NATIONAL BOARD FOR TECHNICAL EDUCATION
NIGERIAN JOURNAL FOR TECHNICAL EDUCATION
Volume 21 Nos. 1 2023
ISSN No. 2992 - 3522

Aeromycological Inventory of Indoor Air of Specialist Hospital Idah, Kogi State, Nigeria

Ohiaba, Emmanuel Enemadukwu; Egbunu, Zacharia Kadiayeno Gwam, Ugo Fred

[1]*Department of Science Laboratory Technology, Federal Polytechnic Idah, Kogi State, Nigeria.*
[2]*Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia.*
[3]*National Biotechnology Development Agency, Abuja, Nigeria.*

**corresponding author's*
Email: emmyohia@fepoda.edu.ng or ohia4433@gmail.com

ABSTRACT

Aeromycological inventory of indoor air was carried out over the Specialist Hospital Idah within the sampling period of August, 2022. The abundance and distribution of fungal aero-pathogens suspended in the atmosphere were investigated. Prepared plates of Potato Dextrose Agar (PDA) were taken to Specialist Hospital Idah and were exposed to five (5) wards to take fungal sample of indoor air of the wards for 15 minute and the plates were taken back to the laboratory for incubation and monitoring of fungal growth. Fungal genera isolated were Mammaria echinobutryiodes (3%), Cladorrhinum foelundisimum (4%), Oidiodendron echinulatun (4%), Idriella lunata (4%), Ryparobius polysporous (6%), Rhizopus sp. (16%), Celphalosporium acremonium (7%), Aspergillus niger (21%), Cladosporium sp. (30%), Mucor sp. (34%) and Penicillium notatum (41%). Penicillium notatum was identified to have the highest frequency (41%). The proportion of fungi in indoor air at Specialist Hospital Idah is not the same within the periods of investigation. Improvement of general hygiene and sanitation system is encouraged in order to reduce the spread of aero-microbes.

KEYWORDS: Aeromycology, Allergens, Spores, Fungi, Hygiene

INTRODUCTION

The quality of air inhaled by an individual within his environment determine to a greater extent of the well being of that individual. Some infectious agent are suspended in the air, therefore the hospital environment could be a potential route for the spread of hospital acquired infection (Agwaranze *et al*., 2020). Aeromycology is the branch of Aerobiology that studies the spread of spores and other fungal elements in indoor and outdoor air, the differences in their concentration and the factors that affect those changes (José *et al*., 2012)

Fungal spores enter hospitals through dust, water introduced into the hospital, through ventilation systems and fungi develop in multiple surfaces releasing more spores (Odebode and Adekunle, 2020). Indoor environments, as the main habitats of modern humans, encompass a complex mixture of viable and dead microorganisms which can affect occupants' health and also deteriorate different parts of buildings. This may also lead to undesirable changes in the structural properties of the building

materials (Negin *et al.,* 2019).
Large quantities of infectious airborne particles are released during many routine checks endemic to health care facilities. Fungi that can spread via airborne or droplet means are many (Fernstrom *et al.,* 2013). Outdoor air markedly influences the prevalence of fungal spore levels in indoor air and thus, it is the major source of fungal infections in indoor environments especially in hospitalized individuals (Leventi, 2021). Three important factors that directly affect airborne fungal populations are the availability of food/substrates, free water for fungal growth and the methods of spore dispersal (Deweili *et al.,* 2019).
Fungi are ubiquitous in all atmospheres. In general, both outdoor and indoor atmosphere are dominated by different species of fungi. Some of these genus are *Cladosporium*, *Penicillium, Aspergillus, Alternaria,* yeasts and *Mycelia sterilia*. *Cladosporium* is always the dominant fungus in outdoor atmospheres and in indoor atmosphere of normal and health building (except hospitals where *Aspergillus* and *Penicillium,* were usually dominant) (Nimisha *et al.,* 2018).
The quality and variety of hospital acquired infection are also rising (Fernstrom *et al*., 2013). Also, in hygienic surgery, the microorganism contamination of air in the room of operation is commonly measured to be a great issue of infection in surgical places (Adil *et al*., 2015). Therefore, the study is aimed at determining the aeromycology inventory of indoor air of Specialist Hospital Idah, Kogi State.

MATERIALS AND METHOD

Media Preparation

Potato Dextrose Agar (PDA) was prepared as per the standard protocols at 5.0 to 8.0 pH concentration. PDA of 39g was weighed using the electronic weighing balance and dissolved in 1000 mL of distilled water in a conical flask; it was then covered tightly with cotton wool and aluminum foil. It was heated for some minute to dissolve properly after which it was sterilize in the autoclave for 15 minute at 121°C. After 15 minute, it was allowed to cool to minimum temperature before it was poured in Petri dishes close to a the flame to prevent microbial contamination. It was then incubated for 24hrs for sterility check.

Sample Collection

The prepared plates were taken to Specialist Hospital Idah and were exposed to five (5) wards (maternity ward, male patients ward, female patient ward, scanning ward, intensive care ward) to take microbial sample of indoor air of the wards for 15 minutes and the plates were taken back to the laboratory for incubation and monitoring of growth.
After 24 hours, the growth on the plate was photographed and the colours were noted. The growth on the plates were examined by preparing a slide from the plates. A drop of lactophenol blue was dropped on the prepared slide, and covered with cover slip; allowed to stay for 5minutes and viewed at ×400 magnification. Fungal were examined by comparing the microscopic images with relevant literatures.

Statistical analysis

The data were subjected to statistical analysis using R-software to determine fungal spores causing allergies among human as well as their concentration using:
% of Species distribution =

$$\frac{\text{Total Number colonies of one species x 100}}{\text{Total No of colonies of all species}}$$

RESULT

Fungal count in the month of August (Thursday 18th – Wednesday 31st, 2022).
The fungal genera isolated were *Mucor sp., Idriella lunata, Penicillium notatum, Mammaria echinobutryiodes, Rhizopus sp., Aspergillus niger, Cladosporium sp., Oidiodendron echinulatun, Celphalosporium acremonium, Ryparobius polysporous* and *Cladorrhinum foelundisimum,* as shown in Table 1 below:

Table 1. Fungal count in the month of August (Thursday 18th – Wednesday 31st).

S/n	Fungal species	Week 1							Week 1						
		Days							Days						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	*Mucor sp.*	3	2	1	2	1	3	1	2	1	2	3	1	2	0
2	*Idriella lunata*	1	0	0	0	1	0	0	0	0	0	0	1	0	0
3	*Penicillium notatum*	2	3	2	2	1	1	3	1	2	2	3	1	2	4
4	*Mammaria echinobutryiodes*	1	0	0	0	0	1	0	0	0	0	0	0	0	0
5	*Rhizopus sp.*	0	1	2	3	0	1	1	1	0	0	0	1	1	0
6	*Aspergillus niger.*	2	1	3	0	1	1	1	1	2	0	0	1	1	1
7	*Cladosporium sp.*	2	4	0	3	2	1	1	2	0	3	1	1	1	0
8	*Oidiodendron echinulatun*	0	0	0	0	0	1	2	0	0	0	0	0	0	0
9	*Celphalosporium acremonium*	0	0	0	0	0	0	0	0	1	1	0	1	1	1
10	*Ryparobius polysporous*	0	0	0	0	0	0	0	2	0	1	1	0	0	0
11	*Cladorrhinum foelundisimum*	0	0	0	0	0	0	1	1	1	0	0	0	0	0
	Total	**11**	**11**	**8**	**10**	**6**	**9**	**10**	**10**	**7**	**9**	**8**	**7**	**8**	**6**

Table 2: The concentration of fungal genera in the indoor air of wards.

S/n	Spores	% Proportion
1	*Mucor sp.*	34.285714
2	*Idriella lunata*	4.285714
3	*Penicillium notatum*	41.428571
4	*Mammaria echinobutryiodes*	2.857143
5	*Rhizopus sp.*	15.714286
6	*Aspergillus niger*	21.428571
7	*Cladosporium sp.*	30.0000
8	*Oidiodendron echinulatun*	4.285714
9	*Celphalosporium acremonium*	7.142857
10	*Ryparobius polysporous*	5.714286
11	*Cladorrhinum foelundisimum*	4.285714

Test statistics: $X^2_{Cal} = 105$, df=10 and P-value= 0.000000000000000022 (2.2 x 10-16)
Conclusion: Since P-value is less than 0.05, we reject H_0 and conclude that the proportion of fungi at Specialist Hospital Idah is not the same (result obtained with R- software).

Table 3: Total number of fungal according to weeks

Fungal	Week 1	Week 2	Total
Mucor sp.	13	11	24
Idriella lunata	2	1	3
Penicillium notatum	14	15	29
Mammaria echinobutryiodes	2	0	2
Rhizopus sp.	8	3	11
Aspergillus niger	9	6	15
Cladosporium sp.	13	8	21
Oidiodendron echinulatun	3	0	3
Celphalosporium acremonium	0	5	5
Ryparobius polysporous	0	4	4
Cladorrhinum foelundisimum	1	2	3
Total	**65**	**55**	**120**

DISCUSSION

The study identified fungal present in the indoor air of five (5) wards (maternity ward, male patients ward, female patient ward, scanning ward, intensive care ward) in Specialist Hospital Idah as well as fungal genera causing pollinosis among patients giving the total number of eleven (11) organisms (*Mammaria echinobutryiodes, Cladorrhinum foelundisimum, Oidiodendron echinulatun, Idriella lunata, Ryparobius polysporous*, *Rhizopus sp., Celphalosporium acremonium, Aspergillus niger, Cladosporium sp., Mucor sp.* and *Penicillium notatum*). Some of the fungal identified in this study like *Rhizopus sp., Aspergillus niger, Mucor sp.* and *Penicillium notatum* have been reported by Deweili *et al.* (2016) to cause allergies such as rhinitis, exacerbation of asthmatic attack as well as pathogenic infection of the respiratory tract. The variation in fungi percentage proportions (*Mammaria echinobutryiodes* (3%), *Cladorrhinum foelundisimum* (4%), *Oidiodendron echinulatun* (4%), *Idriella lunata* (4%), *Ryparobius polysporous* (6%), *Rhizopus sp.* (16%), *Celphalosporium acremonium* (7%), *Aspergillus niger* (21%), *Cladosporium sp.* (30%), *Mucor sp.* (34%) and *Penicillium notatum* (41%) may be influence by sanitation process and number of patients present in the hospitals at different days. From the fungi count, *Penicillium notatum* (41.428571%) have the highest proportion.

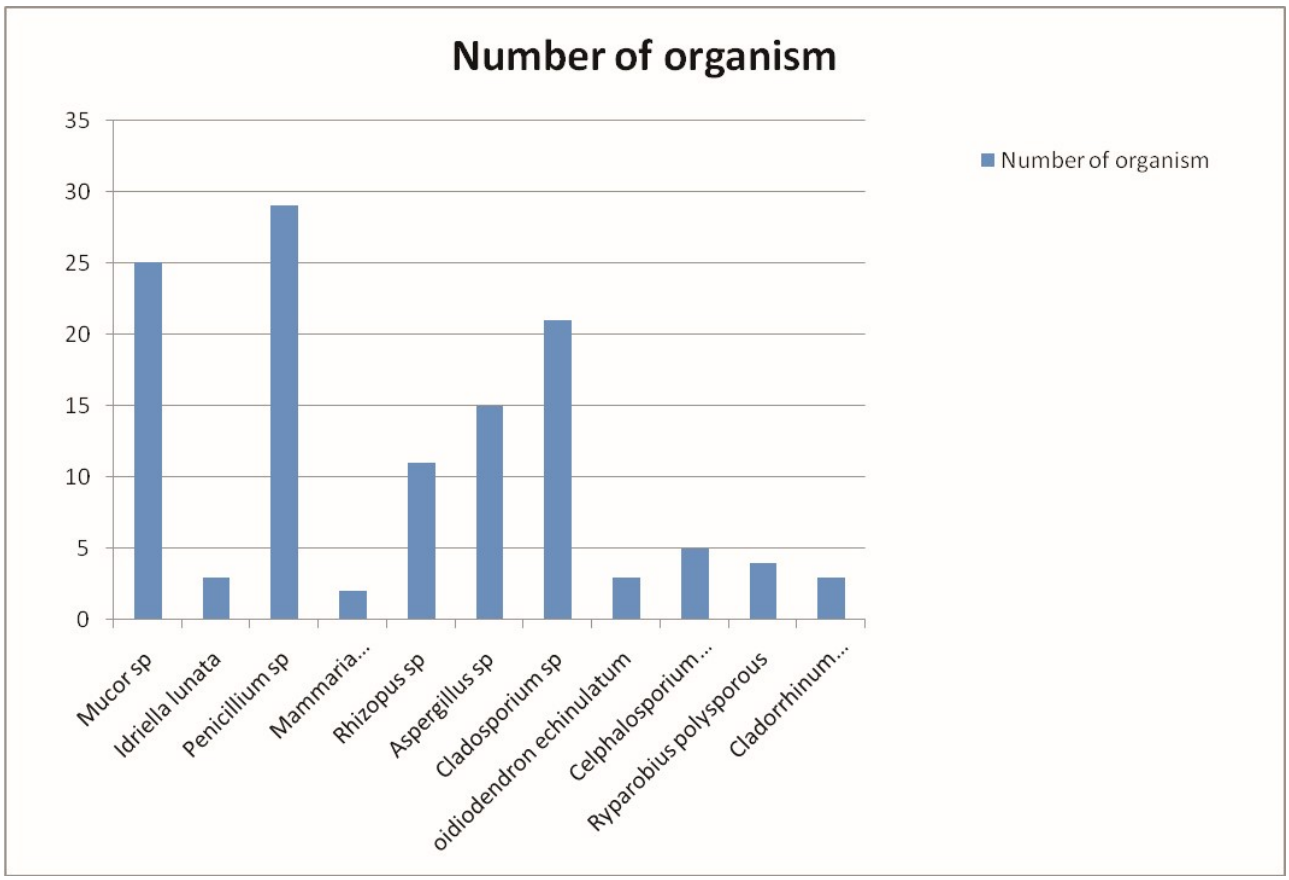

Figure1. Bar chart showing the total number of species recovered from the samples.

In this study, airborne infection particle in Specialist Hospital Idah setting span wide range of sizes and varies in concentration in weeks (first week fungal count was 65 in total and the second week fungal count was 55 in total). This can give a clue about the sanitary condition of the wards. According to Ekhaise and Ogboghodo (2011) finding, they noted that the number and types of airborne microorganisms can be used to determine the degree of cleanliness of an area or environment.

CONCLUSION

In this finding, the aeromycological inventory of indoor air of Specialist Hospital Idah was achieved, showing presence of fungi in indoor air with identification of 11 organisms (*Mammaria echinobutryiodes* (3%), *Cladorrhinum foelundisimum* (4%), *Oidiodendron echinulatun* (4%), *Idriella lunata* (4%), *Ryparobius polysporous* (6%), *Rhizopus sp.* (16%), *Celphalosporium acremonium* (7%), *Aspergillus niger* (21%), *Cladosporium sp.* (30%), *Mucor sp.* (34%) and *Penicillium notatum* (41%). The proportion of fungi in indoor air at Specialist Hospital Idah is not the same within the periods of investigation.

REFERENCES

Adil, H., Ahmad, U., Ijaz, K., Izar, A., Tahir, A. K., Muhammad, N., Junaid, A. S., Zaheeer, U. D., Abdul, M. K. and Beenish, N. (2015). Aerobiological Sudy of Shaheed Benazir Button Teaching Hospital Abbottabad. *International Journal of Scientific and Engineering Research, 6(12): 2—7.*

Agwaranze, D. I., Ogodo, A. C., Ezeonu, C. S., Brown, S. T. C., Nwaneri, C. B. and Husie, L. M. (2020).

Microbiological Assessment of Indoor and Outdoor Air Quality in a General Hospital in North East Nigeria. *Journal of microbiology*, 15: 9—14.

Deweili, E. J, and Chin, S. Y. (2019). Airborne Fungi and Mycotoxin. *Journal of Air*, 3**(2)**: 5—2.

Ekhaise, F. O. and Ogboghodo, B. (2011). Microbiological Indoor and Outdoor Air Quality of two major Hospitals in Benin-city, Nigeria. *Journal of Biomedical Research*, 3: 69—174.

Fernstorm, J. D., Langham, K. A., Marcelino, L. M., Irvine, Z. L., Fernstrom, M. H. and Walter H. K. (2013). The ingestion of different dietary proteins by humans induces large changes in the plasma tryptophan ratio, a predictor of brain tryptophan uptake and serotonin synthesis. *Elsevier,* 32 **(6)**: 1073-1076

José, M. R. Y., Roberto, A., Ramón, F. A., María, C. E. and Raymundo, R. B. H. (2012). Aeromycological Study at the Intensive Care Unit of the "Dr. Manuel GeaGonzalez General Hospital." *The Brazilian Journal of Infectious Disease, 16**(5)**: 432—435.*

Levetin, E. (2021). Contribution of Leaf Surface Fungi to the Air Spora. *Aerobiologi,* 22: 3—12.

Negin, K., Sepideh, P., Abbas, S. M. and John, K. (2019). Environmental Factors Influencing Fungal Growth on Gypsum Boards and their Structural Biodeteroriation. *Plos One,* 14**(8)**: 220—256.

Nimisha, T. N., Raghu, N. K., Ravi, S. and Amit, V. (2018). Microbial Spores: Concepts and Industrial Applications, Microbial Bioprospecting for Sustainable Development. *National diary research institute*, 15, 279—289.

Odebode, A. and Adekunle, A. (2020). Airborne Fungi Spores Distribution in various Location in Lagos, Nigeria. *Environmental Monitoring and Assessment*, 192:5—10.

Acknowledgement: My sincere appreciation goes to the Chief Medical Director of Specialist Hospital Idah for granting us the privilege to carry out this research in their institution.

Conflict of interest: There is no conflict of interest.