First insights of Portuguese Primary schools' Fungal assessment – Is Indoor Air Quality legal framework suitable for this indoor setting?

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Introduction

The assessment of microbial indoor air quality in schools is vital for promoting student health. Portugal's regulations focus on commercial buildings (Ordinance nº 138-G/2021), neglecting standards for schools (1). Evidence suggests indoor/outdoor fungal ratio inadequacies in high-risk areas like schools (2).

Objective

To assess fungal threshold adequacy set by the Portuguese ordinance in different sites of schools located in the Lisbon area

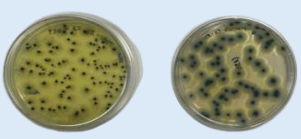
Methods

10 primary schools

- Bathrooms (N=6)
- Canteen (N=9)
- Classrooms N=10)
- Gymnasium (N=6)
- Library (N=8)
- Outdoor (N=10)

200L at 100 L/min

MEA | DG18



27 ºC for 7 days

Fungal identification

Results

- 9 / 10 did not comply with the Portuguese legal framework (I/O ratio) (Figure 1):
  - 5 / 6 in the bathroom
  - 4 / 9 in the canteen
  - 8 /10 in the classrooms
  - 3 / 8 in the library
  - 4 / 6 in the gymnasiums

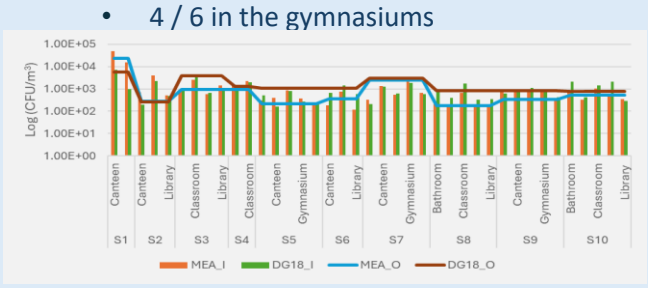


Figure 1: Fungal quantification in MEA and DG18 in all the settings in each school and outdoor concentration.

- 1 / 10 (S7) complies with the Portuguese IAQ legal framework (I/O ratio).
- *Aspergillus* sections identified in all the schools (Table 1), including the one that complied with the legal framework (S7 - sections *Circumdati* and *Fumigati*)

Table 1: *Aspergillus* sections identified in each media per *school.*

	MEA	DG18
Circumdati	4/10	9/10
Flavi	2/10	6/10
Fumigati	3/10	3/10
Nidulantes	3/10	7/10
Nigri	9/10	5/10

Discussion

Although the quantitative cut-off complies in at least one school (S7), it does not meet the toxigenic species quantitative cut-off (1). The presence of critical species such as *Aspergillus* sections *Circumdati*, *Flavi*, *Nidulantes*, *Nigri*, and *Fumigati* in every school environment jeopardizes students' health and hampers learning conditions (3). Regarding *Fumigati* section, being classified as critical by WHO, its presence should be 0 CFU due to its pathogenic potential (4).

Conclusions

- It is crucial to perform microbial air quality surveillance in Portuguese schools.
- The current IAQ Portuguese legal framework is not suitable to apply in schools.
- The risk of exposure to toxigenic and with clinical relevance fungal species poses a major public health threat impacting also students' learning conditions and outcomes.

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References:
1. República D da. Diário da República. [cited 2023 Jun 18]. Portaria n.o 138-G/2021. Available from: https://diariodarepublica.pt/
2. Viegas C, et al. Bioburden in health care centers: Is the compliance with Portuguese legislation enough to prevent and control infection? Building and Environment. 2019;160:106226.
3. Norbäck D, et al. Endotoxin, ergosterol, muramic acid and fungal DNA in dust from schools in Johor Bahru, Malaysia — Associations with rhinitis and sick building syndrome (SBS) in junior high school students. Science of The Total Environment. 2016 Mar 1;545–546:95–103.
4. WHO. WHO fungal priority pathogens list to guide research, development and public health action [Internet]. 2022 [cited 2023 Mar 2]. Available from: https://www.who.int/publications-detail-redirect/97892400602415.