

## GUIDANCE FOR MICROBIAL OCCUPATIONAL EXPOSURE ASSESSMENT IN SAWMILLS

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*H&TRC - Health and Technology Research Center*

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## RELEVANCE OF THE TOPIC AND INNOVATIVE CHARACTER

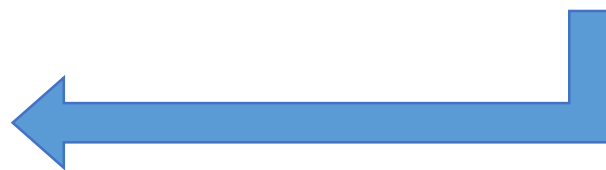


The **number of deaths** attributed to occupational risks is projected to be around **1.2 million** per year (statistics from 2015) **(1)**.



The Commission's **Health Emergency Preparedness and Response Authority (HERA) (2)** presented a priority list of top-3 health threats that require coordination of measures :

- 1. pathogens with high pandemic potential;**
2. chemical, **biological**, radiological and nuclear threats;
3. threats resulting from **antimicrobial resistance**.



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## RELEVANCE OF THE TOPIC AND INNOVATIVE CHARACTER



**3** GOOD HEALTH AND WELL-BEING



The icon for Goal 3, 'Good Health and Well-being', features a white heart and a white ECG line on a green background.

By characterizing the occupational microbial exposure and the potential health risk for workers aiming to reduce the adverse health effects while promoting good working conditions (3).

**8** DECENT WORK AND ECONOMIC GROWTH



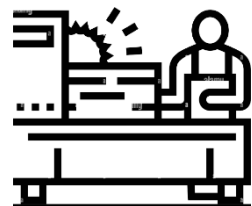
The icon for Goal 8, 'Decent Work and Economic Growth', features a white bar chart with an upward-pointing arrow on a maroon background.

By protecting workers' rights and promoting safe working conditions for all workers (3).



➤ **In all European country's the employers are obliged** by regulation to **assess and prevent exposure to occupational risks** (Directive 89/391/EEC).

➤ Directive 2000/54/EC of the European Parliament and the Council of September 18, 2000, sets the rules regarding **risk assessment if exposure to biological agents cannot be avoided** (2000/54/EC, 2000).



➤ **Sawmill workers** may be exposed to **allergenic, carcinogenic, and immunotoxic agents**, which include **wood derivatives** as well as **microorganisms** that grow on wood and their **metabolites**, all of which are known to be **potential health-harming agents (5–11)**.

International Agency for Research on Cancer



Wood dust, is a complex mixture that is classified as **Group 1 carcinogen** by the International Agency for Research on Cancer (IARC) (4).

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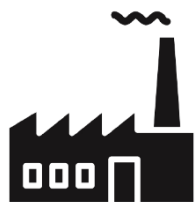
## RELEVANCE OF THE TOPIC AND INNOVATIVE CHARACTER



- The **importation** of wood is very common and the **biocides** (which are commonly used as **wood preservatives**) used in each country can differ inside the azole class (12- 14).
- The chemical profiles of **various wood species** and their **susceptibility to microbial colonization** might vary (15).
- **Mycotoxins** can exist in the environment even in the **absence of any observable fungi** since they can **withstand challenging environmental conditions (16)**.
- Mycotoxins can be present in **airborne dust (16-18)**, which is very common **in sawmills**, however, there are **no studies describing mycotoxins contamination (19)**.
- Mycotoxins **assessment should be performed in this setting**.

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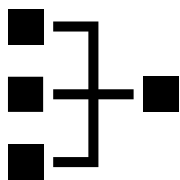
## RELEVANCE OF THE TOPIC AND INNOVATIVE CHARACTER



- Portugal had around **56,000 workers** in about **8700 enterprises** registered in the wood industry in 2019 (20).



- There are **no studies found** that describe occupational microbiological exposure in sawmills in Portugal (19).



- This study will present something innovative: **provide data on the exposure to several risk factors namely: dust, fungi, bacteria and mycotoxins** (16,21,22).

**The aim of this study is to establish a guideline that allows a proper and complete exposure assessment in this specific occupational setting.**



**Main question:**

“What is the best approach to develop a proper microbial occupational exposure assessment in sawmills?”

**Specific questions:**


“What is the best sampling approach for a proper microbial occupational exposure assessment in sawmills?”


“Which will the best assays to apply for a proper microbial occupational exposure assessment in sawmills?”



In order to answer these research questions, this project will comprehend five different tasks.


### TASK 1: Bibliographic Review, Protocol Definition and Study Alignment




**atmosphere** 

Review

### Microbial Occupational Exposure Assessments in Sawmills—A Review

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and Carla Viegas <sup>1,2,3,\*</sup> 

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It allowed to define a protocol to apply in the field work (sampling campaign) and in the lab (assays used).



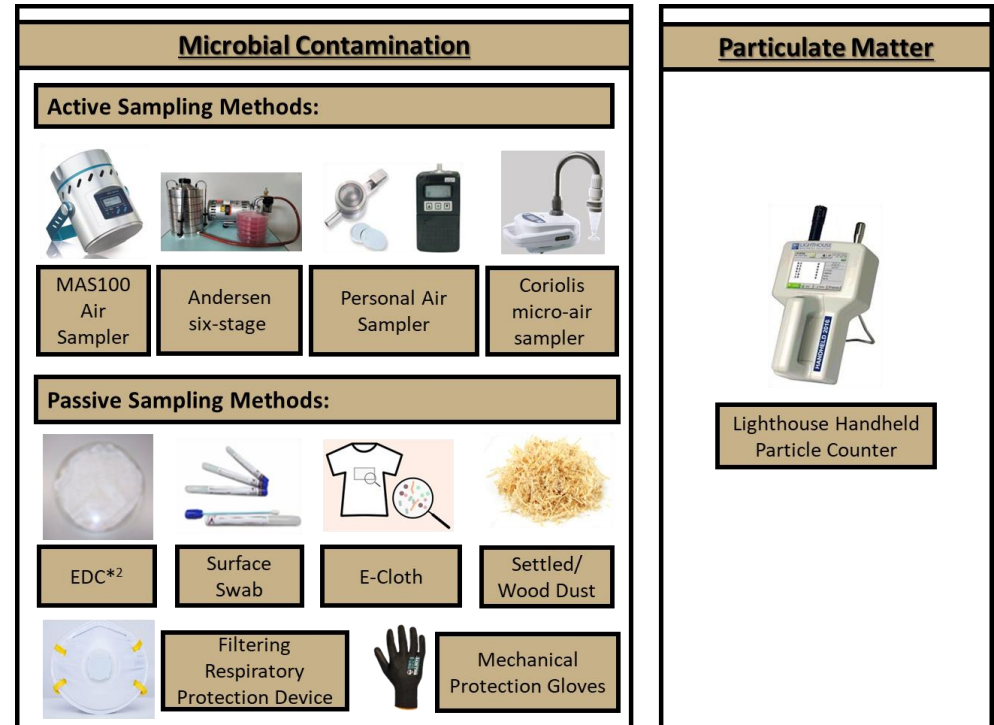
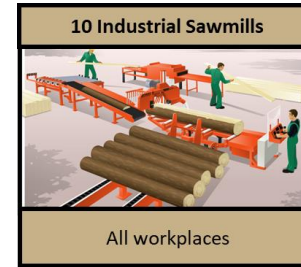
**TASK 2:** Environmental Monitoring Campaigns and Survey of Working Conditions

**TASK 3:** Microbial Contamination Characterization

**TASK 4:** Metabolites Assessment

**TASK 5:** Cytotoxicity Assessment

**TASK 6:** Definition of a Guideline Protocol for Microbial Occupational Exposure Assessment



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## AIM OF THE STUDY AND RESEARCH QUESTIONS

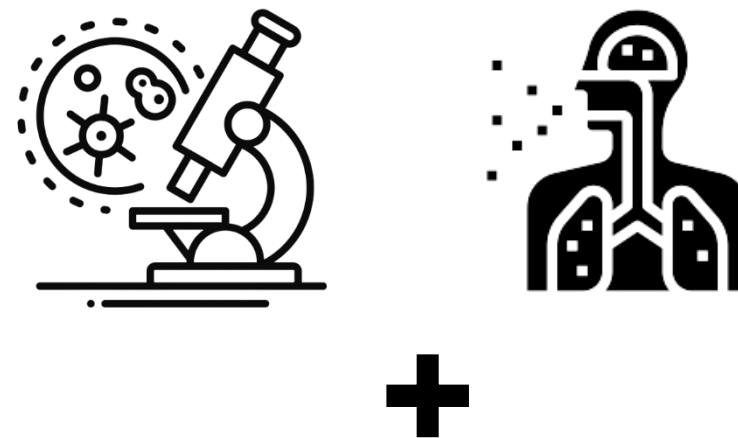
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Data on microbial contamination and biodiversity characterization as well as microbial resistance profile and particulate matter

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**Endotoxins**

**Mycotoxins**



Data on endotoxins and mycotoxins will be obtained through passive sampling methods

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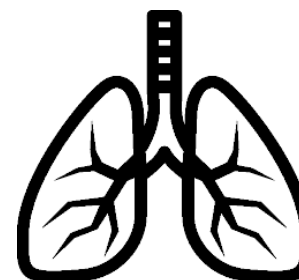
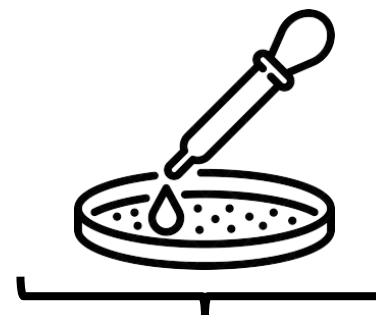
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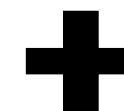
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**Human A549  
adenocarcinoma cells**



**Primary swine kidney  
(SK) monolayer cells**

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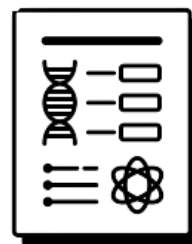
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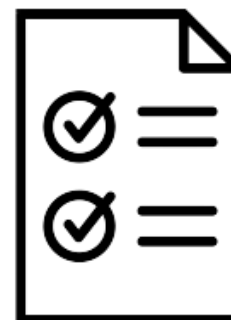
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**Scientific Articles**



**Scientific Reports**



**Guideline Protocol for  
Microbial Occupational  
Exposure Assessment**

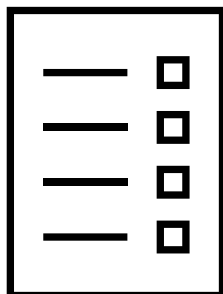
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## TIMELINE

Number	Task	2021	2022												2023												2024										
		Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
1	Bibliographic Review, Protocol Preparation, and Study Alignment	█	█	█	█	█	█	█	█	█	█	█	█																								
2	Environmental monitoring campaigns and survey of working conditions												█	█	█	█	█	█	█	█																	
3	Microbial Contamination Characterization												█	█	█	█	█	█	█	█																	
4	Metabolites Assessment																				█	█	█	█	█												
5	Cytotoxicity Assessment																				█	█	█	█	█												
6	Definition of a Guideline Protocol for Microbial Occupational Exposure Assessment																								█	█	█	█	█	█	█	█	█	█	█	█	█
			1st Paper: Systematic Review												2nd and 3rd Papers: Microbial Contamination Assessment									4th Paper: Mycotoxins and Citotoxicity Assessment				5th Paper: Guideline Protocol									

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## ETHICAL ISSUES



Questionnaires will be applied aiming to collect information regarding working conditions (e.g. RMMs in place) and information of the types of wood used.



The confidentiality of the results and the anonymity of the participants are guaranteed throughout the project.

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## ACKNOWLEDGMENTS

### Membros do projeto

Marta Dias, Msc, PhD student

### Orientadoras:

Carla Viegas, Msc, PhD

Susana Viegas, Msc, PhD

### Membros a colaborar:

Bianca Gomes, Msc, PhD student

Pedro Pena, Msc, PhD student

Renata Cervantes, Msc, PhD student





1. Guidance on priority settings for action [Internet]. [citado 04 de outubro de 2022]. Disponível em: <https://www.who.int/tools/compendium-on-health-and-environment/priority-settings-for-action>
2. List of top-3 health threats to prepare against [Internet]. European Commission - European Commission. [citado 04 de outubro de 2022]. Disponível em: [https://ec.europa.eu/commission/presscorner/detail/en/ip\\_22\\_4474](https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4474)
3. THE 17 GOALS | Sustainable Development [Internet]. [citado 04 de outubro de 2022]. Disponível em: <https://sdgs.un.org/goals>
4. <https://monographs.iarc.who.int/wp-content/uploads/2018/06/mono100C-15.pdf>
5. Cox CS, Wathe CM. Bioaerosols Handbook [Internet]. 1995 [citado 17 de junho de 2022]. Disponível em: <https://www.taylorfrancis.com/books/edit/10.1201/9781003070023/bioaerosols-handbook-christopher-cox-christopher-wathes>
6. Demers PA, Teschke K, Kennedy SM. What to do about softwood? A review of respiratory effects and recommendations regarding exposure limits. *Am J Ind Med.* abril de 1997;31(4):385–98.
7. Dennekamp M, Demers P, Bartlett K, Davies H, Teschke K. Endotoxin exposure among softwood lumber mill workers in the Canadian province of British Columbia. *Ann Agric Environ Med.* 1999;6(2):141–6.
8. Dutkiewicz J, Krysińska-Traczyk E, Prazmo Z, Skońska C, Sitkowska J. Exposure to airborne microorganisms in Polish sawmills. *Ann Agric Environ Med.* 2001;8(1):71–80.
9. Enarson DA, Chan-Yeung M. Characterization of health effects of wood dust exposures. *Am J Ind Med.* 1990;17(1):33–8.
10. Halpin DM, Graneek BJ, Lacey J, Nieuwenhuijsen MJ, Williamson PA, Venables KM, et al. Respiratory symptoms, immunological responses, and aeroallergen concentrations at a sawmill. *Occup Environ Med.* março de 1994;51(3):165–72.
11. Whitehead LW. Health effects of wood dust--relevance for an occupational standard. *Am Ind Hyg Assoc J.* setembro de 1982;43(9):674–8.

12. Kuznetsov YI, Kazansky LP. Physicochemical aspects of metal protection by azoles as corrosion inhibitors. *Russ Chem Rev.* 31 de março de 2008;77(3):219.
13. Derkyi N. Azoles for Renewable Energy Development and Wood Treatment. Em 2020.
14. Sana S, Reddy VG, Bhandari S, Reddy TS, Tokala R, Sakla AP, et al. Exploration of carbamide derived pyrimidine-thioindole conjugates as potential VEGFR-2 inhibitors with anti-angiogenesis effect. *Eur J Med Chem.* 15 de agosto de 2020;200:112457.
15. Straumfors A, Corbin M, McLean D, 't Mannetje A, Olsen R, Afanou A, et al. Exposure Determinants of Wood Dust, Microbial Components, Resin Acids and Terpenes in the Saw- and Planer Mill Industry. *Annals of Work Exposures and Health.* 10 de março de 2020;64(3):282–96.
16. Viegas S, Viegas C, Oppliger A. Occupational Exposure to Mycotoxins: Current Knowledge and Prospects. *Ann Work Expo Health.* 15 de outubro de 2018;62(8):923–41.
17. Flannigan B. Mycotoxins in the air. *International Biodeterioration.* 1 de janeiro de 1987;23(2):73–8.
18. Brera C, Caputi R, Miraglia M, Iavicoli I, Salerno A, Carelli G. Exposure assessment to mycotoxins in workplaces: aflatoxins and ochratoxin A occurrence in airborne dusts and human sera. *Microchemical Journal.* 1 de outubro de 2002;73(1):167–73.
19. Dias M, Gomes B, Cervantes R, Pena P, Viegas S, Viegas C. Microbial Occupational Exposure Assessments in Sawmills—A Review. *Atmosphere.* fevereiro de 2022;13(2):266.
20. aimmp – Associação das Indústrias de Madeira e Mobiliário de Portugal [Internet]. 2019 [citado 17 de junho de 2022]. Disponível em: <https://aimmp.pt/>
21. Brasel TL, Martin JM, Carriker CG, Wilson SC, Straus DC. Detection of airborne *Stachybotrys chartarum* macrocyclic trichothecene mycotoxins in the indoor environment. *Appl Environ Microbiol.* novembro de 2005;71(11):7376–88.
22. Huttunen K, Korkalainen M. Microbial Secondary Metabolites and Knowledge on Inhalation Effects. Em: Viegas C, Viegas S, Gomes A, Täubel M, Sabino R, editores. *Exposure to Microbiological Agents in Indoor and Occupational Environments* [Internet]. Cham: Springer International Publishing; 2017 [citado 6 de outubro de 2022]. p. 213–34. Disponível em: [https://doi.org/10.1007/978-3-319-61688-9\\_10](https://doi.org/10.1007/978-3-319-61688-9_10)