



**PATHOGENIC FUNGI IN MANILA UNIVERSITY SCIENCE LABORATORIES:
BASIS FOR A PROPOSED INDOOR AIR QUALITY MANAGEMENT PLAN**

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INTRODUCTION

Indoor air pollution is recognized as a major environmental health concern worldwide. Fungal pathogens, both indoors and outdoors, contribute significantly to health risks, especially among individuals who spend extensive time in enclosed environments. Literature shows that 90% of pathogenic exposure occurs indoors, particularly in poorly ventilated buildings (Beggs, 2003, Yassin et.al., 2010). Fungal proliferation depends largely on temperature, humidity, organic substrates, and air movement- conditions frequently present in school laboratories.

The Manila University Science Laboratories such as Medical Technology, Pharmacy, Biology, Chemistry, and Physics are commonly used by students and faculty for laboratory activities. The absence of a standardized Indoor Air Quality (IAQ) management policy increases the potential for microbial contamination. This study was conducted to identify pathogenic fungi present in fourteen (14) Manila University science laboratories and to develop an Indoor Air Quality Management Plan tailored to their needs.

METHODS

Research Design

An experimental research design was used to assess fungal air pathogens using settle plate methods, environmental monitoring, colony morphology, microscopic identification and antifungal susceptibility testing across fourteen (14) Manila University laboratories.

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Sampling Site

Fourteen (14) Manila University laboratories were included: Medical Technology: LG 313, Pharmacy: LG 311, LG 310, M 309, M 308, and Research Laboratory, Chemistry: M 307, M 306, M 305, Physics: M302, and Biology: M 503, M 502, M 501 and M 500.

Environmental Monitoring

Temperature and Relative Humidity were measured using an HTC-1 Digital Hygrometer for one day in each laboratory. Acceptable IAQ ranges were 20 for 65% RH and 20-25°C temperature.

Fungal Isolation and Identification:

Settle Plate Methods: Five (5) PDA plates were placed in strategic areas of each laboratory for seven (7) hours.

Incubation: Plates were incubated for 3-7 days

Macroscopic Examination: Colony color, texture, and shape were recorded.

Microscopic Identification: Lactophenol cotton blue staining determined fungal genera (Aspergillus, Penicillium, Rhizopus, Mucor and Absidia).

Quantitative Analysis:

Colony-forming units (CFUs) were counted following FDA Bacteriological Analytical Manual guidelines.

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Antifungal Susceptibility Test

A disc diffusion assay tested the effectiveness of nine (9) disinfectants (D1-D9). D4-handwashing liquid with triclosan served as the primary commercial disinfectant.

Statistical Tools

- Relative Frequency Distribution
- One-Way ANOVA
- Tukey-Kramer Grouping
- Pearson r Correlation
- T-Test

RESULTS

Environmental Conditions

Relative Humidity

Range: 52%-60% (within normal IAQ range)

Highest RH: Chemistry M 307 (60%)

Lowest RH: Medical Technology LG 313 (52%)

Temperature

Range: 29.1°C - 32°C (higher than ASHRAE recommended 20-25°C)

Highest Temperature: Biology M 501 and M 500 (32°C)

Lowest Temperature: Physics M 302 (29.1°C)

Fungal Characteristics

Macroscopic Characteristics

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Fungal colonies exhibited varied colors:

Predominant: White, black, olive green

Other colors: yellow, orange, gray, brown, pink, creamy white

Commonly colony shapes included filamentous, cottony, rhizoid, dark spot. Circular, lobate, sand-like

Identified Pathogenic Fungi

Across fourteen (14) laboratories, microscopy confirmed of the presence of:

Aspergillus niger (most abundant; found in all rooms)

Aspergillus flavus

Aspergillus fumigatus

Penicillium

Rhizopus

Mucor

Absidia (least frequent; detected in MT LG 313 only)

Biology M 502 had the highest fungal abundance (3366 CFUs).

Significant Differences in Fungal Growth

One-Way ANOVA revealed *significant differences* between laboratories ($p=0.000$).

Highest colony count: Biology M 502 (3366 CFUs)

Lowest colony count: Pharmacy LG 310 (256 CFUs)

Tukey-Kramer grouped Biology M 502 separately due to its extremely high values

Relationship Between Environmental Factors and Fungal Growth

Correlation Analysis

Humidity vs Colony Count: *Not significant relationship* ($r = 0.054$; $p = .853$)

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Temperature vs Colony Count: *No significant relationship* ($r = .303$; $p = .293$)

This suggests that other factors dust accumulation, human traffic, construction activities, substrate availability played a larger role.

Effectiveness of Disinfectants

ANOVA showed *significant differences* across disinfectants ($p = 0.000$):

Most Effective

D4 Handwashing Liquid Soap (0.75% triclosan) - Mean = 15.36

D8 Clotrimazole ointment - Mean = 12.57 (control)

D3 Dishwashing Liquid - Mean = 12.21

Least Effective

D9 Distilled water - (Mean = 6.00)

Tukey-Kramer placed D4 in its own highest-effectiveness group, indicating superior antifungal action.

DISCUSSION

The study confirms that *Aspergillus niger*, *Rhizopus*, and *Penicillium* dominate the Manila University laboratories, consistent with global IAQ research on fungal contamination in warm, humid regions. Highest temperatures (near 32°C) likely contributed to increased fungal sporulation, especially during summer months.

Although humidity and temperature were within acceptable IAQ ranges, fungal growth still thrived showing that structural factors (wooden materials, dust, stagnant air), human activity, and ongoing laboratory renovations had stronger influences than microclimate alone.

The strong effectiveness of triclosan based disinfectants highlights the need for standardized cleaning protocols using proven antimicrobial agents.

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CONCLUSION

1. All Manila University laboratories contained multiple pathogenic fungi, with *Aspergillus niger* being most prevalent.
2. Temperature and humidity were not significantly correlated with fungal abundance.
3. Fungal growth varied significantly between laboratories, with Biology M 502 showing extreme contamination.
4. D4 handwashing liquid (triclosan 0.75%) was the most effective disinfectant.
5. An Indoor Air Quality Management Plan is necessary to regulate cleaning, monitoring, and prevention practices.

RECOMMENDATIONS

- Enforce standardized laboratory disinfection procedures using D4 disinfectant or equivalent.
- Install humidity and temperature monitoring systems, especially during humid seasons.
- Conduct regular IAQ seminars for faculty, students and custodians.
- Implement strict handwashing and PPE guidelines.
- Improve ventilation and reduce dust accumulation, particularly in laboratories undergoing renovation.
- Pilot test and institutionalize the proposed Indoor Air Quality Management Plan

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