Neuere Entwicklungen in der Innenraum-Mykologie

New developments in Indoor Mycology

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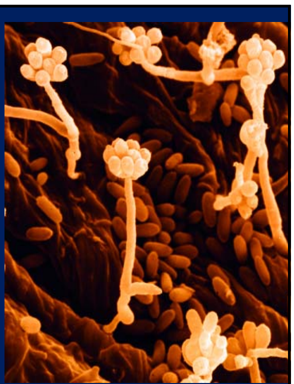
Significance of indoor molds

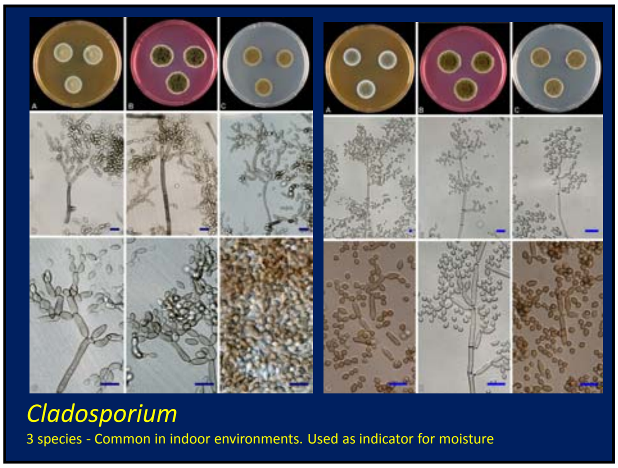
- Biodeterioration of the building
- Health implications
  - Allergy
  - Pathogens (e.g. Aspergillus fumigatus)
  - Toxins (e.g. Black toxic mold)



Ecology of indoor fungi Current concepts

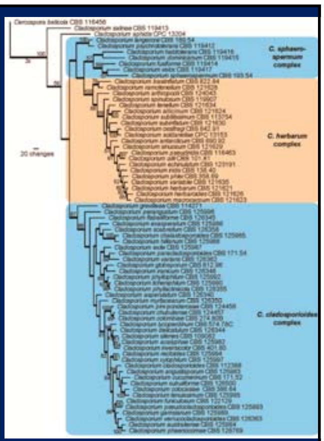
- The mycobiota of indoor environments is known (ca. 120 species) and is different in its composition from outdoors (phylloplane fungi)
- The mycobiota is very similar to that occurring in food
- Many species are xerotolerant or xerophilic
- Indoor fungi cause allergy and can produce toxic metabolites on building materials

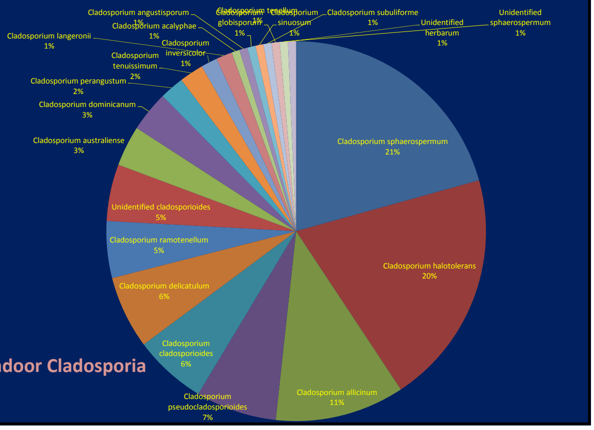

Biodiversity of the indoor mycobiota
New taxonomic developments


Cladosporium
3 species - Common in indoor environments. Used as indicator for moisture

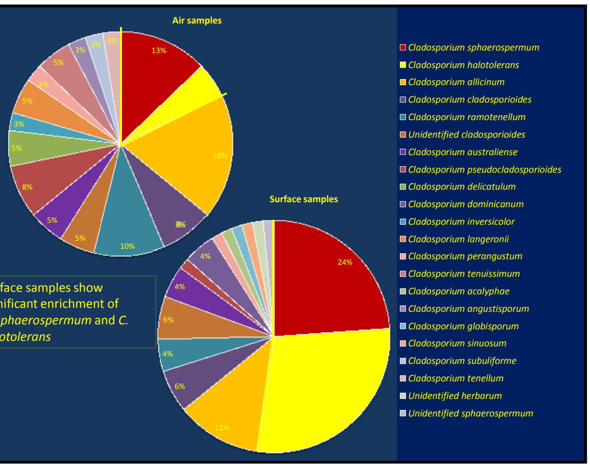
The genus *Cladosporium*

- The taxonomy of the genus *Cladosporium* based on multigene sequences
- Three main species complexes
- Bensch *et al* (Stud Mycol 2012)

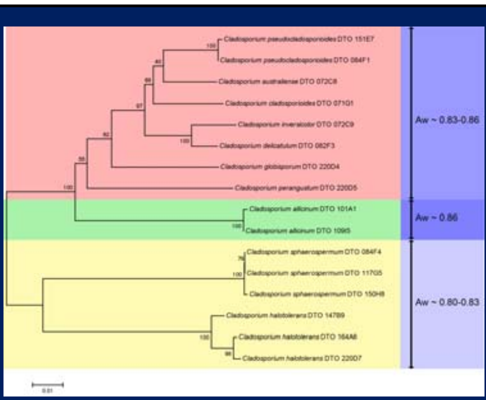




Indoor Cladosporia



Surface samples show significant enrichment of *C. sphaerospermum* and *C. halotolerans*

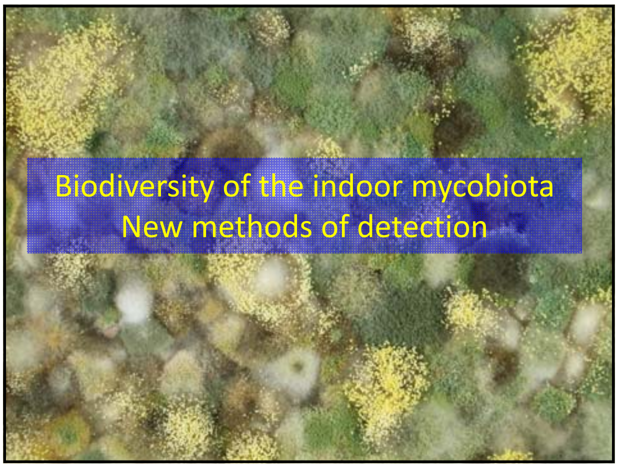


Indoor Cladosporia and their growth at lower water activities

Data provided by Frank Segers CBS

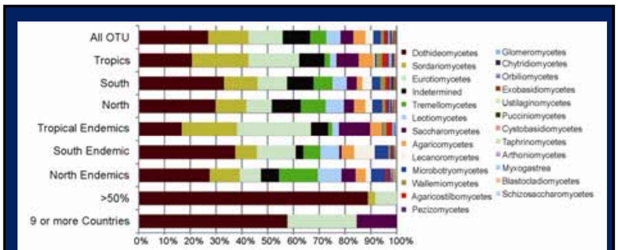
Cladosporium in indoor environments

- The most common indoor *Cladosporium* species are *C. halotolerans* and *C. sphaerospermum*
- These fungi can grow at lower water activities (0.80 – 0.83) which was been previously not known
- *C. herbarum* is rare or not found indoors



Research project sponsored by the Alfred Sloan Foundation (USA)

1. To develop a comprehensive, publicly accessible, on-line database of internal transcribed spacer (ITS) DNA barcodes (including voucher specimens, and DNA sequence chromatograms) for culturable fungi from human dwellings on a global scale.
2. To profile the complete fungal community, including species that cannot be cultured by standard techniques, using state-of-the-art high-throughput DNA sequencing technology.
3. To explore methods of obtaining voucher material (specimens or cultures) of 'nonculturable' fungi using novel techniques.
4. To use bioinformatics and genome mining tools to evaluate the potential of additional genetic loci that might serve as a second fungal barcode for indoor fungi and other ecological groups.
5. Help to develop standards for taxonomically categorizing environmental sequences.



- Settled dust samples (n = 72) from buildings on six continents were collected and pyrosequenced in multiplex using 454 Titanium technology
- A high diversity of indoor fungi
- The diversity is higher in temperate zones than in the tropics
- Building function has no effect on composition of the indoor mycobiota
- The most cosmopolitan OTU's were dominated by Dothideomycete taxa

Amend AS, Seifert KA, Samson, RA, Bruns, TD(2010) Indoor fungal composition is geographically patterned and more diverse in temperate zones than in the tropics. PNAS 107: 13748-13753

Dilution-to-extinction method (d2e)

Culture-independent methods

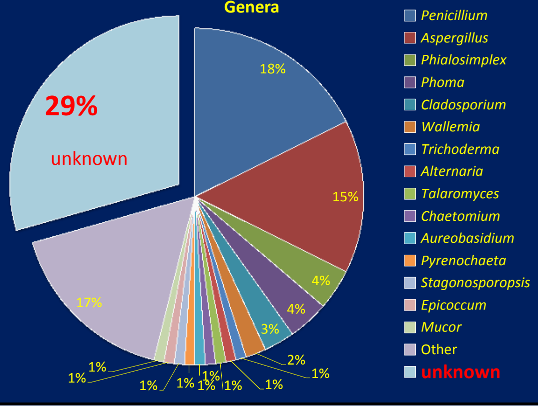
: **194,243** ITS sequences (more than 150bp)

Culture-dependent methods

: **7,938** living cultures

: **2,590** ITS sequences (about 450 to 600bp)

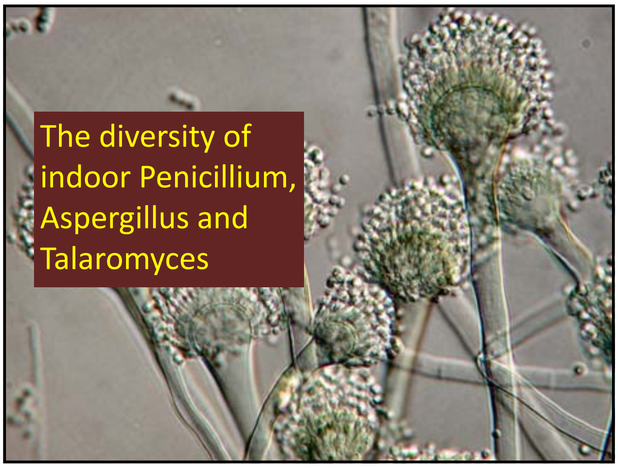
Fungal genera isolated by the d2e method (Preliminary identification of 7,938 living cultures)

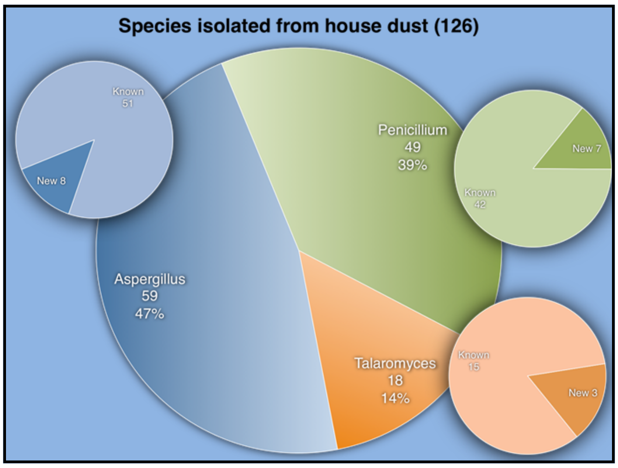


About 1/3 of the OTUs are undescribed or not sequenced and 7.5% of OTUs represent unknown or unsequenced higher taxa

Our estimated diversity → **～1790 species**

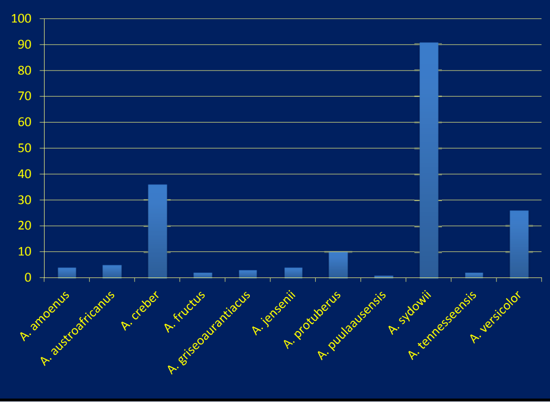
New or unsequenced species → **～600 species**
(～135 higher level taxa)


The diversity of indoor Penicillium, Aspergillus and Talaromyces


Species isolated from house dust (126)
Known 51
New 8
Penicillium 49 39%
New 7
Known 42
Aspergillus 59 47%
Talaromyces 18 14%
Known 15
New 3


Aspergillus versicolor, one of the most common indoor fungi

Aspergillus versicolor – complex found in house dust



Exometabolites in *Versicolores*

A austroafricanus:	St, Or, aniduquinolones, calbistrins
A jensenii:	St, Or, calbistrins, cyclopenols, sh, versicolamides, versicotides
A protuberus:	St, Or, cottoquinazolines, cyclopenols, sh, versicolamides, versicotides
A puulaauensis:	St, Or, brevianamide M, insulicolides, sh, versicolamides
A amoenus:	St, Or, kipukasins, versicolamides
A creber:	St, ---, aniduquinolones, versicolamides
A cvjetkovicii:	St, ---, brevianamide M, cottoquinazolines, epi-deoxybrevianamide E, 1,3,6,8-tetrahydroxyanthraquinone, versicolamides, versicotides
A venenatus:	St, Or, epi-deoxybrevianamide E, versicolamides
A fructus:	St, Or, anthcolorins, glyanthrypine, tryptoquivalins
A subversicolor:	St, Or, ”unique exometabolites”
A tennesseensis:	St, Or, brevianamide M, brevianamides J,K,Q,R,T-W, cottoquinazolins
A versicolor:	St, Or
A sydowii:	---,Or, 5’-deoxy-5’-methylamino-adenosine, butyrolactones, sydonic acids, sydowinins, WIN 64745 & 64821
A tabacinus:	---,Or

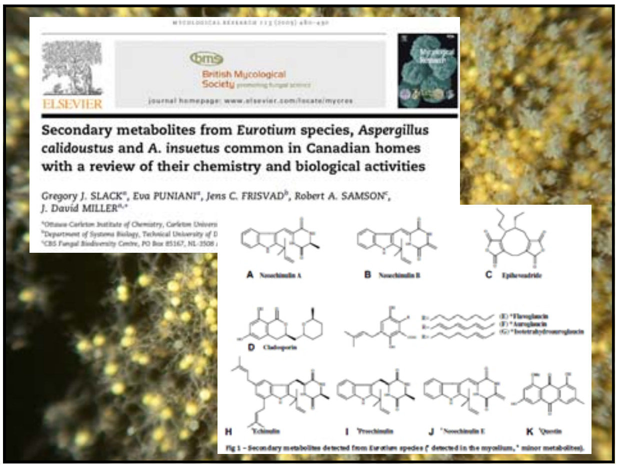
St = sterigmatocystins, Or = Orsellins & violaceols, Sh = shamixanthone der.

Data from Jens C. Frisvad

Indoor fungi and toxin production

Indoor moulds	Growth on building material	Toxins on building materials
Alternaria spp	yes	No toxins found
Aspergillus flavus	Yes but very wet	No aflatoxins
Aspergillus niger	Yes but very wet	No toxins found
Aspergillus versicolor	yes	Sterigmatocystin but not produced at aw<0.9
Aspergillus calidoustus	Yes but poor growth	No toxins found
Chaetomium globosum	yes	Chaetomins and chaetoglobins
Cladosporium spp	yes	No toxins found
Penicillium chrysogenum	yes	No toxins found
Stachybotrys chartarum	Yes but wet	Trichothecenes, satratoxins
Ulocladium spp	Yes but wet	No toxins found

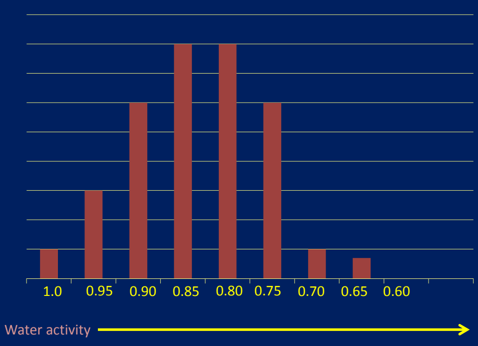
Data from Kristian Nielsen - DTU



Summary

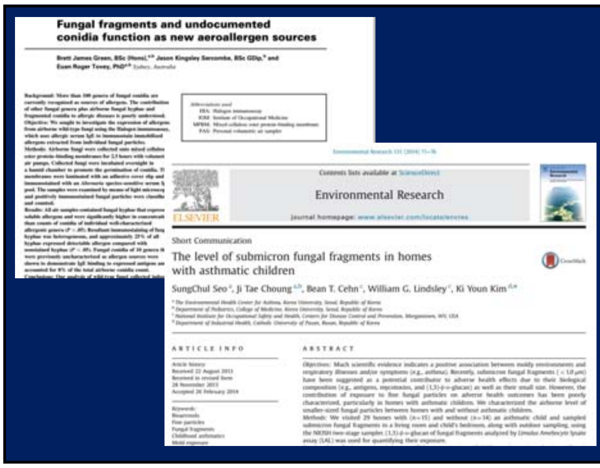
- There are many genera/species which were not expected indoors and are unknown to science
- Some fungi which occur commonly prove to be taxonomically complex and each species have special characters of growth and metabolite production
- How can we deal with all the new species and what is their significance?
- What does it mean that there are many xerophilic species
- Which species are responsible for allergy or toxins ??

Ecology of indoor fungi
Number of species with growth at various water activities



Summary

- There are many fungi which were not expected indoors and are unknown to science
- Some fungi which occur commonly prove to be taxonomically complex (e.g. *Scopulariopsis*)
- How can we deal with all the new species?
- What does it mean that there are many xerophilic species
- Which species are responsible for allergy or toxins (glucan) ??



Fungal fragments and undocumented conidia function as new aeroallergen sources

Brett James Green, BSc (Hons), Jason Kingsley Sercombe, BSc GDip, and Euan Roger Tovey, PhD

Environmental Research

Short Communication

The level of submicron fungal fragments in homes with asthmatic children

SungChul Seo, Ji Tae Choung, Bean T. Cehn, William G. Lindsley, Ki Youn Kim

ARTICLE INFO

ABSTRACT