

Gesundheitliche Bewertung von Schimmelpilzen im Innenraum – Möglichkeiten und Grenzen

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 - 1.2 other biogenic noxae: actinobacteria, mycotoxins, MVOC, cell wall components, etc.
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 - B. Infection, “rare fungi”
 - C. Intoxication, immune-modulation
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1. Introduction

Suche: 942

Ergebnisse 1 - 10 von [Google](#) für **gesundheitliche Bedeutung Schimmelpilze Innenraum**. (0,30 Sekunden)

pro1 Zusammenfassung 1 Charakteristik der Schimmelpilze in...
Dateiformat: PDF/Adobe Acrobat - HTML-Version
Schimmelpilze im Innenraum: Wachstumsbedingungen, gesundheitliche Gefährdung ...
Diese sind von besonderer **gesundheitlicher Bedeutung**, weil sie bei 37°C ...
[www.dgip.de/pages/tagungen/berichtsband/ab_69-CD/b69-01.pdf - Ähnliche Seiten](#)

Wissenschaftstransfer, Arbeitsmarktanalyse, Stellenangebote ...
Ihre **gesundheitliche Bedeutung** ist noch nicht ausreichend erforscht. ... Wir bieten
Beratung zu den Ursachen von **Schimmel**, **gesundheitlichen Auswirkungen**, ...
[www.wilabonn.de/645_2296.htm?h214027h21402_51k - In Cache - Ähnliche Seiten](#)

Wohnumwelt - Lebensqualität im Innenraum sichern
Mehr Informationen und Angebote zu **Innenraum**-Untersuchungen und
Sachverständigenleistungen erhalten Sie ... **Gesundheitliche Bedeutung von Schimmelpilzen** ...
[www.wohnumwelt.de/ - 59k - In Cache - Ähnliche Seiten](#)

pro1 Leitfaden des Umweltbundesamtes zur Vorbeugung, Untersuchung...
Dateiformat: PDF/Adobe Acrobat - HTML-Version
Ein weiteres Problem bei der Beurteilung von **Schimmelpilzen im Innenraum** ist das ...
Schimmelpilze, denen eine besondere **gesundheitliche Bedeutung** ...
[www.bfz.bund.de/cv/232/schimmelpilz_leitfaden_des_umweltbundesamtes.pdf - Ähnliche Seiten](#)

pro11 Pilztagung des VDB e.V. mit dem Themenschwerpunkt ...
Dateiformat: PDF/Adobe Acrobat - HTML-Version
„gesundheitliche Bewertung von Schimmelpilzen im Innenraum“ ... von nebensächlicher
Bedeutung in der mit Spannung erwarteten ...
[www.bioökologie.schuenemann.de/uploads/media/Presstext11-Schipi-Tagung_VDB.pdf - Ähnliche Seiten](#)

Gesundheitsgefährdung durch Schimmelpilze
Die **Bedeutung** dieser Wirkungen bei Schimmelpilzwachstum in Innenräumen ist unklar
Gesundheitliche Probleme durch rezidierende Wirkungen von **Schimmelpilzen** ...
[www.baybooks.de/archiv/schimmelpilze.html - 12k - In Cache - Ähnliche Seiten](#)

pro1 Gefahren durch Schimmelpilze
Dateiformat: PDF/Adobe Acrobat

Highest risk !?

- FungiPhobia (pers. comm. Buzina)
- YES and NO

They can be nice, wouldn't you say?

1.1 Species spectra – Influenced by water activity (a_w -value)

Figure 1.1 Examples of moisture sources and building defects.

1.2 Other biogenic noxae – Actinobacteria (Förderkennzeichen UBA 205 62 236)



Taxon	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 6	Probe 7	Probe 8	Probe 9	Probe 10	Probe 11	Probe 12A	Probe 12B	Probe 13A	Probe 14	Probe 15	total
1) Actinomyces	1																1
2) Actinopolymorpha						4											4
3) Aeromicrobium		1	1										1				3
4) Aeromonas	1													1			2
5) Agromyces																1	1
6) Amycolatopsis						8	24	2	39			28	11	8			120
7) Antrhobacter	8	1								1	1	1	6		20	3	44
8) Blastococcus																3	3
9) Brachybacterium				1							4						5
10) Breuibacterium		2		1				6			1	1					11
11) Conobacter															1		1
12) Crocebacterium													1	1			2
13) Crossiella												3					3
14) Crucibacterium		1															1
15) Cryocota						1								1			2
16) Georigenia													1				1
17) Goodfellowia															1		1
18) Jiangella	1	1	2	2		8						9					23
19) Kneococcus																1	1
20) Kocuria															1		1
21) Kribbella															1		1
22) Leifsonia			1			2											3
23) Lentzea	1											3	1				5
24) Microbacterium		1			4					1				1			7
25) Micrococcia														2			2
26) Microcladius							1	1				2					4
27) Micromonospora																2	2
28) Modestobacter															2		2
29) Mycobacterium				1												1	2
30) Nesterenkonia					33												33
31) Nocardia						1	1	2						1			5
32) Nocardioidea					5		1						1	5	11		23
33) Nocardiopsis				2		4	9	1	1								17
34) Parkia								1									1
35) Patulibacter			1														1
36) Prauserella						1											1
37) Prauserella									1								1
38) Promicromonospora		1	1	1	12	2	7		14				7	8			52
39) Propionibacterium		1															1
40) Pseudonocardia	1	22	1	3	18	14	1	7	3			2	14	12	1	1	105
41) Rathayibacter						1	4								1		6
42) Rhodococcus																2	2
43) Saccharomonospora						2		2				5					9
44) Saccharopolyspora		17		3		8		33	1			10		2	3		77
45) Saccharothrix			1														1
46) Sanguibacter												3					3
47) Solirubrobacter																1	1
48) Stackebrandtia						1											1
49) Strapomyces			1			2	10	2	18			11	17	20			81
50) Tetrasphaera																1	1
51) Yania					8												8
52) Uncultured Rubrobacteridae																	1
53) Uncultured Actinobacterium										1							1
54) Candidatus Microthrix						3											3
total	12	47	12	55	55	82	34	86	39	6	77	68	62	14	30	15	694

2. Risk assessment – Preliminary remarks

- Fungal growth in indoor environments is generally a hygienic problem and can not be tolerated → minimise exposure !!!
- Final evaluation of health risks due to fungal exposure indoors not possible because of:
 - 1. synchronous exposure to numerous other noxae (microbial, chemical)
 - 2. lack of reliable exposure data (pulmonary exposure)
 - 3. parameter that best describes fungal exposure is still lacking: living and dead fungi, fungal allergens, cell wall components, mycotoxins?
- The risk **can not** be quantified on the basis of the current knowledge
 - The risk matrices developed allow definition of a relative risk



Quantification of risk not possible in an epidemiological sense

Allergy:	yes	no
Exposure:		
High	A	B
Normal (Background)	C	D

- Risk for highly exposed = $A / (A + B) = R_{Exp}$.
- Risk for background exposure = $C / (C + D) = R_{Non-Exp}$.
- Relative Risk = $R_{Exp} / R_{Non-Exp}$.
- Such data do not exist for typical indoor fungi !



2A. Risk analysis for allergy – Preliminary remarks



- 3 – 10 % of the population are sensitized against fungi: but !!!
- This prevalence was deduced from test with „outdoor species“ !
- „Indoor-species“ not assessed, because test extracts are not available commercially !

2A. Problems in allergy diagnostics

- Only a few test extracts available:

- ... \cong **80** spezie occur in indoor environments,
- ... **18** of which are commercially available for routine diagnostics in allergology,
- ... **6** of which are associated with fungal contamination due humidity problems:

Aspergillus versicolor, *A. terreus*, *Emericella nidulans*, *Penicillium chrysogenum*, *Chaetomium globosum*, *Stemphylium botryosum*

- Under which name are they available and from which company?

Name of test extract: -

Penicillium notatum
Alternaria tenuis
Epicoccum purpurascens
Helminthosporium halodes
Rhizopus nigricans
Penicillium frequentans

Valid botanical name:

Penicillium chrysogenum
Alternaria alternata
Epicoccum nigrum
Exserohilum rostratum
Rhizopus stolonifer
Penicillium glabrum



2A. Humidity indicators (#) and availability of commercial test extracts (+)

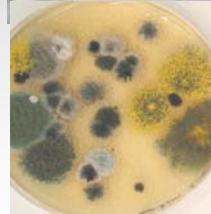
Species :	Hum.-Indic.	Allergen extract, manufacturer				Species:	Hum.-Indic.	Allergen extract, manufacturer			
		APH	BEN	ALK	HAL			APH	BEN	ALK	HAL
<i>Acremonium strictum</i>	#					<i>P. aurantiogriseum</i>					
<i>Alternaria alternata</i>		+	+	+	+	<i>P. brevicompactum</i>					+
<i>Aspergillus flavus</i>						<i>P. chrysogenum</i>		+	+	+	+
<i>A. fumigatus</i>		+	+	+	+	<i>P. citrinum</i>					
<i>A. niger</i>		+	+		+	<i>P. digitatum</i>					
<i>A. ochraceus</i>						<i>P. commune</i>					
<i>A. parasiticus</i>						<i>P. crustosum</i>					
<i>A. penicilloides</i>						<i>P. expansum</i>					+
<i>A. restrictus</i>						<i>P. glabrum</i>					
<i>A. sydowii</i>						<i>P. griseofulvum</i>					
<i>A. tamarii</i>						<i>P. purpurogenum</i>					
<i>A. terreus</i>	#	+				<i>P. olsonii</i>					
<i>A. ustus</i>						<i>P. roqueforti</i>					
<i>A. versicolor</i>	#	+				<i>Phialophora fastigiata</i>	#				
<i>Aureob. pullulans</i>				+	+	<i>Phoma glomerata</i>					
<i>Botrytis cinerea</i>				+	+	<i>Rhizopus stolonifer</i>			+	+	(+)
<i>Chaetomium globosum</i>	#	+			+	<i>Rhodotorula minuta</i>					
<i>C. cladosporio</i>						<i>Scopulariopsis brevicaulis</i>	#				
<i>C. herbarum</i>						<i>Scopulariopsis fusca</i>	#				
<i>C. sphaerospermum</i>						<i>Stachybotrys chartarum</i>	#				
<i>Curvularia lunata</i>						<i>Stemphylium botryosum</i>	#		+		+
<i>Emericella nidulans</i>					+	<i>Trichoderma harzianum</i>	#				
<i>Epicoccum nigrum</i>				+	+	<i>Trichoderma viride</i>	#		+		
<i>Eurotium herbariorum</i>						<i>Tritirachium album</i>	#				
<i>Fusarium culmorum</i>					+	<i>Ulocladium chartarum</i>					
<i>Fusarium solani</i>		+				<i>Verticillium spp.</i>					
						<i>Wallemia sebi</i>					

Legende: + = Allergen-Extrakt available [Bencard as prick- und povocation test ; ALK-Scherax as prick-, intrakutan- and provokation test ; HAL and Allergopharma: no information], humidity indicator = species highly indicative of humidity

2A. Cross reactivities and homologies / „Outdoor-Species“

Outdoor species occur indoors, but do not colonize or multiply on building materials !

Species	Allergen, MW (kD)	Biological function	Crossreactivity (species), Homologies (allergen)
<i>A. alternata</i>	Alt a 1 (28)	GP	<i>Stemphylium spp.</i> <i>Ulocladium spp.</i>
	Alt a 3	HSP 70	
	Alt a 4 (57)	Pd-Iso	
	Alt a 5 (11)	SRP P2	Cla h 4
	Alt a 6 (45)	Enolase	Cla h 6 (46)
	Alt a 7 (22)	YCP4	Cla h 5
	Alt a 8 (29)	Mannitol dehyd.	
	Alt a 10 (53)	ADH	Cla h 3
	Alt a 12 (11)	SRP P1	
	Alt a 13 (26)	Glu-S-tra	
<i>C. herbarum</i>	Cla h 2 (23)	GP, Ag45	<i>C. cladosporioides</i>
	Cla h 5 (11)	SRP P2	Alt a 5
	Cla h 6 (46)	Enolase	Alt a 6 (45)
	Cla h 7 (22)	YCP4	Alt a 7
	Cla h 10 (53)	ADH	Alt a 10
	Cla h 12 (11)	SRP P1	
<i>Curvularia lunata</i>	(26), (31), (38), (45), (50)		<i>A. alternata</i> , <i>E. nigrum</i> (26), (45), (50)
<i>E. nigrum</i>	(17), (26), (43) (37), (80) (36), (63) (34)	13 A. (9S,6M)	<i>A. alternata</i> <i>C. lunata</i> <i>C. herbarum</i> <i>P. citrinum</i>



(Data from: Horner et al. 1995 [30], Breitenbach et al. 2002 [12], Bisht et al. 2003 [9], Kurup 2003 [33])

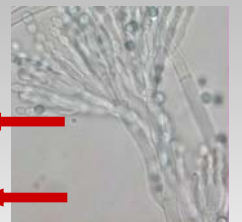
2A. Cross reactivities and homologies / „Indoor species“

Species	Allergen, MW (kD)	Biological function	Crossreactivity (Spezies), Homologies (Allergen)
<i>P. brevicompactum</i>	Pen b 13		
<i>P. chrysogenum</i> (<i>P. notatum</i>)	Pen chr 13 (34)	ASP	Pen c 1, Asp f 11, 13
	Pen chr 18 (32)	VSP	Pen c 1
	Pen chr 20 (68)	N-aG	
<i>P. citrinum</i>	Pen c 1 (33)	ASP	<i>P. chrysogenum</i> , <i>P. brevicompactum</i>
	Pen c 2 (39)	VSP	<i>A. niger</i>
	Pen c 3 (18)	PoxiMP	Asp f 3
	Pen c 13	ASP	<i>Aspergillus oryzae</i> , <i>A. flavus</i> , <i>A. fumigatus</i>
	Pen c 18 (34)	VSP	
	Pen c 19 (70)	HSP	
	Pen c 22 (46)	Eno	Asp f 22
	Pen c 24 (25)	EF 1-β	<i>S. cerevisiae</i>
<i>P. oxalicum</i>	Pen o 18 (34)	VSP	Pen c 1

(Data from: Horner et al. 1995 [30], Breitenbach et al. 2002 [12], Bisht et al. 2003 [9], Kurup 2003 [33])

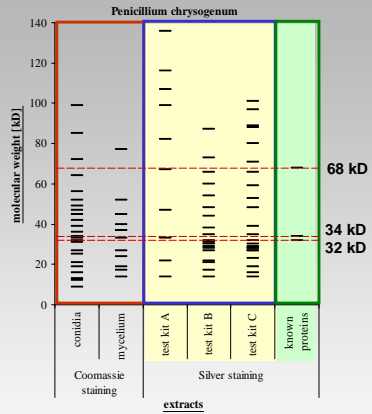
Test extracts available

Food als possible allergen source !

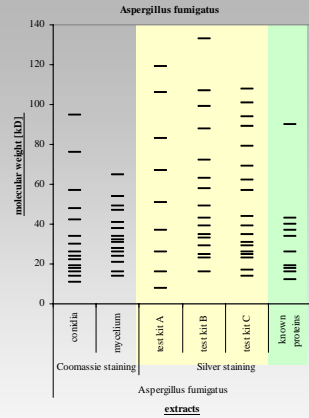


- minimise problems in diagnosis due to cross reactivity and homologies by:
 - differentiated exposure assessment of air-borne and dust-borne fungi
 - intensify cooperation between allergology and mycology

2A. Quality and standardisation of test extracts



Comparison of the protein content between conidia and mycelium of a selected strain of *Penicillium chrysogenum*, commercial test kits and named proteins in allergen databases

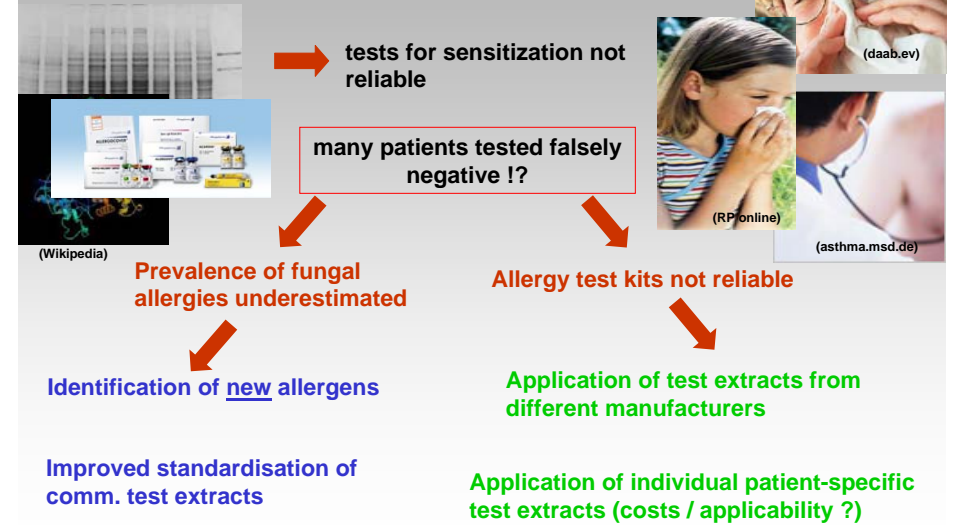


Comparison of the protein content between conidia and mycelium of a selected strain of *Aspergillus fumigatus*, commercial test kits and named proteins in allergen databases



2A. Problems in diagnostics of fungal allergies

- Comm. allergen extracts badly standardised
- protein spectra differ from environmental strains

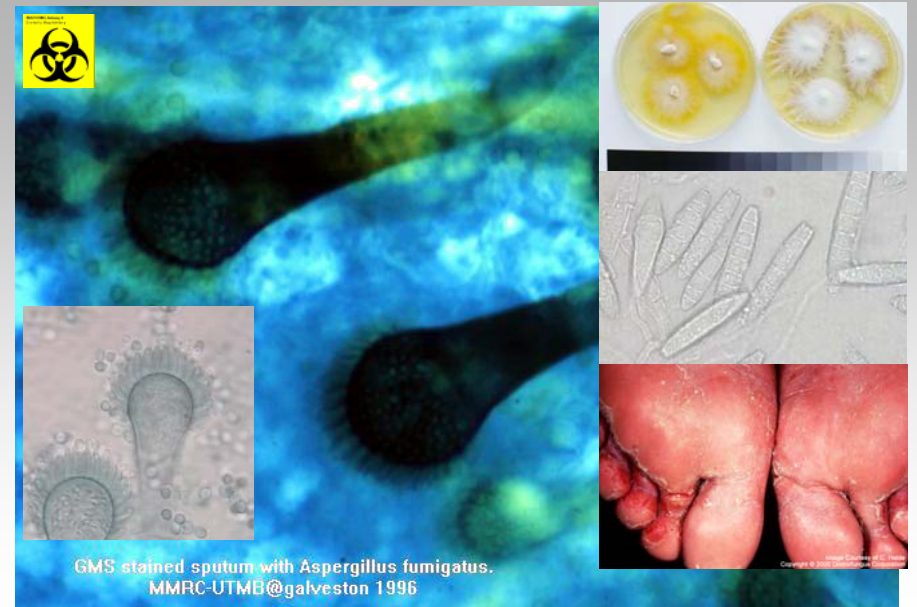


Risk for sensitisation / manifestation of allergy

Fungal species	No allergy		Allergy* not against fungi	Allergy* against fungi known	Allergy* against specific species
	without parental pre- disposition	with parental pre- disposition			
Species without known sensitizing, allergic effect					
Species with known sensitizing, allergic effect z.B.: <i>A. fumigatus</i> , <i>Alternaria alternata</i> , <i>P. chrysogenum</i>					

* Clinical relevance of allergy must be proven after diagnosed sensitization

2B. Infection



GMS stained sputum with *Aspergillus fumigatus*.
MMRC-UTMB@galveston 1996

FUNGISCOPE
Global Rare Fungal Infection Registry



Under the auspices of

ID Working Party of the German Society of Hematology and Oncology



Paul Ehrlich Society for Chemotherapy



Istituto Italiano Micopatologia Umana ed Animale



German-Speaking Mycological Society



ESCMID Fungal Infection Study Group



Austrian Society of Medical Mycology



German Society of Infectious Diseases



Societatea Româna de Micologie Medicală și Microbiologie



Coordinators

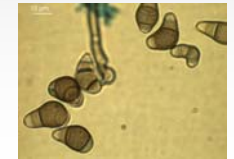
	Germany	Austria	Italy	Brazil
Clinical ID	Oliver A. Cornely, MD Cologne (chair)	Elisbeth Presterl, MD Vienna	Livio Pagano, MD Rome	Marcio Rio de Janeiro
Microbiology	Guido Fischer, BS Aachen	Cornelia Leo-Pflügl, MD Innsbruck	Maurizio Sangalli, MD Rome	
Molecular Biology	Ralf Büchel, MD Kiel	Walter Busina, MD Graz	Annamaria Tortorano, MD Milano	
Pathology	Claudia Wickenhauser, MD Cologne	Ulrich Strasser, MD Innsbruck	Gianluigi Vago, MD Milano	
Pharmacology	Carsten Müller, MD Cologne	NEI	Andrea Novelli, MD Perugia	



Rare opportunistic fungi in the environment



- Species from „Fungiscope“:
- **Zygomycota:** *Absidia corymbifera* (*Mycocladius ramosus*), *Mucor hiemalis*, *Rhizomucor pusillus*, *Rhizopus oryzae*
- **Ascomycota (conidial):** *Acremonium* sp., *Curvularia lunata*, *Fusarium solani*, *Fusarium oxysporum*, other *Fusarium* spp., *Paecilomyces lilacinus* (*Paecilium lilacinum*), *Trichoderma longibrachiatum* Sect., *Penicillium islandicum* Ser.
- **Basidiomycota (yeasts):** *Schizophyllum commune*, *Trichosporon asahii*, *Cryptococcus neoformans*, *Rhodotorula glutinis*

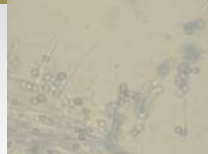
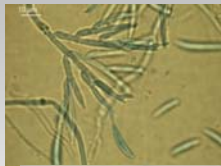


- Is there any increased exposure to such species indoors?

2B. Indoor as a possible source for rare opportunistic fungi ?

- Question: What is the risk for immune-compromised patients, when they are exposed to fungal contaminations indoors ?
- Potentially opportunistic species to be found in higher concentrations in indoor environments with humidity problems:

- *Fusarium solani* (one of the most frequent *Fusarium* species indoors)
- *Trichoderma longibrachiatum* Sect. (often in cellars, growth on wood materials!)
- *Acremonium* spp. (mostly *A. strictum*)
- *Penicillium islandicum* „group“ (often found in under floor constructions, identical isolate in Fungiscope sent from India !)



2B. Concentrations of opportunistic fungi in air

- Background concentrations (95% percentiles) in cfu/m³, n = 40 (Trautmann et al. 2005)
- Similar concentrations indoor and outdoor !

Time, location	Winter:		Summer:	
	Outdoor	Indoor	Outdoor	Indoor
Species:				
<i>Acremonium</i> spp.	5 (Max.)	20 (Max.)	10 (Max.)	0
<i>Aspergillus fumigatus</i>	65	51	45	40
<i>Fusarium</i> spp.	40	10	200	162
<i>Mucor</i> spp.	5	5	20	20
<i>Rhizopus</i> spp.	5	5	20	20
<i>Paecilomyces</i> spp.	5 (Max.)	45 (Max.)	10	10
<i>Trichoderma</i> spp.	20 (Max.)	5 (Max.)	20	5

2B. Concentrations of opportunistic fungi in house dust

- Background concentrations (95% percentiles) in cfu/g in house dust, n = 40 (Trautmann et al. 2005)
- **High concentrations in house dust !**

Time, location	Winter:		Summer:	
Species:	95.P	Max.	95. P	Max.
<i>Acremonium</i> spp.	100	40.000	0	0
<i>Aspergillus fumigatus</i>	5.100	50.000	21.500	80.000
<i>Fusarium</i> spp.	20.000	20.000	271.500	900.000
<i>Mucor</i> spp.	10.000	40.000	10.000	100.000
<i>Rhizopus</i> spp.	10.000	40.000	11.500	100.000
<i>Paecilomyces</i> spp.	0	10.000	0	10.000
<i>Trichoderma</i> spp.	5250	20.000	10.000	100.000

2B. Ratios of air / house dust for opportunistic fungi

- Background values air (cfu/m³) to house dust in cfu/g
- **High ratios for *Fusarium*, *Trichoderma*, *Paecilomyces* and *Rhizopus***

Time, location	Winter:		Summer:		Ratio dust / air
Species:	95.P	Max.	95. P	Max.	cfu g ⁻¹ / cfu -m ⁻³
<i>Acremonium</i> spp.	100	40.000	0	0	20 x
<i>Aspergillus fumigatus</i>	5.100	50.000	21.500	80.000	100 x
<i>Fusarium</i> spp.	20.000	20.000	271.500	900.000	1.000 x
<i>Mucor</i> spp.	10.000	40.000	10.000	100.000	500 – 1.000 x
<i>Rhizopus</i> spp.	10.000	40.000	11.500	100.000	500 – 1.000 x
<i>Paecilomyces</i> spp.	0	10.000	0	10.000	1.000 x
<i>Trichoderma</i> spp.	5250	20.000	10.000	100.000	500 – 2.000 x

2B. Summary „rare fungi“

- Exposure concentrations of *Aspergillus* crudely known, not for other genera of „rare fungi“
- Numerical risk for infection **can not** be quantified:
 - What is the risk for immuno-competent? None?
 - No data on exposure in environment available
- Dose-effect-concentrations lacking (effectiveness of immune response can not be determined)
- **Relativ risk can be defined (no / low / high immune suppression)**
- Need for investigations of **exposure** to “rare fungi” of immuno-compromised patients for **prophylaxes!**

2B. Risk matrix infection

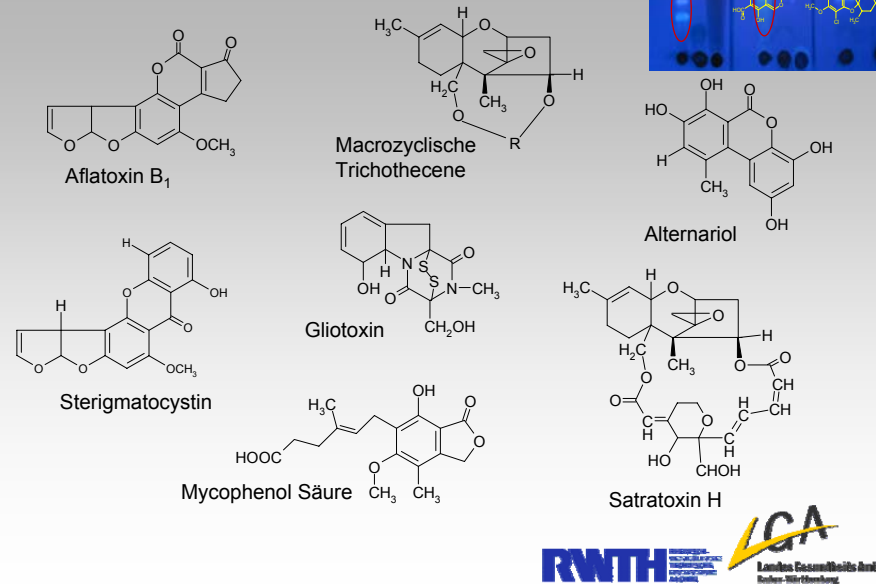
Risk for infection

Fungi \ Predisposition	No immunosuppression	Slight immunosuppression	Severe immunosuppression
Non-infectious fungi e.g.: <i>Cladosporium herbarum</i> , <i>C. cladosporioides</i>			
Opportunistic infectious fungi (R1) z.B.: <i>A. niger</i> , <i>A. clavatus</i> , <i>A. alternaria</i>			
Potential infectious fungi (R2) z.B.: <i>A. fumigatus</i> , <i>A. flavus</i>			

Alter > 64 Jahre, Diabetes mellitus, chronische Herz-, Lungen-, Leber-, Nierenerkrankung, Alkoholabusus, HIV-Infektion (abhängig von CD4-Zellzahl, CDC-Stadium, opportunistischen Infektionen)

Organtransplantation, fortgeschrittenes Tumorleiden, Chemotherapie, Strahlentherapie, Konnektivitis, Mukoviszidose (Zystische Fibrose), Steroidtherapie (> 20 mg/Tag und länger als 14 Tage), andere Immunsuppressiva, HIV-Infektion (abhängig von CD4-Zellzahl, CDC-Stadium, opportunistischen Infektionen)

2C. Mykotoxine von Schimmelpilzen



2C. Cytotoxic effect of mycotoxins on lung cells

Concentration of mycotoxins (µg/ml) toxic in different cell systems (MTT-assay)

Study	Target cells	Species	80% MTT-cleavage activity*					
			Glio-toxin	Penicillic acid	Afla-toxin B ₁	Verru-culogen	Ochra-toxin A	Peni-trem A
Hanelt et al., 1994	SK (epitheloid, kidney)	pig	0.8	3.1	> 50	> 50		
	MDCK (epitheloid, kidney)	dog	0.4		> 200	> 200		
	HeLa (cervix carcinoma)	human	0.8		25	> 50		
Thißen et al., submitted (HB06-747)	A549 (lung carcinoma)	human	equally	~ 10	~ 20	> 20	8.0	4.0
	primary BE cells	human		≈ 10 x more toxic				

- ⇒ primary BE-cells are significantly more sensitive for mycotoxins than hepatic and lung cells (A549)
- ⇒ effective concentration (µg/ml) still ranges about 10 to 100 times above the effective concentration of single compounds (ng/ml) in bioaerosols

2C. Fungi, mycotoxin exposure and toxicological effect

Species	Mycotoxin	Present in conidia	Produced on building material	Cytotoxicity (IC ₅₀ in µg/ml)	Immune-modulation (ng/ml)
<i>Alternaria alternata</i>	Alternariol	?	+	low ⁽¹⁾	
<i>A. flavus</i>	Aflatoxin	+ (7)	- (2, 3)	11 ⁽¹³⁾	0.0001 ⁽¹⁷⁾
<i>A. fumigatus</i>	Gliotoxin	+ (4)	+ (5)	0.7	34 – 83 ⁽¹³⁾
"	Verruculogen	+	?	29	?
<i>A. ochraceus</i>	Ochratoxin	- (4)	? / dust of Aircon ⁽⁶⁾	5	4 ⁽¹⁸⁾
<i>A. versicolor</i>	Sterigmatocystin	+ (7, 8)	+ (9)	Sp.: low ⁽¹⁴⁾	Sp.: high ⁽¹⁴⁾
<i>A. niger</i>	Ochratoxin	?	- (10)	5	4 ⁽¹⁸⁾
<i>A. niger</i>	Tetracyclines	+	+ (10)	?	?
<i>A. ustus</i>	Austocystins	?	- (1)	?	?
<i>Ch. globosum</i>	Chaetoglobosins A, B	?	+ (1)	Yes ⁽¹⁵⁾	?
"	Sterigmatocystine	+	+ (1)	0.03-20 ⁽¹⁵⁾	?
<i>P. brevicompactum</i>	Mycophenolic acid	- (4)	+ (1)	?	yes
<i>P. chrysogenum</i>	Citrinin	?	+ (9)	67,800 ⁽¹³⁾	8,300 ⁽¹³⁾
"	Roquefortin C	+ (11)	+ (1)	?	32 ⁽¹⁶⁾
<i>P. polonicum</i>	3-Methoxy-viridicatin, Verrucosidin, Verrucofortine	?	+ (1)	?	?
<i>P. crustosum</i>	Penitrem A	+	?	7	?
<i>S. chartarum</i>	Satratoxins	+	+	10 ng ⁽¹²⁾	2.5 ⁽¹²⁾

(1)=Nielsen et al. 1999; (2)=Rao et al. 1997; (3)= Ren et al. 1999; (4)=Fischer et al. (2006); (5)=Nieminen et al. 2005; (6)=Richard et al. 1999; (7)=Fischer et al. 2004; (8)=Engelhard et al. 2002; (9)=Tuomi et al. 2000; (10)=Nielsen et al. 2002; (11)=Thissen et al. 2006; (12)=Chung et al. 2003; (13)=Wichmann et al. 2002; (14)=Murtoniemi et al. 2001; (15)=Pieckova 2003; (16)=Keblyls et al. 2004; (17)=Cusumano et al. 1996; (18)=Corrier 1991

2C. Risk analysis intoxication / immune modulation

- Mycotoxins occur in airborne spores
- Concentrations in indoor too low to cause toxic effects →
 - exception eventually gliotoxin, satratoxins
 - ...but: „aerogenic“ concentrations may be responsible for immune-modulatory effects to support allergy development

Eines ist sicher ...

Hier brauchen Sie keine Gefährdungsabschätzung
... hier können Sie Pilze sammeln !

