ISOLATION, IDENTIFICATION AND CHARACTERIZATION OF AIRBORNE FUNGI IN SCIENCE LABORATORY TECHNOLOGY (SLT) LIBRARY AND CLASSROOM, UNIVERSITY OF BENIN

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(MICROBIOLOGY TECHNIQUES)

DEPARTMENT OF SCIENCE LABORATORY TECHNOLOGY

FACULTY OF LIFE SCIENCES

UNIVERSITY OF BENIN

NOVEMBER, 2025

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AN UNDERGRADUATE PROJECT WORK SUBMITTED TO THE DEPARTMENT OF SCIENCE LABORATORY TECHNOLOGY, FACULTY OF LIFE SCIENCES, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, NIGERIA; IN PARTIAL FUFILMENT OF THE REQUIREMENTS FOR AWARD OF BACHELOR OF SCIENCE (B.SC.) DEGREE IN SCIENCE LABORATORY TECHNOLOGY

NOVEMBER, 2025

CERTIFICATION

This is to certify that this research work titled **Isolation, Identification and Characterization of Airborne Fungi in Science Laboratory Technology (SLT) Library and Classroom, University of Benin** was carried out by **Sharon Chidimma ASEMOTA**, with Matriculation Number **LSC2007275**, from the Department of Science Laboratory Technology, Faculty of Life Sciences, University of Benin, Benin City, Edo state. Under the supervision of Mr. O. Haruna.

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External Examiner

Date

DEDICATION

This work is dedicated to God Almighty, the source of all wisdom and knowledge. I also dedicate it to my loving parents and family, whose sacrifices, support, and prayers have been the bedrock of my success and to everyone who believed in me.

ACKNOWLEDGEMENT

I express my sincere gratitude to Almighty God for His unending grace, strength, and guidance throughout the course of this research work. I also deeply appreciate my supervisor, Mr. O. Haruna, for his encouragement, valuable insights, and support, which contributed significantly to the successful completion of this project.

Special thanks to my beloved parents, Mr. and Mrs. Asemota, and my siblings for their unwavering love, support, and prayers throughout this academic journey.

I am truly grateful to one of my biggest supporters Liberty Gift, for his consistent motivation, understanding, and support in the completion of this work. I also extend heartfelt appreciation to my dear cousin, Mrs. Peace Godwin, and her husband, Mr. Emmanuel Godwin, for their continuous encouragement, kind advice, and steadfast support. Finally, I want to appreciate my friend, Favour Maxwell for her support and contribution in the successful completion of this work.

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ABSTRACT

Airborne fungi are microscopic organisms that disperse through the atmosphere in the form of spores or fragmented hyphae. These spores are naturally present in both indoor and outdoor environments and play essential ecological roles in organic matter decomposition and nutrient recycling. This study examined the Isolation, Identification and Characterization of Airborne Fungi in the Science Laboratory Technology (SLT) classroom and library of the University of Benin. Air samples were collected using the open plate sedimentation method and cultured on Potato Dextrose Agar (PDA). Fungal isolates were identified through macroscopic and microscopic examinations. The species obtained included *Aspergillus niger, Aspergillus flavus, Penicillium spp., Mucor spp., Fusarium spp., and Neurospora crassa*. The library recorded a higher fungal load than the classroom, likely due to poor ventilation and dust accumulation. The dominance of *Mucor and Aspergillus species* indicates that humidity and airflow significantly influence indoor fungal growth. This study concludes that classrooms and libraries can serve as reservoirs for airborne spores, and recommends improved ventilation, regular cleaning, and routine monitoring to ensure a healthier learning environment and protect educational materials.

CHAPTER ONE

1.1 Background of the Study

Airborne fungi are a diverse group of microorganisms dispersed through the atmosphere as spores or fragments. They are naturally present in both outdoor and indoor environments, where they play ecological roles such as organic matter decomposition, nutrient cycling, and interaction with plants and animals (Segers *et al.*, 2023). However, in confined spaces like classrooms and libraries, airborne fungi can accumulate, creating conditions that may affect human health and the integrity of building materials (Al Hallak *et al.*, 2023).

Indoor airborne fungi are influenced by various environmental factors such as temperature, humidity, ventilation, and human activity (Precha e*t al*., 2023). Educational facilities, especially classrooms and libraries, are highly vulnerable to fungal contamination due to the presence of organic substrates such as paper, wood, textiles, and dust particles that provide favorable growth conditions (El Jaddaoui *et al.,* 2023). In libraries,characteriz of old books, archives, and low ventilation systems can lead to fungal colonization and eventual deterioration of materials, reducing the shelf-life of educational resources (Wu *et al.*, 2021).

The impact of indoor airborne fungi is not limited to structural damage; they also pose health risks to occupants. Exposure to fungal spores can trigger allergic reactions, respiratory infections, asthma, and toxic responses due to the production of mycotoxins (Al Hallak *et al.*, 2023). Students and staff who spend extended hours in classrooms and libraries are therefore at risk of chronic exposure. Studies have shown that schools and other public buildings frequently harbor diverse fungal communities, with species belonging to genera such as *Aspergillus, Penicillium, Cladosporium, and Alternaria* being predominant (Jasim *et al*., 2021; Kacprzak *et al.,* 2023).

Advances in fungal identification techniques, including culturing, microscopy, and molecular sequencing, have improved the accuracy of isolating and characterizing airborne fungi in indoor spaces (Wu *et al.,* 2021). Moreover, predictive models employing machine learning are being developed to assess indoor fungal concentrations and associated health risks (Lee *et al*., 2025). These advancements highlight the global importance of monitoring airborne fungi in enclosed spaces, particularly in institutions of learning where large populations gather.

In the Nigerian context, the study of indoor airborne fungi remains limited, despite the humid tropical climate that favors fungal growth. The University of Benin's Science Laboratory Technology (SLT) classrooms and libraries represent critical environments where students spend prolonged periods. Identifying and characterizing airborne fungi in these spaces is therefore essential to safeguard public health, preserve educational materials, and provide baseline data for environmental monitoring.

1.2 Aim of the Study

The aim of this study is to isolate, identify and characterize airborne fungi present in the Science Laboratory Technology (SLT) classrooms and library at the University of Benin.

1.3 Objectives of the Study

The specific objectives of this research are to:

1. isolate airborne fungi present in SLT classrooms and library.

2. identify and characterize the fungal isolates based on their morphological and microscopic characteristics.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of Airborne Fungi

Airborne fungi are microscopic organisms that disperse through the atmosphere in the form of spores or fragmented hyphae. These spores are naturally present in both indoor and outdoor environments and play essential ecological roles in organic matter decomposition and nutrient recycling (Segers *et al.,* 2023; Haas *et al.,* 1999). Indoors, however, their accumulation can pose health risks and cause material deterioration. The diversity and concentration of airborne fungi depend on environmental conditions, building characteristics, and human activity (Wu *et al*., 2021; Rostami *et al.*, 2017).

Fungal spores are particularly resilient due to their protective cellular structures and adaptive mechanisms, such as natural folding that enhances dispersal and long-term survival in air (Segers et al., 2023). Common airborne fungal genera include *Aspergillus, Penicillium, Cladosporium, and Alternaria* species frequently identified in libraries, classrooms, and public buildings (Jasim *et al*., 2021; Kacprzak *et al*., 2023). These organisms can remain viable for extended periods, especially under humid tropical conditions that favor sporulation and germination.

2.2 Sources and Pathways of Airborne Fungal Contamination

Indoor fungal contamination often originates from outdoor air, occupants, and materials within the building. According to (Al Hallak *et al*. 2023), fungal spores enter through ventilation systems, doors, and windows, while indoor reservoirs such as carpets, papers, and wooden shelves provide surfaces for colonization. Libraries and classrooms are particularly prone to contamination due to the abundance of organic matter, dust, paper, and

books that serve as nutrient sources for fungal growth (El Jaddaoui *et al.,* 2023; Fakunle *et al.,* 2022).

Once inside, fungal spores adhere to surfaces and reproduce under suitable environmental conditions. Poor ventilation, high relative humidity, and inadequate cleaning contribute significantly to spore accumulation. Studies have shown that schools and public buildings often harbor diverse fungal communities, especially when air exchange is limited or when moisture control is poor (Wu *et al.*, 2021; Lu *et al.,* 2022).

2.3 Environmental Factors Affecting Indoor Airborne Fungi

Environmental conditions such as temperature, humidity, and air circulation strongly influence the abundance and diversity of airborne fungi. (Precha *et al.* 2023) observed that fungal concentration in dormitories increased during humid seasons and decreased during dry periods, while (Lu *et al*. 2022) noted that relative humidity and air stagnation were the strongest predictors of fungal diversity in academic buildings. High humidity promotes sporulation and mycelial growth, while temperature affects the metabolic rate of fungi. Inadequate ventilation allows spores to remain suspended in air longer, increasing the likelihood of colonization.

Building design and maintenance also play a role. (Kacprzak *et al.* 2023) found that older buildings with poor insulation and natural ventilation systems exhibited higher fungal loads than newer facilities. Similarly, dust accumulation on surfaces provides organic material that sustains fungal growth, emphasizing the importance of proper cleaning and air filtration in indoor environments.

2.4 Health Implications of Airborne Fungi

Exposure to airborne fungal spores is a major public health concern. Fungal species such as

Aspergillus and Penicillium can produce mycotoxins toxic metabolites that cause allergic reactions, respiratory distress, and other health complications (Al Hallak *et al.*, 2023; Al-Shaarani and Pecoraro, 2024). Prolonged exposure, especially in enclosed environments like classrooms and libraries, can lead to chronic respiratory infections and asthma (Wu *et al*., 2021; do Nascimento *et al.,* 2023).

El Jaddaoui *et al.* (2023) emphasized that library workers and students are at high risk of allergic alveolitis and mycoses due to frequent exposure to dust-laden fungal spores. The risk is heightened in tropical climates where fungal proliferation is naturally high. Consequently, monitoring airborne fungi in indoor environments is crucial to prevent health hazards and ensure safe learning spaces.

2.5 Isolation and Identification Techniques

Accurate identification of airborne fungi requires both cultural and molecular methods. Traditional approaches involve collecting air samples using sedimentation plates or air samplers, followed by culturing on selective media such as Potato Dextrose Agar (PDA) or Sabouraud Dextrose Agar (SDA) (Jasim *et al.*, 2021; Rostami *et al.*, 2017). Colonies are identified based on macroscopic characteristics (color, texture, margin) and microscopic features such as spore type and hyphal structure (Wu *et al.*, 2021; Giri, 2020).

Recent studies have integrated high-throughput sequencing and machine learning algorithms to predict fungal concentration and diversity using environmental parameters (Lee *et al.,* 2025). These modern approaches enhance detection accuracy and enable the prediction of contamination risk levels.

2.6 Fungal Contamination in Libraries and Educational Buildings

Educational environments are particularly vulnerable to fungal colonization due to heavy

human traffic, accumulation of organic dust, and insufficient ventilation. In their review, (El Jaddaoui *et al.,* 2023) reported that libraries worldwide harbor diverse fungal species, some capable of degrading cellulose and lignin in paper materials. Aspergillus niger, Cladosporium cladosporioides, and Penicillium chrysogenum are among the most frequently isolated species from library air and surfaces.

(Wu *et al.,* 2021) found that indoor airborne fungal concentration in libraries fluctuates seasonally, with higher counts during warm and humid months. Similarly, (Jasim *et al.*, 2021) identified multiple airborne fungal species in school buildings in Babylon Province, Iraq, linking contamination levels to ventilation patterns and occupancy density. These findings highlight the importance of regular environmental monitoring and cleaning practices in educational institutions.

2.7 Emerging Research and Technological Advances

Modern fungal ecology increasingly employs machine learning models and bioinformatics tools to study airborne fungal dynamics. (Lee *et al.* 2025) demonstrated that artificial intelligence models can predict indoor fungal concentrations based on environmental variables such as temperature, humidity, and CO_2 levels, findings consistent with those of (Lu *et al.* 2022) who linked such parameters to fungal community structure.

Additionally, advancements in molecular biology and microscopy have improved the identification of unculturable fungi (Wu *et al.,* 2021). These technologies enhance the understanding of fungal diversity, distribution, and potential health impacts.

2.8 Summary of Literature Review

The reviewed literature indicates that airborne fungi are ubiquitous in indoor environments and influenced by environmental and structural factors. Libraries and classrooms, due to

their confined spaces and organic materials, are hotspots for fungal contamination. Recent studies emphasize the health implications of prolonged exposure to airborne fungal spores and the need for regular monitoring using both traditional and modern identification techniques.

Despite global research advances, there is limited data from tropical African universities such as the University of Benin. This gap underscores the need for localized studies to assess the diversity, abundance, and health risks of airborne fungi in Nigerian educational facilities. Such research will contribute valuable insights for public health, environmental safety, and material preservation.

CHAPTER THREE

3.1 MATERIALS AND METHODS

3.1.1. Materials

Petri dishes, Conical flask, Beaker, Cotton wool, Measuring cylinder, Micropipette, Foil paper, Bunsen burner, Masking tape, Spatula, Glass-slide, Coverslip, Canister, Media (PotatoDextroseAgar), Antibacterial (Chloraphenicol)

3.1.2. Equipment

Hotairoven, Weighing balance, Autoclave, Refrigerator, Microscope, Gas cylinder

3.1.3. Reagents

Lactophenol cotton blue

3.2 Research Design

This study adopted an experimental descriptive design aimed at isolating, identifying, and characterizing airborne fungi in the Science Laboratory Technology (SLT) classrooms and library at the University of Benin. The research involved the collection of air samples, culturing of fungal spores, and identification of isolates based on their morphological and microscopic characteristics. Comparisons were made between fungal abundance and diversity in the classroom and library environments.

3.3 Study Area

The study was conducted within the Department of Science Laboratory Technology (SLT), Faculty of Life Sciences, University of Benin, Benin City, Nigeria. The area is located in a humid tropical climatic zone characterized by high relative humidity (70–90%), frequent

rainfall, and average temperatures ranging from 25°C to 32°C. These environmental conditions favor fungal proliferation.

Sampling was carried out in two main locations:

1. SLT Classrooms – enclosed teaching spaces with moderate ventilation and high student occupancy.
2. SLT Library – a semi-enclosed room housing books, journals, and paper-based materials with limited air circulation.

3.4 Sample Collection

Airborne fungal spores were collected using the sedimentation (settle plate) method

- Sterile Petri dishes containing Potato Dextrose Agar (PDA) supplemented with chloramphenicol (50 mg/L) to inhibit bacterial growth were used.
- Plates were exposed to the air for 25–30 minutes at selected points in each environment (five sites per classroom and library).
- After exposure, plates were covered immediately, labeled (with date, time, and location), and transported to the microbiology laboratory for incubation.

3.5 Preparation of Culture Media

Potato Dextrose Agar (PDA) was prepared by dissolving 7.9g of the powdered medium in 200ml of distilled water, followed by heating to achieve complete dissolution.

The medium was sterilized by autoclaving at 121°C for 15 minutes.

After cooling to about 45°C, chloramphenicol was added aseptically.

The sterile medium was poured into Petri dishes and allowed to solidify before exposure.

3.5 Incubation and Isolation of Fungi

- The exposed plates were incubated inverted at 27 ± 2°C for 3 days.
- Fungal colonies that developed were counted to determine the colony-forming units per plate (CFU/plate).
- Distinct colonies were sub-cultured onto fresh PDA plates to obtain pure cultures.
- Each isolate was labeled and stored for subsequent identification.

3.6 Identification and Characterization of Isolates

Identification was based on macroscopic and microscopic characteristics, following the procedures of (Kacprzak *et al.,* 2023; El Jaddaoui *et al.,* 2023).

3.6.1 Macroscopic Examination

- Pure colonies were examined for:
- Colony color (obverse and reverse)
- Texture and margin
- Pigment production
- Growth rate and surface morphology

3.6.2 Microscopic Examination

- A small portion of the colony was mounted on a slide with a drop of lactophenol cotton blue and covered with a coverslip.
- Observations were made under a compound microscope (×10 and ×40 objectives).
- Fungal structures such as hyphae, conidia, sporangia, and conidiophores were observed and compared with standard identification keys (Wu *et al.,* 2021; Jasim *et al.,* 2021).

3.7 Quality Control

To ensure accuracy and reliability of results:

All glassware and instruments were sterilized before and after use.

Media sterility was confirmed by incubating one unexposed plate as a control.

Sampling was conducted under aseptic conditions to prevent contamination.

Duplicate samples were collected for each site to ensure consistency.

CHAPTER FOUR

RESULTS

4.1 Fungal Load of Airborne Fungi

The total colony counts obtained from the classroom and library of the Department of Science Laboratory Technology are presented below. Fungal growth was observed on all exposed plates after incubation, showing variation in colony number between the two sampling sites.

4.2 Morphological Characteristics of Fungal Isolates

The cultural characteristics of fungal isolates recovered from the classroom and library samples are presented in the table below. Variations were observed in color, texture, growth rate, and pigmentation of colonies cultured on Potato Dextrose Agar (PDA).

4.3 Microscopic Characteristics of Fungal Isolates

The microscopic examination of the fungal isolates revealed distinctive hyphal structures, spore forms, and other identifying features used for taxonomic identification. These characteristics are summarized below.

Table 4.1: Total Fungal Count of Airborne Fungi from SLT Classroom and Library.

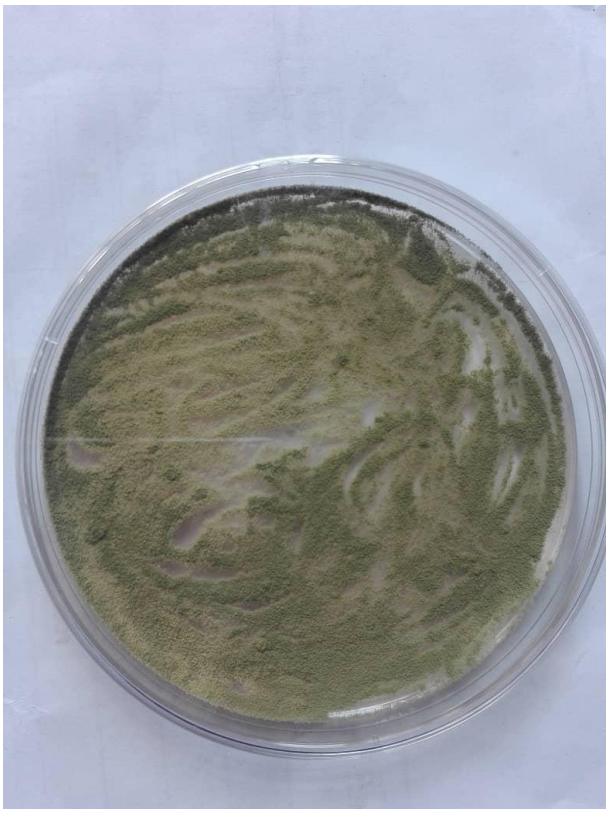
Sampling site	Plate 1	Plate 2	Plate 3	Plate 4	Plate 5	Total count
Library	22	20	18	19	27	106
Classroom	24	18	14	22	16	94

Table 4.2: Cultural and Morphological Characteristics of Fungal Isolates from SLT Classroom and Library.

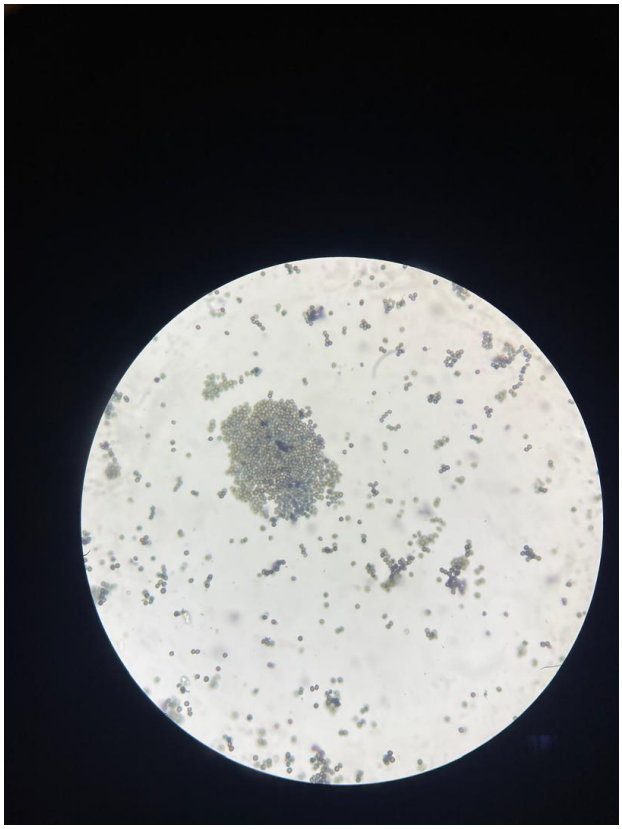
Sampling Site	Isolate Code	Colony Color	Texture	Growth Rate	Reverse color	Pigmentation color	Probable specie
Library	Lib 1	White	Cottony	Very Rapid	Colorless	Nil	*Mucor spp*
Library	Lib 2	White	Cottony	Very rapid	Colorless	Nil	*Mucor spp*
Library	Lib 3	Dark brown	Powdery	Rapid	Pale yellow	Nil	*Aspergillus niger*
Library	Lib 4	Light pink	Powdery	Rapid	Pale Yellow	Nil	*Fusarium spp*
Library	Lib 5	Light orange	Fluffy	Very rapid	Pale yellow	Red	*Neurospora crassa*
Library	Lib 6	Olive green	Powdery	Rapid	Pale yellow	Nil	*Aspergillus flavus*
Classroom	Cl 1	White	Cottony	Very rapid	Colorless	Nil	*Mucor spp*
Classroom	Cl 2	Dark brown	Powdery	Rapid	Pale yellowish	Nil	*Aspergillus niger*
Classroom	Cl 3	Moss green and white	Velvety	Moderate	Pale yellowish	Nil	*Penicillium spp*
Classroom	Cl 4	Light pink	Powdery	Rapid	Pale yellow	Nil	*Fusarium spp*
Classroom	Cl 5	Orange	Fluffy	Very rapid	Pale yellow	Red	*Neurospora crassa*
Classroom	Cl 6	Orange	Fluffy	Very rapid	Pale yellow	Red	*Neurospora crassa*

Table 4.3: Microscopic Characteristics of Fungal Isolates from SLT Classroom and Library.

S/N	Isolate	Hyphae Type	Conidia / Spore Type	Conidiophore / Sporangiophore	Distinctive Microscopic Features
1	*Aspergillus niger*	Septate	Rough, black, round conidia in chains	Long, smooth-walled, hyaline stalks	Dark brown to black conidial heads, radiating and compact
2	*Aspergillus flavus*	Septate	Spherical, spiny conidia arranged in chains	Rough, thick-walled, hyaline	Yellow-green conidial heads, rough and spiny conidia
3	*Penicillium spp.*	Septate	Round, unicellular conidia in unbranched chains	Erect, branched structure	Brush-like conidiophore arrangement(Penicillus structure)
4	*Neurospora crassa*	Septate (uninucleate cells)	Asexual spores that are unicellular	Simple branched structures that bears conidia	Orange-reddish Produces orange-reddish colonies
5	*Fusarium spp.*	Septate	Macro- and micro-conidia	Branched conidiophores	Sickle-shaped macroconidia with multiple septa
6	*Mucor spp.*	Broad, aseptate (coenocytic)	Large round sporangia at the tip of the sporangiophores	Arise without rhizoids, small spherical to oval spores	No rhizoids ,sporangiophores are unbranched and arise directly from hyphae

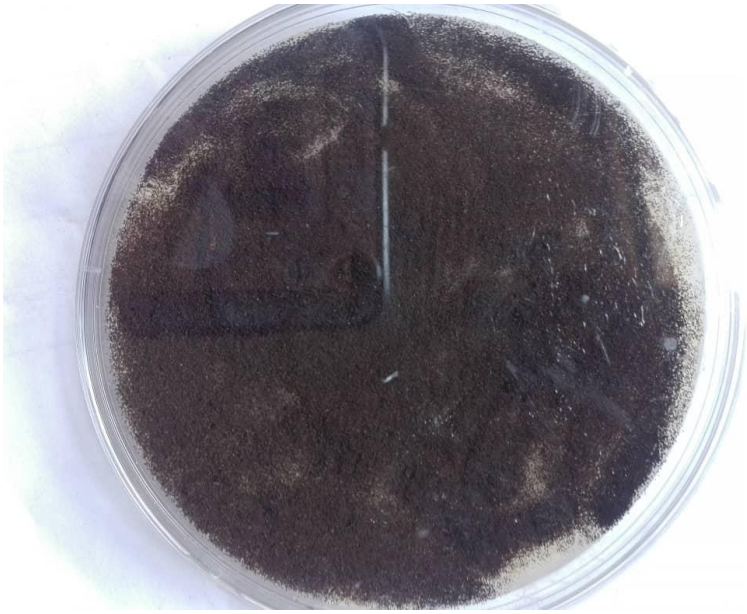


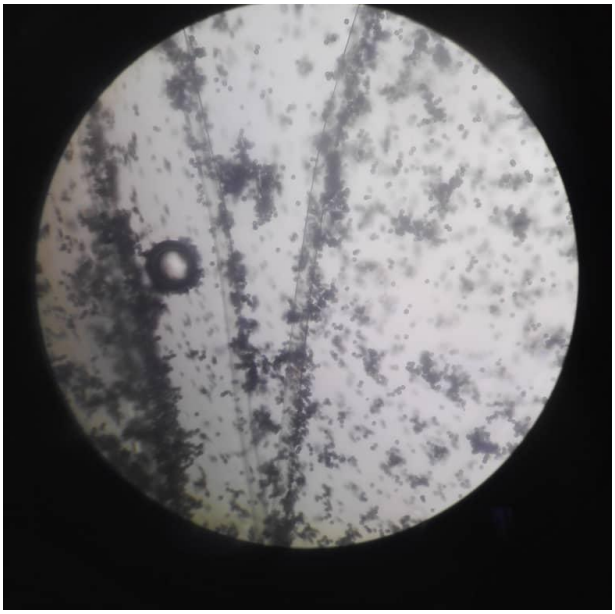
A



B

Plate 1 A and B: Macroscopic and Microscopic view of *Aspergillus flavus*





A

B

Plate 2 A and B: Macroscopic and Microscopic view of *Aspergillus niger*

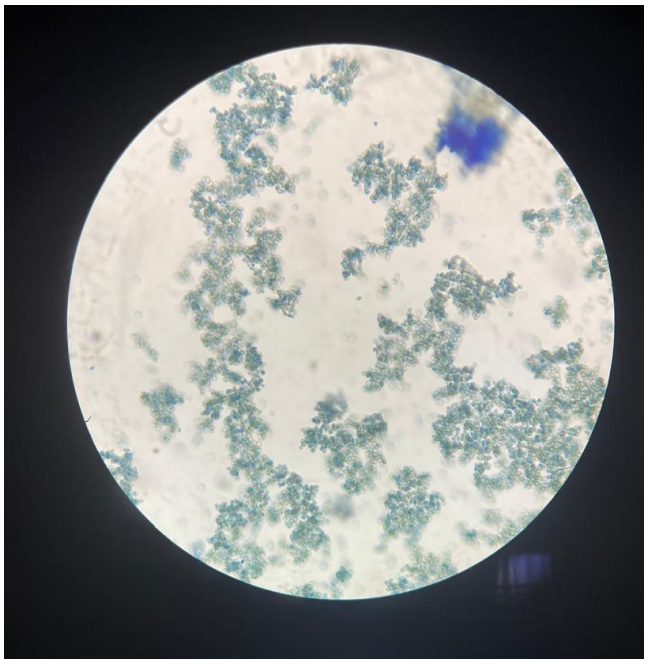
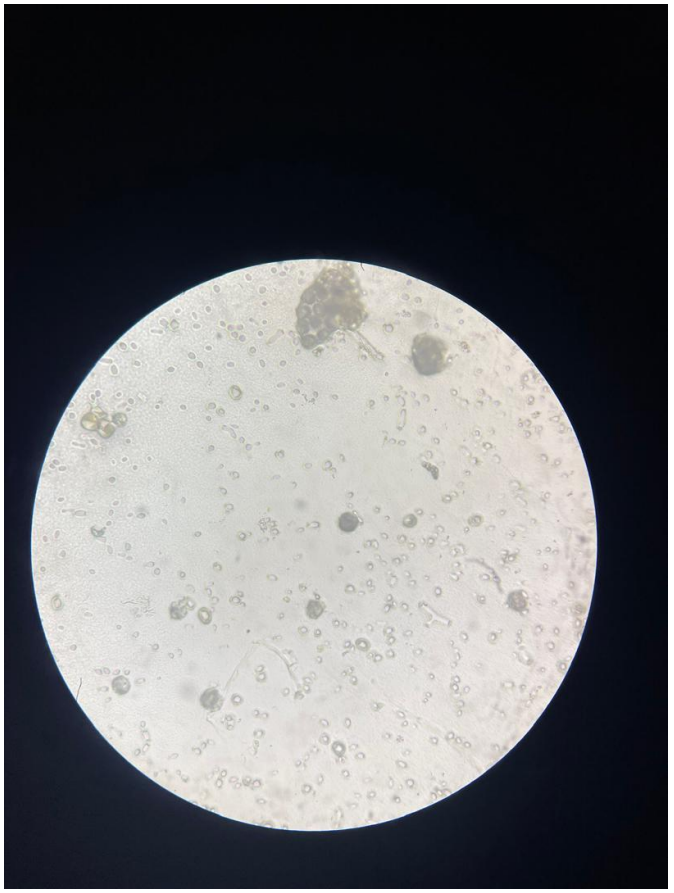


Plate 3 A and B: Macroscopic and Microscopic view of *Mucor spp*

A

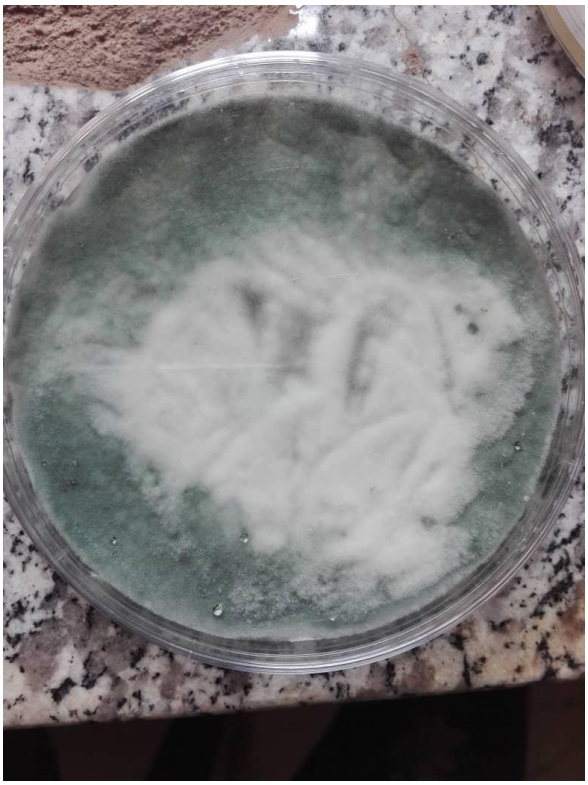
B

A

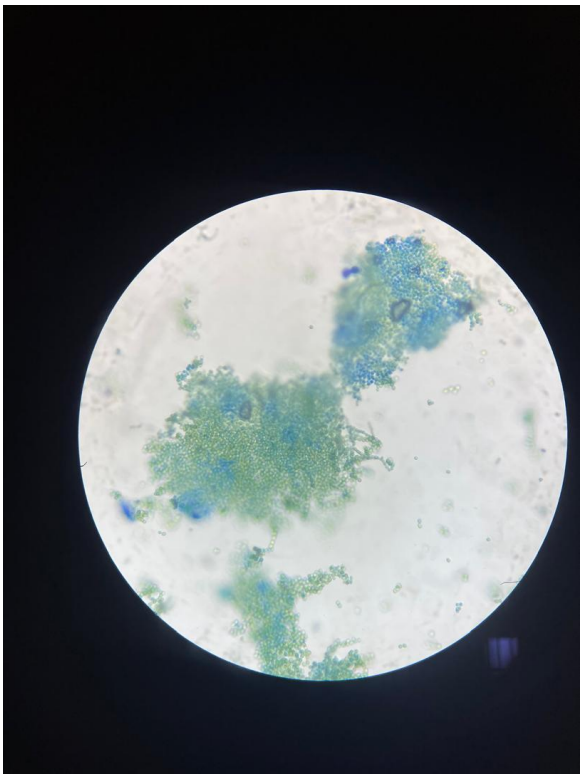


B

Plate 4 A and B: Macroscopic and Microscopic view of *Fusarium spp*



A



B

Plate 5 A and B: Macroscopic and Microscopic view of *Penicillium spp*

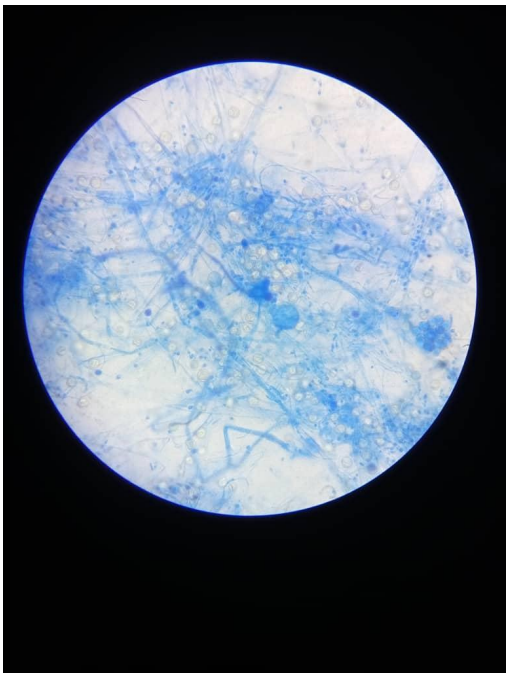


Plate 6 A and B: Macroscopic and Microscopic view of *Neurospora crassa*

A

B

Plate 7: Production of pigmentation by *Neurospora crassa*

CHAPTER FIVE

5.0 DISCUSSION

The findings of this study revealed that airborne fungi were present in both the SLT classroom and library environments at the University of Benin. Fungal growth was observed on all exposed plates, confirming the presence of diverse fungal spores in indoor air. The library recorded a slightly higher colony count than the classroom, indicating that conditions within the library may be more favorable for fungal accumulation. Factors such as limited ventilation, the presence of old paper materials, and relatively higher humidity likely contributed to this increase. This observation agrees with the findings of (El Jaddaoui *et al.* 2023), who reported that libraries serve as suitable environments for fungal proliferation because they often contain cellulose-based materials that support fungal colonization. (Wu *et al.* 2021; Giri 2020) similarly noted that fungal populations in library environments tend to rise during warm and humid seasons due to poor air circulation and the organic dust that settles on books and shelves.

The presence of fungal spores in the classroom was also significant, reflecting the impact of human activity and environmental factors such as temperature, ventilation, and dust disturbance. (Precha *et al.* 2023; Lu *et al.* 2022) reported that moisture, humidity, and poor ventilation are the major determinants of fungal concentration in educational environments. The tropical climate of Benin City, characterized by high humidity and temperature, creates ideal conditions for spore germination and persistence. The detection of fungi in both environments therefore supports the assertion of (Al Hallak *et al.* 2023; Haas *et al.* 1999) that indoor air quality is strongly influenced by microclimatic and structural conditions of buildings.

The fungal isolates obtained included *Aspergillus niger, Aspergillus flavus, Penicillium spp., Mucor spp., Fusarium spp., and Neurospora crassa*. The predominance of *Aspergillus* and *Penicillium species* is consistent with several studies that identified these genera as the most common airborne fungi in educational and residential buildings (Jasim *et al*., 2021; Kacprzak *et al*., 2023; Rostami *et al.,* 2017). These organisms produce abundant spores that easily become airborne, explaining their

frequent detection in both the classroom and library. Mucor spp. was also prevalent in this study, which aligns with the report of (Kacprzak *et al*. 2023) and (Lu *et al*. 2022), who found Mucor species as a dominant genus in naturally ventilated and humid buildings. The high occurrence of *Mucor* may be linked to its rapid growth rate and ability to thrive in humid conditions typical of tropical indoor environments.

Microscopic examination confirmed the structural diversity among the fungal isolates. The septate hyphae and conidial arrangements observed in *Aspergillus and Penicillium species,* as well as the aseptate coenocytic hyphae in *Mucor spp*., correspond with the descriptions reported by (Wu et al. 2021; El Jaddaoui *et al.* 2023). These microstructures facilitate efficient spore production and dispersal, enabling fungi to remain suspended in air for long periods. (Segers *et al*. 2023) explained that airborne fungal spores possess protective folding mechanisms that allow them to survive under environmental stress, which supports the persistence of these isolates in the studied indoor environments.

The distribution and frequency of occurrence of fungal isolates in this study reflect the influence of multiple environmental factors. Mucor spp. recorded the highest frequency, followed by Aspergillus niger, Aspergillus flavus, Penicillium spp., and Fusarium spp., while Neurospora crassa had the lowest. The higher frequency of Mucor spp. may be attributed to its rapid colonization potential and ability to produce numerous sporangiospores even under fluctuating humidity. According to (Precha *et al.* 2023), fungi with higher sporulation rates tend to dominate enclosed environments with restricted airflow. The co-occurrence of Aspergillus and Penicillium species also confirms their strong environmental adaptability and resilience, as documented by (Al Hallak *et al*. 2023) and (Al-Shaarani and Pecoraro 2024), who highlighted their role as primary colonizers of damp building materials.

The detection of potentially pathogenic fungi such as Aspergillus and Fusarium species has significant health implications. These genera are known producers of mycotoxins and allergens capable of causing respiratory infections, asthma, and hypersensitivity reactions (Al Hallak *et al.,*

2023; do Nascimento *et al.*, 2023; Fakunle *et al.,* 2022). Students and staff who spend long hours in poorly ventilated classrooms and libraries are therefore at risk of exposure to fungal spores and toxins. Prolonged inhalation of spores can result in allergic alveolitis and bronchial irritation, especially among individuals with pre-existing respiratory conditions. (El Jaddaoui *et al*. 2023) similarly reported that library workers often experience allergic responses due to long-term fungal exposure.

In addition to the health risks, these fungi may also compromise the structural integrity of books and paper materials by degrading cellulose and lignin components, leading to reduced durability of library collections (Wu *et al.,* 2021; Jasim *et al., 2*021). The findings from this study emphasize the need for routine monitoring of indoor air in academic environments, as recommended by (Lu *et al.* 2022; Lee *et al*. 2025). Regular ventilation, control of moisture sources, and proper cleaning of bookshelves and classroom surfaces can minimize fungal buildup. Furthermore, (Lee *et al*. 2025) proposed the integration of predictive environmental models using machine learning to estimate indoor fungal concentrations based on parameters such as temperature, humidity, and occupancy level. Such innovations could enhance environmental safety and allow institutions like the University of Benin to implement data-driven strategies for indoor air quality management.

Overall, the results of this study are consistent with global findings on indoor airborne fungi and underscore the importance of maintaining hygienic and well-ventilated educational environments. The presence of diverse fungal genera in both the SLT classroom and library demonstrates the ubiquity of airborne fungal spores and their resilience under tropical climatic conditions. The outcomes of this research therefore contribute valuable local data on fungal diversity within the University of Benin and reinforce the need for proactive health and environmental monitoring to ensure safer learning spaces for students and staff.

Conclusion

This study investigated the Isolation and Identification of Airborne Fungi in the SLT classroom and library of the University of Benin. Air sampling and culture results revealed the presence of *Aspergillus niger, Aspergillus flavus, Penicillium spp., Mucor spp., Fusarium spp., and Neurospora crassa*. The library had a higher fungal load, likely due to poor ventilation and dust accumulation.

The dominance of *Mucor, Aspergillus, and Penicillium* species shows that humidity and airflow greatly influence fungal growth. Some of these fungi pose health risks and can damage books and materials.

Airborne fungi are common in both the classroom and library. Their presence reflects inadequate ventilation and moisture control. Improving air circulation and hygiene will reduce fungal contamination.

Recommendations:

- Improve ventilation and cleanliness.
- Keep humidity low.
- Regularly monitor indoor air.
- Air and clean library materials frequently.

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