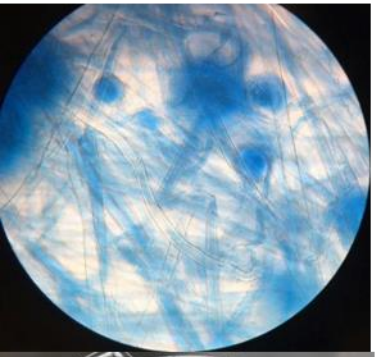
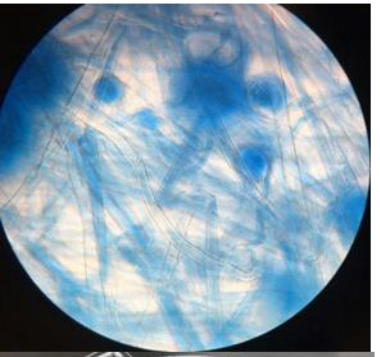


Filtering respiratory protective devices. What is the efficacy for fungal burden exposure?

Carla Viegas, MsC, PhD

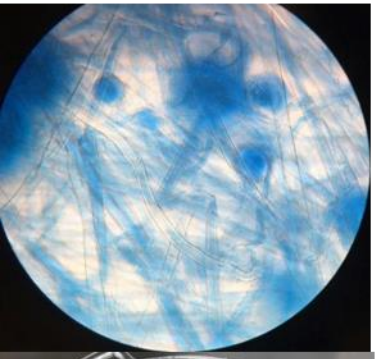
Beatriz Almeida, Marta Dias, Susana Viegas

Outline



1. Background
2. Materials and methods
3. Results
4. Main findings discussion
5. Next steps

1. Background

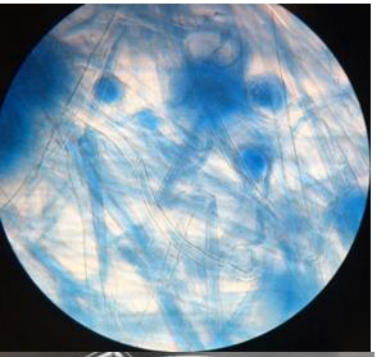


Ann. Occup. Hyg., 2016, Vol. 60, No. 7, 812–824
doi:10.1093/annhyg/mew032
Advance Access publication 31 May 2016

BOHS
The Chartered Society for Worker Health Protection

Feedback on Measured Dust Concentrations Reduces Exposure Levels Among Farmers

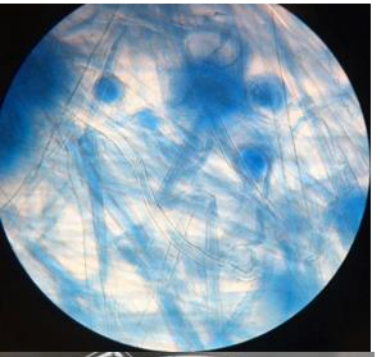
Ioannis Basinas[1*], Torben Sigsgaard[1], Jakob Hjort Bønløkke[1], Nils Testrup Andersen[1], Øyvind Omland[2,3], Hans Kromhout[4†] and Vivi Schlünssen[1,5†]



1. Background

- Waste from non-biodegradable materials is sorted on waste sorting units to produce recyclable raw materials, leading to direct access to waste by workers.
- The organic residues present on waste serve as substrate for numerous microorganisms, increasing workers exposure to biological agents.
- Waste industry increase workers exposure to microbial contaminants, such as fungi and bacteria (bioburden) and previous studies reported health risks associated with such environments.
- Filtering Respiratory Protective Devices (FRPD) are of mandatory use.

(Park et al. 2016; Černá et al. 2017)

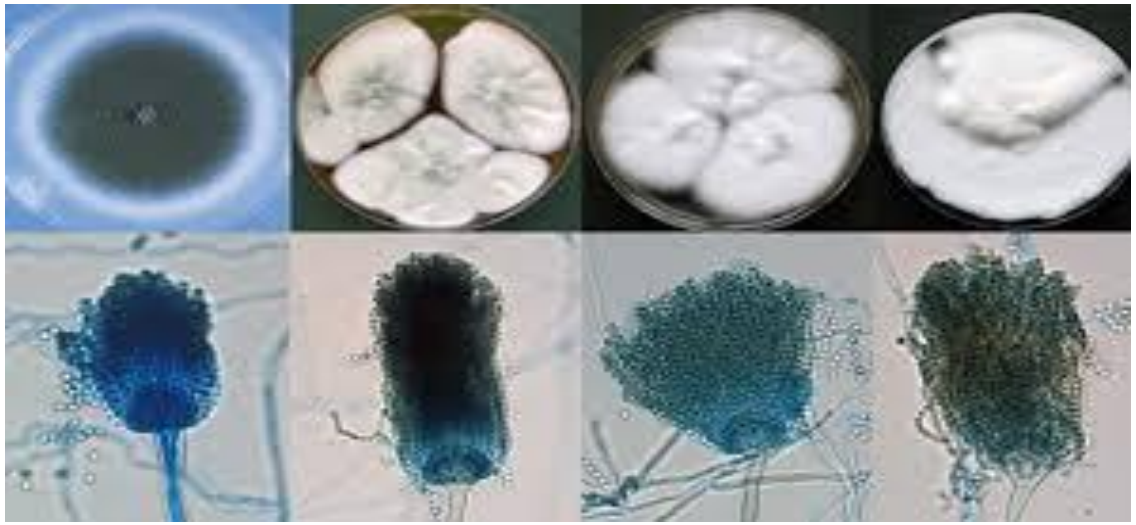


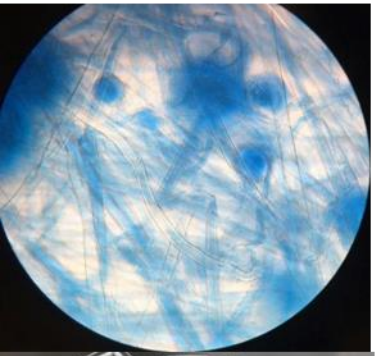
- *Aspergillus* spp. species are filamentous fungi commonly found in different environmental compartments, where they thrive as saprophytes. Some species among the *Aspergillus* genera can be occasionally harmful to humans.

(Seyedmousavi et al. 2015)

- Only a few species are considered as significant opportunistic pathogens in humans.

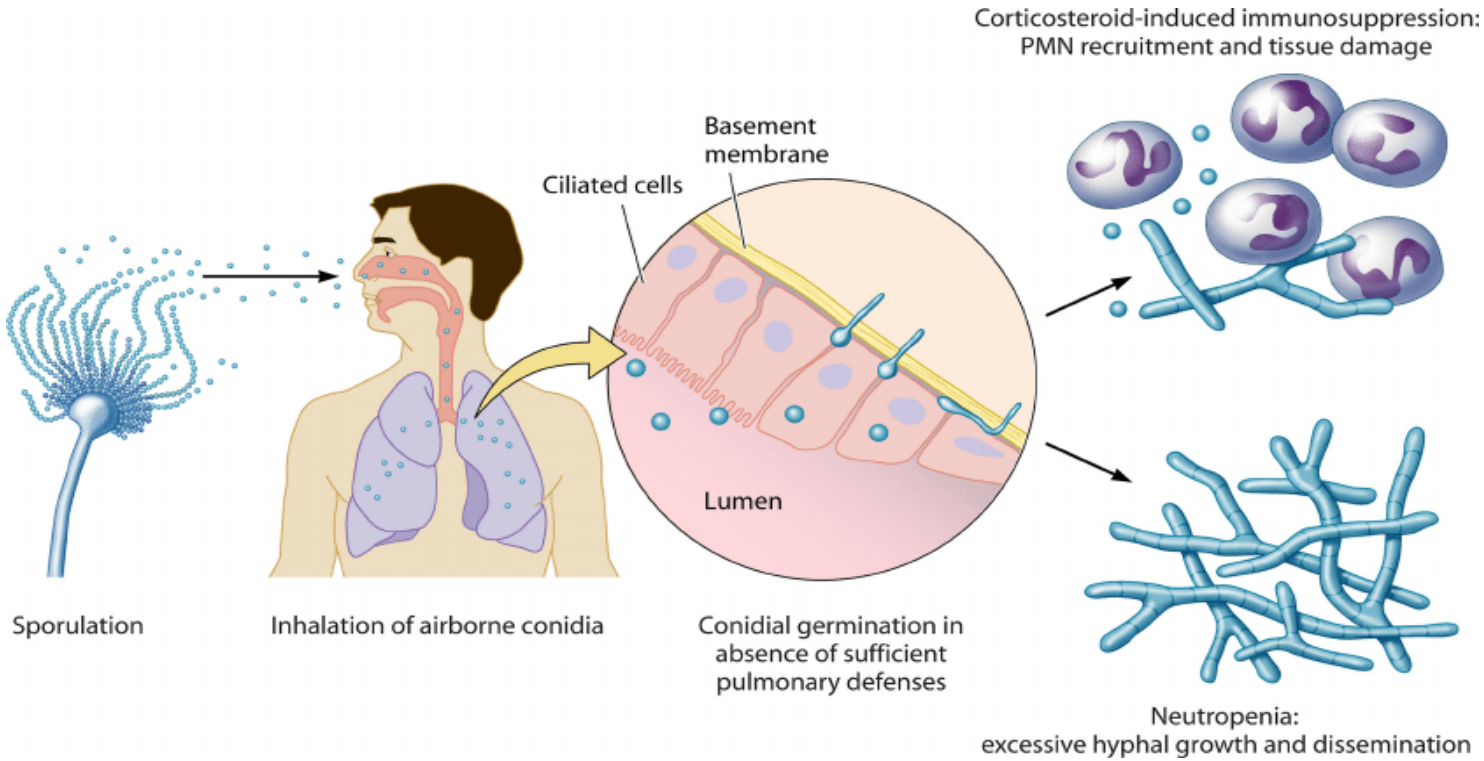
(Heitman 2011)





Aspergillus section *Fumigati* is an opportunistic pathogen of immunocompromised hosts and one of several *Aspergillus* species that cause a wide range of respiratory disorders.

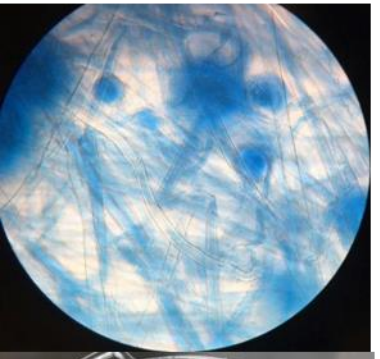
(Hope et al. 2008)



(Dagenais and Keller 2009)

Another feature that should not be neglected is the fact of several *Aspergillus* sections have **toxigenic potential leading to multiple occupational exposure risks.**

(Varga et al. 2015; Viegas et al. 2018)



toxins

MDPI

Article

Occupational Exposure to Mycotoxins in Swine Production: Environmental and Biological Monitoring Approaches

Susana Viegas [1,2,*], Ricardo Assunção [3,4], Carla Martins [2,3,4,5], Carla Nunes [2,5], Bernd Osteresch [6], Magdalena Twarużek [7], Robert Kosicki [7], Jan Grajewski [7], Edna Ribeiro [1] and Carla Viegas [1,2]

Annals of Work Exposures and Health, 2018, 1–19
doi: 10.1093/annweh/wxy070
Review

BOHS The Chartered Society for Worker Health Protection

OXFORD

Review

Occupational Exposure to Mycotoxins: Current Knowledge and Prospects

Susana Viegas,[1,2]* Carla Viegas[1,2] and Anne Oppliger[3]

[1]H&TRC- Health & Technology Research Center, ESTeSL- Escola Superior de Tecnologia da Saúde, Instituto Politécnico de Lisboa, Lisbon 1990-096, Portugal; [2]Centro de Investigação em Saúde Pública, Escola Nacional de Saúde Pública, New University of Lisbon, Lisbon 1600-560, Portugal; [3]Institute for Work and Health, University of Lausanne, Lausanne CH-1015, Switzerland

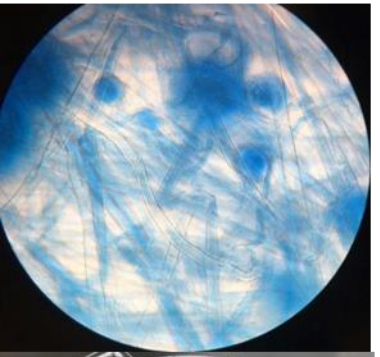
- During protective equipment use, humidity and temperature conditions provide favorable conditions for fungal growth, among other microorganisms.

(Jankowska et al. 2000; Majchrzycka et al. 2016)

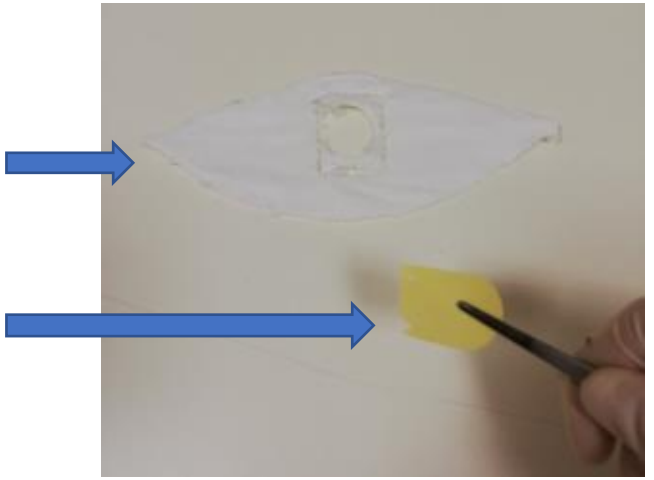
Due to the pathogenic potential from *Aspergillus* spp. the presence on FRPD may be a severe occupational hazard to the workers.

The aim of this study was to characterize fungal distribution retained by FFRs. A case study developed in one waste management plant was developed to allow understanding the variables that influence FRPD contamination.

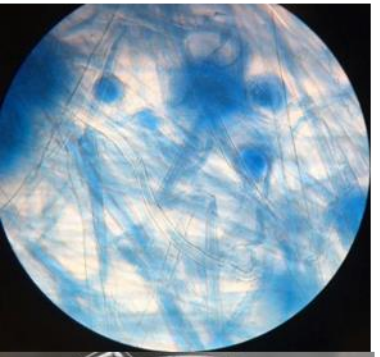
2. Materials and methods



FRPD — Passive Sampling — interior layer; exhalation valve



Workstations	Tasks	Total
FMW	Feeding machines with waste	FRPD 120
SW	Sorting waste	
MI	Machines inspection	
MSVO	Machines and special vehicles operator	



Bioburden exposure assessment

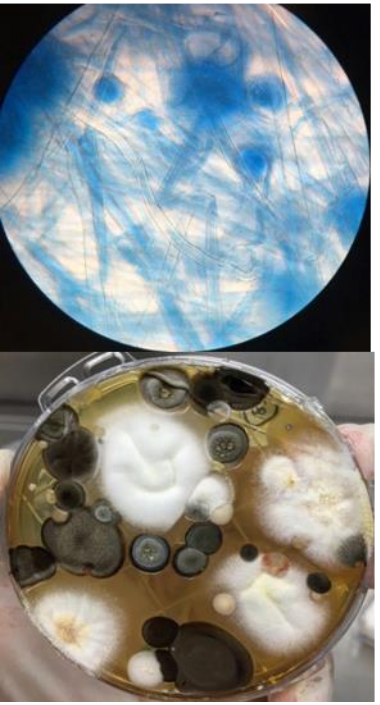
- Bacteria
  - Inoculation in tryptic soy agar (TSA), incubation at 30ºC for 7 days
  - Inoculation in violet red bile agar (VRBA), incubation at 37ºC for 7 days
- Fungi
  - Inoculation in 2% malt extract agar (MEA) with 0.05 g/L chloramphenicol media, incubation at 27ºC for 5 to 7 days
  - Inoculation in dichloran glycerol (DG18) agar-based media, incubation at 27ºC for 5 to 7 days

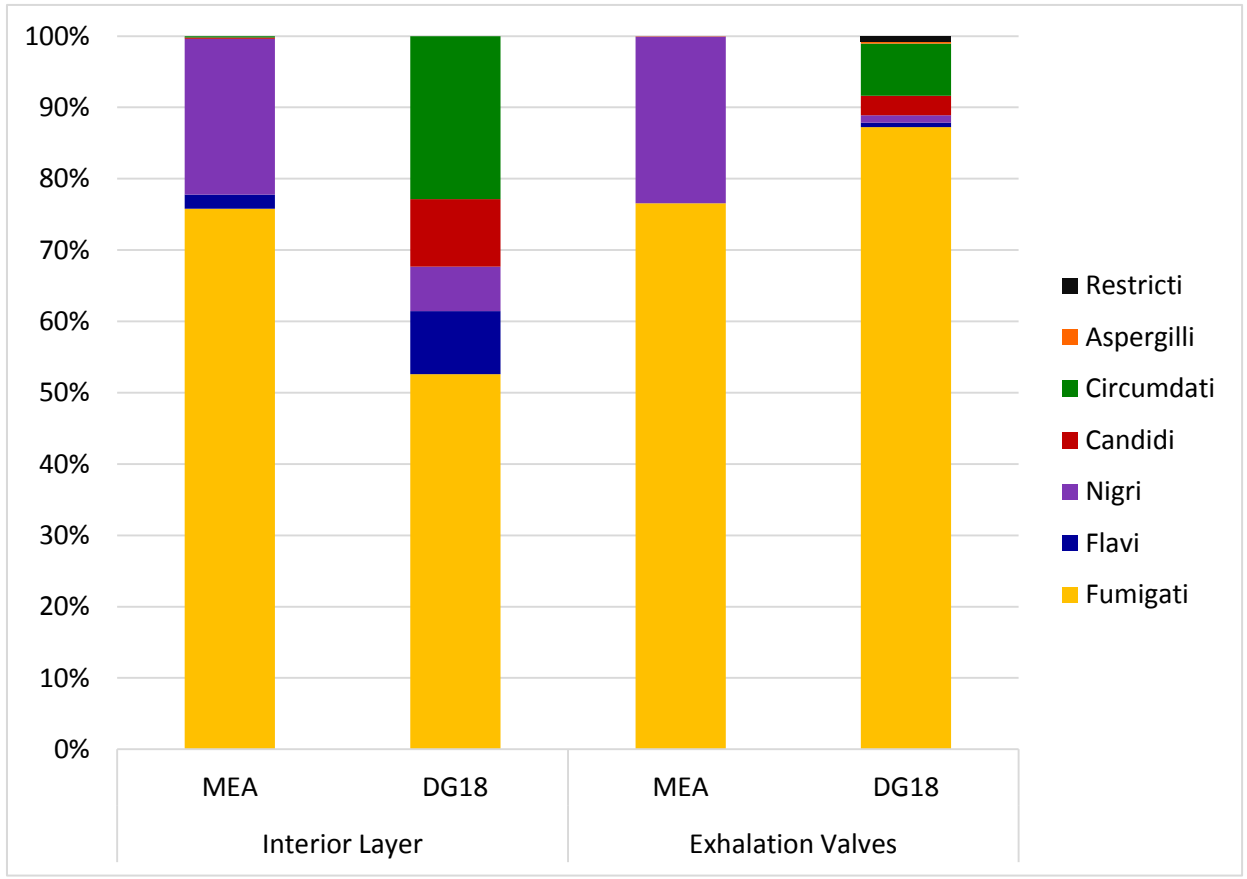
Assays performed

- Fungal biomass
- Toxigenic fungal strains (*Aspergillus* sections *Flavi* and *Fumigati)*
- Azole resistance
- **Mycotoxins**

3. Results - Fungi contamination

- Valves presented *Aspergillus* spp. as the most prevalent genera on MEA media (44.4%) among all fungi.

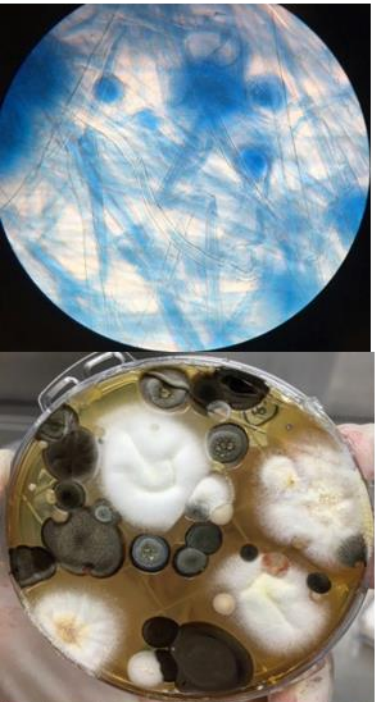




- *Aspergillus* section *Fumigati* was the one with highest prevalence, both in exhalation valves (76.57% MEA; 87.24% DG18) and interior layer (75.81% MEA; 51.22% DG18).
- *Nigri* section was the second more observed on MEA.
- In DG18, besides *Fumigati* and *Nigri, Flavi, Circumdati* and *Candidi* were also detected with a relevant prevalence

3. Results – Toxigenic strains on FRPD

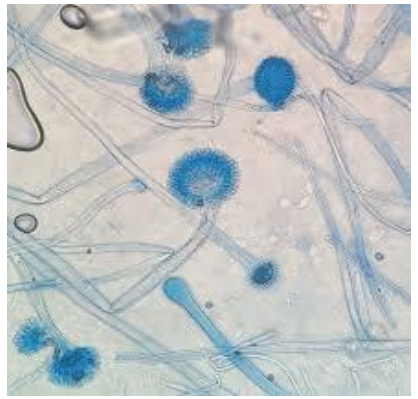
qPCR analysis successfully amplified DNA from the *Aspergillus* sections *Flavi* and *Fumigati*.



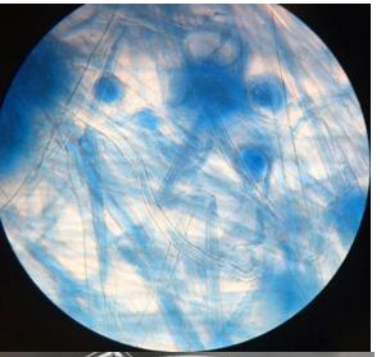
Aspergillus section *Flavi*

Interior layer

5% (6 samples out of 120)



- The presence of this section was not identified by culture based methods in 2 of the samples where it was detected by qPCR.
- It was observed in more samples with culture based-methods (15%; 18 out of 120 samples).



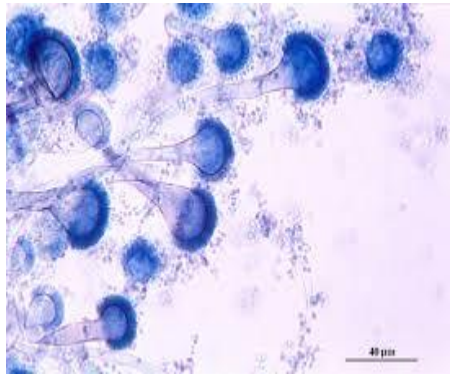
Aspergillus section *Fumigati*

Interior layer

33.33% (40 samples out of 120)

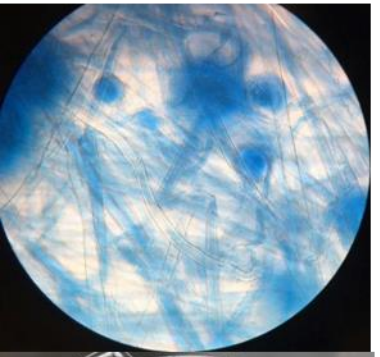
Exhalation valves

1.66% (2 samples out of 120)



- The presence of this section was not identified by culture based methods in the exhalation valves.
- In 25 of the interior layers where it was detected by qPCR it was not identified by culture-based methods.
- It was observed in more samples with culture based-methods (35.83% interior layers - 43 out of 120 samples; 30% in exhalation valves - 36 out of 120 samples).

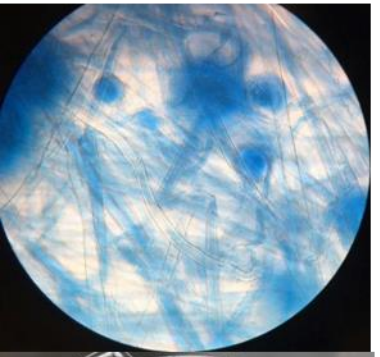
4. Main findings and discussion



The results highlight the occupational concern regarding the exposure to microbiologic agents, more specifically to *Aspergillus*.

- Employers are obliged to assess and control the risks due to biological agent's exposure.
- Among the measures that can minimize exposure is the use of appropriate personal protective equipment.

(Directive 2000/54/EC)



However, and as suggested by our results:

- deposited microorganisms on the equipment analysed are able of rapid proliferation in the material in conditions of high humidity (resulting from exhaled air/ sweating).

(Majchrzycka et al. 2016)

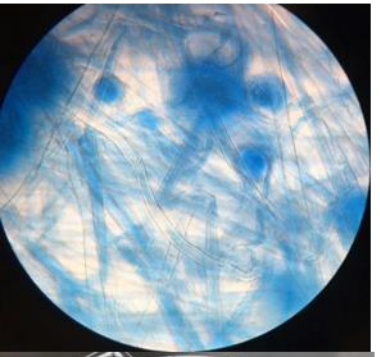
- organic dust deposited on the equipment material, which is a source of nutrients, can favor the microorganism's development.

(Jankowska et al. 2000; Maus, Goppelsröder, Umhauer 2001)

- The lack of hygienic procedures when wearing the equipment; inadequacy of the FRPD for this specific setting; replacement frequency …

***Aspergillus* contamination found on FRPD**

FRPD fungal contamination is mimicking the environment contamination



- Applied as a **passive sampling method** to assess occupational exposure

Mycotoxin Res (2017) 33:285–295
DOI 10.1007/s12550-017-0288-8

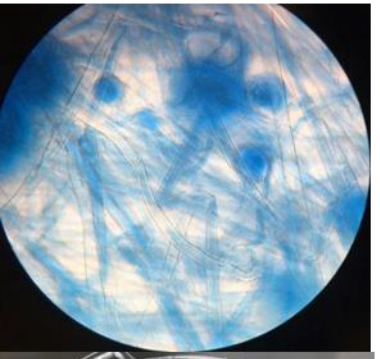
ORIGINAL ARTICLE

A new approach to assess occupational exposure to airborne fungal contamination and mycotoxins of forklift drivers in waste sorting facilities

Carla Viegas · Tiago Faria · Ana Cabeda de Oliveira · Liliana Aranha Caetano · Elisabete Carolino · Anita Quintal-Gomes · Magdalena Twarużek · Robert Kosicki · Ewelina Soszczyńska · Susana Viegas

5. Next steps

- Inform workers about the fungal burden on the equipment to easier behavior changes for hygienic measures



So HOW do I fit my mask correctly?

For FILTERING FACEPIECE (FFP) (disposable mask)

✓ Clean shaven at start of your shift

✓ Always check the fit before every use:

- fit around the nose/nose clip where applicable
- fit around the chin
- check the position of straps

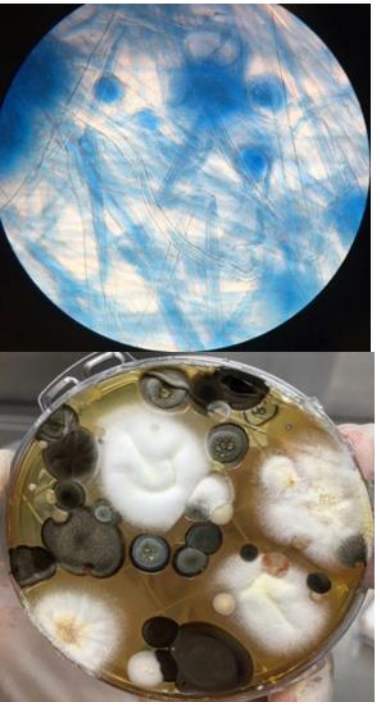
✓ Carry out a 'fit-check'

Remember!

- Ensure the mask is clean and in good working order **before** each use
- Carry out a fit check with your mask before each use
- Do not remove the mask in the hazardous area, for example to talk or to inspect your work
- Replace disposable masks and replaceable filters in line with your training
- Store the mask in a clean area when not being used

Due the complexity of these samples, and to better understand the potential biological effect, the FRPD will be evaluated by source assessing cell viability:

- on a human monocytic cell line (THP-1) - as a model for function and biology of human macrophages;
- on cultured human airway epithelial cell line that is used as a model of human respiratory function and inflammatory responses (Calu-3).



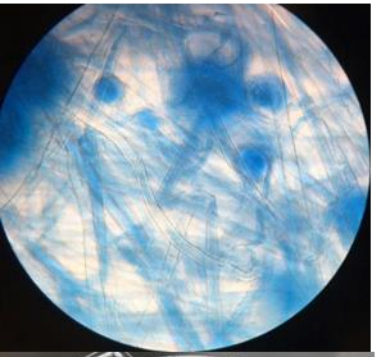
toxics

MDPI

Article

Cytotoxic and Inflammatory Potential of Air Samples from Occupational Settings with Exposure to Organic Dust

Susana Viegas [1,2,*], Liliana Aranha Caetano [1,3], Merja Korkalainen [4], Tiago Faria [1], Cátia Pacífico [1], Elisabete Carolino [1], Anita Quintal Gomes [1,5] and Carla Viegas [1,2]



FRPD - What is the efficacy for fungal burden exposure?

Not enough regarding fungal occupational exposure!!!

Thank for your attention!

Acknowledgments

The authors are grateful to FCT – Fundação para Ciência e Tecnologia for funding the project EXPOsE – Establishing protocols to assess occupational exposure to microbiota in clinical settings (02/SAICT/2016 – Project nº 23222) and to Instituto Politécnico de Lisboa, Lisbon, Portugal for funding the Project "Waste Workers' Exposure to Bioburden through Filtering Respiratory Protective Devices" (IPL/2018/WasteFRPD_ESTeSL). The project is co-financed by FCT – Fundação para Ciência e Tecnologia and the Polish National Agency for Academic Exchange (PPN/BIL/2018/1/00231).