controlled exposure to the same fungus in apparently non-atopic persons.

The aim is to develop a valid test for subclinical atopy for better and more secure advising of the occupants. The study is designed as a double blind placebo controlled exposure to *Penicillium chrysogenum*.

C: Development of an in vitro assay for "airway active" fungal metabolites in organic dust: Effects on bronchial cilia in chickens

The aim is to develop and validate a relatively inexpensive and rapid method for the detection of potential toxic effect of organic dust from buildings by comparing the ciliostatic effect of different dust samples to the effect of sterigmatocystin.

Project 3: Characterization of moulds associated with damp buildings

The aim is to identify the contaminating moulds in buildings - the building associated fungi - and thereby estimate the potential exposure of fungal allergens, mycotoxins and other biologically active components to the occupants. Furthermore to characterise - according to their ecological and physiological characteristics - the profiles of growth, temperature and water activity of the microfungi growing in damp buildings. Based on their physiological response possibly harmless methods for combating moulds as well as recommendations of preventive measures should be suggested.

Project 4: Exposure to moulds in buildings - "From wall to nose"

The aim is to study the route of exposure by investigating the production, release and dispersal of fungal spores (conidia) and of fungal volatile metabolites, MVOC, from visible and hidden surfaces of building materials to the ambient air on to the mucosa or skin of the exposed persons. The study will be performed under field conditions as well as during laboratory experiments with simulated spore liberation. A better elucidation of these mechanisms will lead to a better understanding of fungal exposure to occupants in mouldy buildings and add to more precise recommendations for intervention and prevention [2].

Project 5: Rapid detection methods for moulds in buildings

The project consists of three studies:

A: Enzyme method, the Mycometer-Test[®], a field method for detection of mould growth.

B: DNA (PCA) method, a field method for detection of moulds to genus or species level.

C: MVOC method, a field method for detection of moulds to species level.

The aim is to develop and validate standard sampling methods for quick detection of moulds on building materials for field engineers [3-4].

Building aspects

Project 6: Collection of present knowledge regarding critical and safe constructions in relation to mould infestation

The aim is to identify and quantify the risk of water damage and mould in different building structures and materials. Furthermore the project serves as a framework for co-ordination and discussions of the results of the research programme with a collaborative group consisting of persons from consultant engineers with specific knowledge of moisture and moulds in buildings.

Project 7: Standardized methods for inspection and assessment of mould infestation in buildings

The aim is to elaborate a standardized system of inspection methods and detection methods for the assessment of extent of mould growth, state of maintenance, condition of building constructions and installations in residences, schools other institutions and offices. I should create the basis for the necessary and sufficient decontamination and remediation, remedial activities, improvement of buildings, adequate maintenance and future preventive measures.

Project 8: Resistance of building materials to mould infestation

The aim is to study the climatic conditions responsible for mould infestation of building materials such as plasterboards, different kinds of wooden materials, wallpaper and paste. Based on the data obtained in the study mentioned above a method for the assessment of the resistance to mould attacks of different building materials will be developed. Threshold for water activity, materials and combination of material with a low risk of mould infestation under realistic indoor climate conditions will be recommended [5-6].

Project 9: Decontamination and remediation of materials and building structures with mould infestation

The aim is to establish an evaluation of available physical, chemical and mechanical methods for decontamination and remediation of mould infested building materials by testing and evaluating the selected methods on different materials, consecutively collected from mould infested buildings and contaminated materials from projects 1 & 8. Furthermore to elaborate a description of methods and parameters for quality control.

RESULTS

An important mean to reach the goals of the projects included in the programme has been to establish a common ground and a close collaboration between the participants from the three different disciplines involved: medicine, microbiology and building research. This has been successfully achieved, as several papers from the mould programme presented at this conference will demonstrate.

More details can be found on www.sbi.dk and www.ibt.dtu.dk/mycology/myindx.htm

REFERENCES

1. Gunnarsen, L., Afshari, A.: Occurrence of fungi and house dust mites in Danish apartments.
2. Healthy Buildings 2000 (in press).
3. Kildesø, J., Würtz, H., Nielsen, K.F., Wilkins, C.W., Gravesen, S., Nielsen, P.A., Thrane, U., Schneider, T: The release of fungal spores from water damaged building materials. Healthy Buildings 2000 (in press).
4. Reeslev, M., Miller, M.: The Mycometer-Test: A new rapid method for detection and quantification of mould in buildings. Healthy Buildings 2000 (in press).
5. Wilkins, W.: Volatile sesquiterpenes from *Stachybotrys chartarum*. Indicators for trichothecene producing mould species? Healthy Buildings 2000 (in press).
6. Nielsen, K.F., Nielsen, P.A., Holm, G.: Growth of moulds on building materials under different humidities. Healthy Buildings 2000 (in press).
7. Nielsen KF, Madsen JØ, 2000. Determination of ergosterol on mouldy building materials using isotope dilution and GC-MS/MS. Journal of Chromatography A (submitted).

