International Journal of Applied Sciences: Current and Future Research Trends
(IJASCFRT)
ISSN: 2790-3990
https://ijascfrtjournal.isrra.org/index.php/Applied_Sciences_Journal

Fungal Contamination and its Distribution in Cafeteria Surfaces: Study from the College of Education for Girls, University of Baghdad

Ibtesam Hameed Jadoa*

Ministry of Education, The second Karkh,Al-Taqwa Preparatory School for Girls,Baghdad 10011,Iraq
Email:e-ibtisam.hameed1202a@ihcoedu.uobaghdad.edu.iq

Abstract

This research was carried out to detect the level of fungal contamination on some surfaces in cafeteria College of Education for Girls, University Baghdad. Fungal contamination was identified and enumerated in a total 514 dust samples collected from chairs, tables, table clothes and containers; these results were expressed as colony-forming units per cubic meter (CFU m-1). Aspergillus niger, Penicillium sp., and Cladosporium spp. were the three most abundant fungal species in all samples. Total fungi in the first set of samples were counted up to 242 CFU. m-1, and Aspergillus niger was the most common fungus identified (76.4% of total fungi). In the second group of samples, the level of fungal contamination was higher and included 500 CFUE. m-1, where Aspergillus sp. represented the other 72.3%). The third set had the least amount of contamination, giving an average 283 CFU. The proportion of Aspergillus showed a slight decrease by m-1, but it was still unchanged with 42.4% in total (Table This study highlights the health risks that may exist in public spaces such as a cafeteria due to fungi specifically A. niger, which implies better sanitation strategies are needed to reduce exposure and related contamination hazards.

Keywords: Aspergillus niger; Cafeteria hygiene; Cladosporium sp; Colony-forming units (CFU); Fungal contamination; Penicillium sp; Public health; Surface contamination; Sanitation practices.

Received: 9/1/2024
Accepted: 11/1/2024
Published: 11/11/2024

---

* Corresponding author.

1. Introduction

Fungi are the heterogeneous group of microorganisms and sustain on various environments. These are naturally-occurring creatures belonging to the environment The air, soil, water and surfaces has always been their own habitat[1]. Fungi are important both as symbionts and parasites of animals often causing diseases, decomposition or spoilage in humans living habitats[2]. Their spores are readily aerosolized and subsequently contaminate stored foods, work surfaces like cutting boards or silverware, as well our more hands-on approaches to preparing food. Gastrointestinal contributions of Fungi from the Museum cafeteria means a big crisis to public health [3].

Most public health concerns about fungi have to do with the negative effects of molds[4]. Many fungi, such as the indoor fungal species Aspergillus and various Penicilliums or Cladosporium are able to elicit allergic reactions in addition respiratory problems (Medical Mycology: The Year of Nano) [5]. And sometimes they could also cause invasive mycosis (mainly in the immunocompromised) Aspergillus niger is one of the most common species among them located in contaminated environments [6]. It can live under various conditions and is frequently conected with polluted food, hence leading to the spoilage of foods as well as possible health risks[7]. This species produces mycotoxins which can see an escalation to respiratory issues such as asthma or continue and result in long-term health problems if it is breathed over a period of time [8].

Cafeterias and other food-serving establishments create optimal environments for fungi to grow and be transmitted, because they provide the necessary moisture content, organic material support (e.g. prepared tomato sauce) and are places in which human intervention is constant during the day [9]. The air known to carry fungal spores, will essentially lay those living things on a variety of surfaces such as: tables, chairs and containers-especially in spaces that are not kept clean or have robust ventilation systems[10]. For example, suppose there are surfaces that come in frequent contact with food or human hands; they will tend to harbor growths if not properly disinfected(Fungi Count in first section). Research has shown that the fungal load in these environments varies depending on cleaning practices, season, and environmental factors [11]. The indoor humidity level can, for example, considerably tip the scale towards a prevalence of fungi because they love damp environments[12].

This study has two aims; to determine the levels of fungal contamination on different surfaces in cafeteria at college for girl Education University of Baghdad, and secondly evaluation The predominant genus. This study specifically considers chairs, tables and food containers over other surfaces as they are moving hands consistently and hence may have a tendency of having microbial contaminants. Quantification of Fungal colonies and colony forming units per cubic meter (CFU/m3) m99), which is an indicator commonly employed to estimate the degree of microbial pollution for environmental exploration. Through this evaluation of both the types and amounts of fungal species existing, we hope to gain an indication as whether these levels hold potential health risks for the occupants in such a communal setting.

Our data inform about the abundance and community structure of fungi in cafeterias, which is important for establishing hygienic standards related to public food serving areas. Previous studies in comparable

environments have shown that the levels of fungal contamination are frequently higher than expected, which highlights the importance regular and comprehensive practice for cleaning to be maintained. The detection of harmful species, such as Aspergillus niger, emphasizes the necessity for focused sanitation approaches and should be directed at particularly vulnerable sites where food or people make direct contact to surfaces. Furthermore, public spaces have fungi that can help in grease the wheels of identifying an index for indoor air quality and surface cleanliness which is indispensable to maintain a safe environment for the masses Coyle hopes that, aside from pin-pointing the fungi there and their amounts present in the cafeteria of your average lunch scientist, this work serves as a wider heads-up for our future fungus-filled lives. The researchers hope their results will lead to guidance on improved sanitation policy and possibly stricter cleaning procedures for the health risks caused by household fungal contamination. The research also highlights the necessity of on-going food- serving environments' microbial contamination survey to insure public health.

2. Materials and Methods

2.1. Study Area

This study was carried out at the college of education for girls cafeteria / University of Baghdad. Because it is where most students and staff eat, fungal contamination in the cafeteria must be addressed before more serious health problems occure. The cafeteria of the Facility was chosen for sampling because it is a common place where different staff and team members come to eat every day hence replicating transmission within the facility. Samples were collected from hard-to-clean/sharing objects used by all employees present there like chairs, tables and food containers (these are high-touch surfaces commonly touched in daily opeational activities).

2.2. Sample Collection

Samples of fungus were collected from three different surface types: chairs, tables and containers. Sampling was conducted three times to allow for within-season variability in fungal contamination. The same, however for object samples swabs that were all sterile and rubbed over the surface area of 10 cm^2. After collection, swabs were immediately placed in sterile tubes and suspended with 10 mL of saline solution to preserve the samples for laboratory analysis[13].

2.3. Fungal Culture and Identification

The samples were tested in the microbiology lab immediately upon arrival. All of the fungal strains were plated on Potato Dextrose Agar (PDA) a widely used growth medium for cultivating fungi. The plates were incubated at 25°C for 5±7 days so that fungal colonies Were apparent. After the incubation period, fungal colonies were then counted and identified by morphological characteristics of colony and pigmentation. CFU.m-1 colony forming units was quantified to determine the fungal load in each sample [14].

2.4. Fungal Species Identification

Confirmation of fungal species new cultures were verified for identification based on visual colony characteristics and microscopic examination [15]. The identification of the genera and species was based on

characteristics like spore size, shape, color and growth character. The main fungi found were Aspergillus niger, Penicillium sp., Cladosporium sp., Alternaria ssp and yeast among others. These fungi were compared with reference cultures and identification manuals for confirmation[16].

2.5. Data Analysis

Fungal count of each sample was calculated as CFU. m-1. The sums of the CFU for each fungal species per surface type (chairs, tables and containers) were determined. We also calculated the normalized percent contribution of each species to fungal load, which allowed us to make inferences on what fungi are globally most abundant across different surfaces [17]. Data from all 3 sampling occasions were pooled and compared, to provide an overview of the extent of fungal contamination between different time-points.

2.6. Statistical Analysis

Total fungal counts and percentage of individual species were summarized using descriptive statistics. The total fungal count (CFU. The numbers of individuals per surface (0 m−1, 4.5-m-1/for each habitat were averaged over the three sampling occasions The percentage of the total fungal count for each surface type, which was represented by abundance levels were performed on a per species level. An examination of contamination rates at the level of chairs, tables and containers was also conducted to determine where most heavily contaminated mycotic material may be located.

2.7. Quality Control

All the procedures to align and recruit all the species were perfomed under sterility for preservation of correct associations with a reduced risk contamination. Control experiments were employed to confirm the absence of airborne contamination during sample collection and culturing. The laboratory environment passively monitored background contamination to determine if collected fungal evidence were the result of specific surface samples or part of a general (background) environmental load[18].

3. Results

The present study aimed to assess the ambient fungal contamination of the cafeteria located in college of education for girls/university Baghdad, Iraq on three surface types: chairs, tables and containers. Fungal counts were reported in colony-forming units per cubic meter (CFU. m-1). The fungi identified were Aspergillus niger, Penicillium sp., Cladosporium sp., Alternaria sp.; and yeasts. Details of each sampling event are given in the following.

3.1. Fungal Contamination on Chairs, Tables, and Containers

The study indicated that Aspergillus niger species was the most abundant type across all surfaces and chairs typically have 120 CFU for this fungus (the highest copy number) which composed flagship of general fungal count on these objects. The most globally contaminated were the chair (172 CFU), due to repeated handling.

Tables and containers had an average of 70 CFU (range, <10 to >100) and 60 CFU (range, <10–>100), respectively; again Aspergillus niger was the primary cause of contamination on these surfaces. Other species, Penicillium sp. and Cladosporium sp. and Rhizopus sp. were also present but in substantial less proportion and Trichoderma sp. became little more than the odd seat — completely marginalized. Among fetems, low-level yeast was the only other indicator detected (on surface tables and containers).

The second sample shows a substantial increase in fungal contamination compared to the first sample. Chairs exhibited a marked rise in contamination, with a total CFU of 315, largely driven by Aspergillus sp., which reached 250 CFU. Tables also showed an increase in contamination (115 CFU), with Aspergillus sp. contributing the majority (70 CFU). Containers had similar contamination levels to the first sample (70 CFU), but Penicillium sp. contributed a significant portion of the fungal load on containers. This sample highlights Aspergillus sp. as the dominant fungal species across all surfaces, indicating that environmental conditions during this sampling event may have favored the growth of this particular species. The presence of Cladosporium sp. and yeasts, although still present, was less prominent than in the first sample.

In the third sample, total fungal contamination levels dropped on chairs (106 CFU) and tables (29 CFU), but contamination levels on containers increased significantly (148 CFU), driven by a high count of Aspergillus niger (80 CFU). This sample shows a more balanced distribution of fungal species, with yeasts, Penicillium sp., and Alternaria sp. also contributing significantly to the fungal load, particularly on containers. The lower counts on chairs and tables may indicate improved cleaning practices during the sampling period or environmental factors that were less conducive to fungal growth. However, the significant contamination of containers suggests that these surfaces may be more prone to fungal growth due to their material or usage as shown in figure 1.

Tables 1-3 present the fungal count (CFU.m-1) for each species identified on chairs, tables, and containers across three sampling events.

Table 1: Fungal Count (CFU.m-1) in the First Sample for Chairs, Tables, and Containers

Surface	Fungal Species	CFU (Chairs)	CFU (Tables)
Penicillium sp.	35	10	15
Cladosporium sp.	10	5	2
Alternaria sp.	3	3	0
Rhizopus sp.	3	0	0
Aspergillus niger	120	40	60
Yeast	5	2	0
Trichoderma sp.	2	0	0
Total	172	70	60

Table 2: Fungal Count (CFU.m-1) in the Second Sample for Chairs, Tables, and Containers

Surface	Fungal Species	CFU (Chairs)	CFU (Tables)
Cladosporium sp.	50	15	5
Alternaria sp.	5	0	0
Aspergillus sp.	250	70	40
Penicillium sp.	30	0	25
Yeast	10	0	0
Total	315	115	70

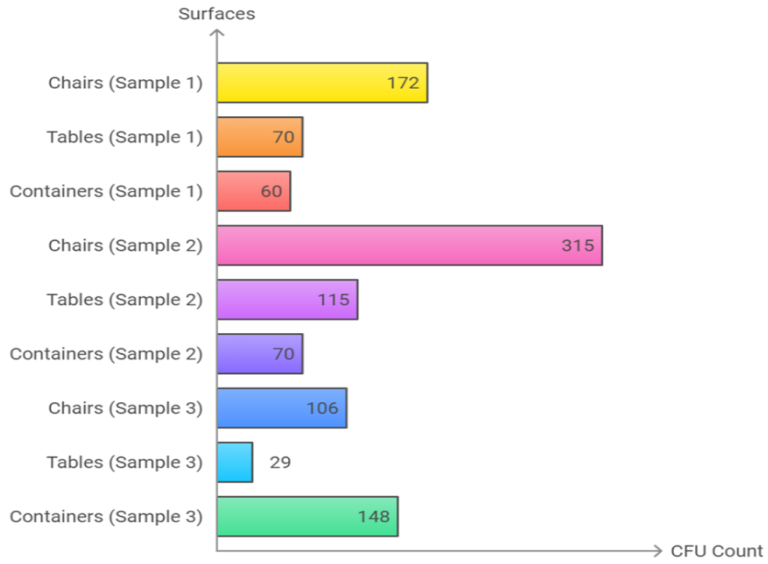

Figure 1: Fungal Contamination Levels Across Surfaces

Table 3: Fungal Count (CFU.m-1) in the Third Sample for Chairs, Tables, and Containers

Surface	Fungal Species	CFU (Chairs)	CFU (Tables)
Yeast	8	12	15
Mycelia sterilia	3	2	0
Penicillium sp.	25	10	35
Cladosporium sp.	5	5	8
Alternaria sp.	30	0	10
Aspergillus niger	40	0	80
Total	106	29	148
Surface	8	12	15

3.2. Total Fungal Count Across All Samples

The most prevalent fungus that infested all samples regardless of the surface was Aspergillus niger, representing 76.4% of fungal load in the first sample (Table 4). Penicillium sp. the second abundant species, 13.2% of the

total fungi other fungi, e.g. Cladosporium sp. yeast…, contributed much smaller percentages. Such distribution could indicate that A. niger was enjoyed the most from whatever environmental conditions would have been present at time of sampling (e.g humidity scores, relative air speed etc.)

Aspergillus Sp. was found in the second sample accounted for 72.3% of all fungi in the ecosystem Cladosporium sp. and Penicillium sp. composing 14.1% and 11.0%, respectively, In total fungal load this sample had the most amount (500 CFU) and maybe related to environmental conditions, possibly more humidity or insufficient cleaning during time of sampling. Alternaria sp. was present and yeast was minimal giving an indication of high dominance by Aspergillus sp. in this sample.

However, the third sample is particularly more biased in taxa due to a better evenly distribution of fungi species as compared with that from samples 1 and 2. To our knowledge, A. niger continued to be the main contributor (42.4%) followed by other species such as Penicillium sp., etc (24.7%) and Alternaria sp. (14.1%), also started with high levels of four isoflavones The shift in the distribution of species could result from modification in environmental conditions or an uneven surface contamination inventory. The increase in Candida(12.4%) present,demonstrates that due to the extreme factors of isolation there were good conditions for yeast growth; likely on containers, where several fermentable and metabolic products are found useful as nutrient source. Figure 2. In Tables 4–6, the total fungal count for each sample is expressed and gives an overview of the percentage distribution of fungi within all measurements.

Table 4: Total Fungal Count (CFU.m-1) in the First Sample

Fungal Species	CFU	Percentage (%)
Aspergillus niger	185	76.4
Penicillium sp.	32	13.2
Cladosporium sp.	11	4.5
Yeast	4	1.7
Alternaria sp.	2	0.8
Other species	8	3.4
Total	242	100

Table 5: Total Fungal Count (CFU.m-1) in the Second Sample

Fungal Species	CFU	Percentage (%)
Aspergillus sp.	360	72.3
Cladosporium sp.	70	14.1
Penicillium sp.	55	11.0
Alternaria sp.	5	1.0
Yeast	10	2.0
Total	500	100

Table 6: Total Fungal Count (CFU.m-1) in the Third Sample

Fungal Species	CFU	Percentage (%)
Aspergillus niger	120	42.4
Penicillium sp.	70	24.7
Yeast	35	12.4
Alternaria sp.	40	14.1
Cladosporium sp.	13	4.6
Mycelia sterilia	5	1.8
Total	283	100

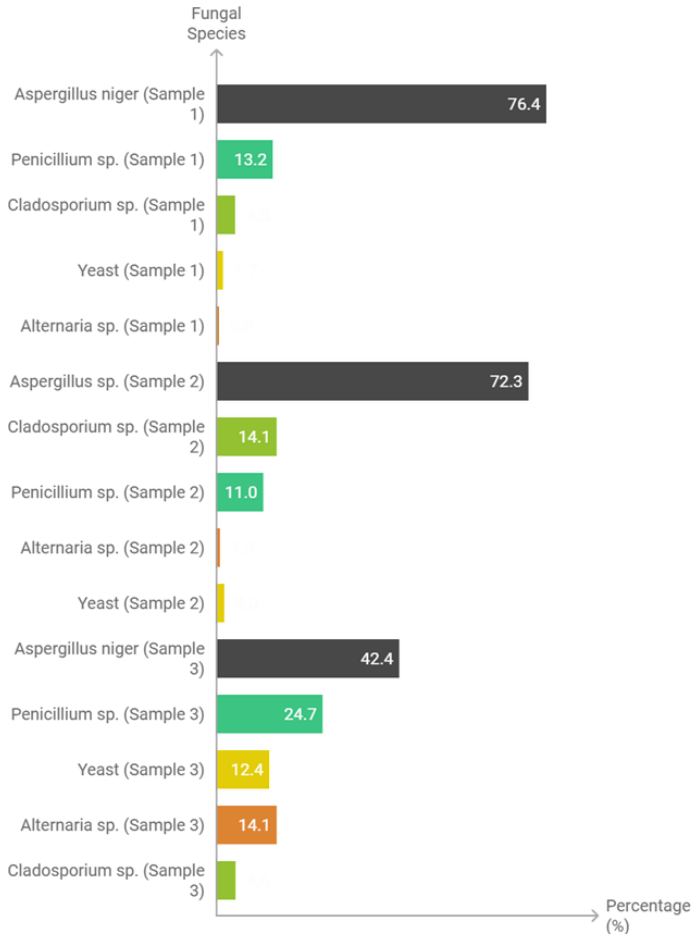

Figure 2: Fungal Species Distribution Across Samples

One important thing the study unravelled was that, in all samples analysed, fungus Aspergillus niger ruled supreme and possessed a larger population compared to some other fungi present on chairs or containers. The fungal load fluctuated in the different sampling occasions and can be caused by environmental aspects like humidity, temperature or cleaning practices. Containers had a significantly higher rate of fungal contamination, especially within the third sample set signaling that such surfaces should be included in specific cleaning protocols. This is to emphasize the need for adequate routine cleaning in order to alleviate fungal bio-burden

and prevent potential health risks due exposure of fungus in communal areas.

4. Discussion

The outcomes of the present study point out a high fungal pollution in one-of-a-kind websites on this canteen of university college for women, Baghdad. Aspergillus niger and Penicillium sp. were the most common in CF patients (14/25[56 %] vs 6/32[19 %]). comprised 76.4% of the total fungal counts (highest % among all) in the first sample and, although reduced to a lower level achieved by another Aspergillus sp., still made up for considerable portion (42. The dominance of this genus is worrisome because fungi of different species from the Fungi kingdom, particularly in immunocompromised individuals, are well-known to trigger strong negative health outcomes that range from allergic reactions and respiratory issues to invasive infections [19]

Total CFU was different among the three collections of samples, being higher in second sample (500 CFUs. m-1), conforming the first (242 cfu. m-1) and third (283 CFU. m-1) samples. Possible factors contributing to this variability might be the influence of environmental variables like humidity, temperature and cleaning frequency in between samples. Among the various conditions, humidity especially contributes to fungal proliferation. Cafeterias are perfect fungal corner because of wet environment being maintained by frequent spills and dropped plates[20].

4.1. Fungal Species Distribution

Across the different surfaces, chairs consistently showed the highest levels of fungal contamination, especially in the second sample, where Aspergillus sp. alone reached 250 CFU.m-1. This indicates that chairs, which are in constant contact with users, are likely to harbor high fungal loads. The contamination on tables and containers, though lower, still presents a health risk, particularly since these surfaces come into direct contact with food and utensils. Previous studies have reported similar findings, where chairs and other frequently touched surfaces exhibited higher microbial contamination due to continuous handling[21].

Interestingly, the presence of Penicillium sp. was also notable, particularly in the third sample (24.7%), where its count was second only to Aspergillus niger. Penicillium species are known to be common indoor contaminants and, while they are less harmful than Aspergillus, prolonged exposure can still lead to allergic reactions or infections. Their significant presence in this study underscores the importance of thorough cleaning and disinfection practices in public spaces[22]

Yeasts were also present in moderate quantities, especially in the third sample (12.4%). Although yeasts are generally less harmful than filamentous fungi like Aspergillus and Penicillium, their presence in food-serving areas could still pose contamination risks. Yeasts can cause spoilage of food products, making their control essential in environments where food is prepared and consumed[23].

4.2. Implications for Public Health and Hygiene

This emphasizes that strict hygiene measures are necessary within the cafeteria since we found high fungal

counts. An especially alarming discovery was that Aspergillus niger which pose a severe threat to human health in high volumes, could cause life-threatening complications including allergic bronchopulmonary aspergillosis (ABPA) and invasive aspergillosis. This causes a lot of fungal exposure to healthy as well as weak immune individuals in buildings [24].

This one lines up pretty close to the key findings of this study — and that is we have a serious problem with our cleaning protocols. The magnitude of variation in counts is indicated by the significant differences between sample groups and indicates that inconsistencies with cleaning practices may explain some of this variability. Cafeterias must impose regular cleaning regimeFungi Count in first s… Furthermore, proper ventilation in confined spaces like cafeterias may decrease the amount of airborne fungal spores flying around indoors.

4.3. Limitations and Future Research

This study has a number of potential strengths in terms understanding fungal levels, as well as some limitations applicable to all observational studies on public cafeteria [10]. One, the study in one location which may not reflect other settings. There was a lack of systematic measurement for environment factors, including humidity and temperature that is important in providing an indication on the favoured situation needed for fungal growth. Additional research should be conducted with multi-sites samples and environmental conditions) in public places to broaden our understanding of fungal instances.

Future research avenues may additionally consider the application of more sophisticated fungal identification tools, e.g., molecular techniques to enable a deeper insight into the identified fungi. This would narrow down on any specific pathogenic strains based and give an improved assessment of the health risks that come with it.

5. Conclusion

In this study, the detection of fungal contamination on some surfaces frequently touched in cafeteria at College of Education for Girls / Baghdad University were investigated which include chairs, tables and containers. Indeed, Aspergillus niger and Penicillium sp. were selected as potential isolates for further investigation in the bioleaching of nickel ore due to their growth performance under submerged conditions on low-grade ores [34]. dominated the three sampling events where Aspergillus niger was significantly responsible for a substantial proportion of total mycoflora count, specifically in sample (1st = 76.4%; followed by second [2nd] =72.3%).

The fungal counts on surfaces and in samples (in terms of CFU) differ significantly between the different methods—chairs are invariably the most contaminated, located at 315CFU .m-1 making this highest initial count. in the second sample. The highest level of fungal contamination occurred in the third sample (148 CFU.m-1, $p < 0.05$), particularly for containers(EXPR_149)., largely Aspergillus niger (80 CFU. m-1). Tables had the lowest degree of contamination possibly but still were an important source of fungi.

Furthermore, insights into the nature and strength of horizontal transmission within cafeterias including high fungal counts on chairs and containers highlight crucial areas where hygiene control could be improved. Such a vast presence of Aspergillus niger (which is problematic for anyone with respiratory issues or whose immune

system may be compromised) should demonstrate the necessity and importance that clinics maintain proper cleaning, disinfection protocols.

Finally, the results of this study will serve as an important reference since extensive and systematic cleaning together with the well-ventilated area is necessary to minimize fungal contamination in environments where food serving is occurring. This may be followed by future research to explore the environmental conditions associated with fungal growth in cafeterias, and application of advanced molecular techniques for pathogenic strain-level identification since it is only these strains that would potentially cause higher health risks.

References

[1] Jha, Y., 2024. Differential fungal metabolite accumulation in response to abiotic and biotic stresses. In Fungal Secondary Metabolites (pp. 457-467). Elsevier.

[2] Yiallouris, A., Pana, Z.D., Marangos, G., Tzyrka, I., Karanasios, S., Georgiou, I., Kontopyrgia, K., Triantafyllou, E., Seidel, D., Cornely, O.A. and Johnson, E.O., 2024. Fungal diversity in the soil Mycobiome: Implications for ONE health. One Health, p.100720.

[3] Obayori, O.S., 2023. Indoor and outdoor aeromicrobiology. In Aeromicrobiology (pp. 59-88). Academic Press.

[4] Caillaud, D., Keirsbulck, M., Leger, C., Leynaert, B. and Outdoor Mould ANSES Working Group, 2022. Outdoor Mold and respiratory health: state of science of epidemiological studies. The Journal of Allergy and Clinical Immunology: In Practice, 10(3), pp.768-784.

[5] Devi, R., Kaur, T., Kour, D., Rana, K.L., Yadav, A. and Yadav, A.N., 2020. Beneficial fungal communities from different habitats and their roles in plant growth promotion and soil health. Microbial Biosystems, 5(1), pp.21-47.

[6] Belizario, J.A., Lopes, L.G. and Pires, R.H., 2021. Fungi in the indoor air of critical hospital areas: a review. Aerobiologia, 37(3), pp.379-394.

[7] Akinsemolu, A.A. and Onyeaka, H.N., 2024. Microorganisms Associated with Food Spoilage and Foodborne Diseases. In Food Safety and Quality in the Global South (pp. 489-531). Singapore: Springer Nature Singapore.

[8] Fagade, O.E., Adelowo, O.O., Adesokan, H.K., Nwadike, B.I. and Adekanmbi, A.O., 2023. Airborne prokaryotes and toxins. In Aeromicrobiology (pp. 177-204). Academic Press.

[9] Bhatia, M. and Ahanger, T.A., 2021. Intelligent decision-making in smart food industry: quality perspective. Pervasive and Mobile Computing, 72, p.101304.

[10] Li, X., Liu, D. and Yao, J., 2022. Aerosolization of fungal spores in indoor environments. Science of

The Total Environment, 820, p.153003.

[11] Owusu-Apenten, R. and Vieira, E., 2022. Food safety and sanitation. In Elementary food science (pp. 197-215). Cham: Springer International Publishing.

[12] Guarnieri, G., Olivieri, B., Senna, G. and Vianello, A., 2023. Relative humidity and its impact on the immune system and infections. International Journal of Molecular Sciences, 24(11), p.9456.

[13] Chandratre, G.A., 2023. Collection, Preservation, Processing, and Dispatch of Clinical Material of Goats. Principles of Goat Disease and Prevention, pp.49-61.

[14] Nyang'au, M.N., Akutse, K.S., Fathiya, K., Charimbu, M.K. and Haukeland, S., 2023. Biodiversity and efficacy of fungal isolates associated with Kenyan populations of potato cyst nematode (Globodera spp.). Biological Control, 186, p.105328.

[15] Selva Pandiyan, A., Siva Ganesa Karthikeyan, R., Rameshkumar, G., Sen, S. and Lalitha, P., 2020, November. Identification of bacterial and fungal pathogens by rDNA gene barcoding in vitreous fluids of endophthalmitis patients. In Seminars in Ophthalmology (Vol. 35, No. 7-8, pp. 358-364). Taylor & Francis.

[16] Jampílek, J. and Kráĺová, K., 2020. Impact of nanoparticles on toxigenic fungi. In Nanomycotoxicology (pp. 309-348). Academic Press.

[17] Savković, Ž., Stupar, M., Unković, N., Ivanović, Ž., Blagojević, J., Popović, S., Vukojević, J. and Grbić, M.L., 2021. Diversity and seasonal dynamics of culturable airborne fungi in a cultural heritage conservation facility. International Biodeterioration & Biodegradation, 157, p.105163.

[18] Zahran, S., Mannocci, F. and Koller, G., 2022. Impact of an enhanced infection control protocol on the microbial community profile in molar root canal treatment: an in vivo NGS molecular study. Journal of Endodontics, 48(11), pp.1352-1360.

[19] Oliveira, M., Oliveira, D., Lisboa, C., Boechat, J.L. and Delgado, L., 2023. Clinical manifestations of human exposure to fungi. Journal of Fungi, 9(3), p.381.

[20] Shourie, A., Girdhar, A., Singhal, K., Rawat, C. and Chapadgaonkar, S.S., 2024. Biocontaminants in Indoor Environments: Occurrence, Spread, and Prevention. Airborne Biocontaminants and Their Impact on Human Health, pp.1-25.

[21] Ugwu, C.C., Ezugwu, R.I. and Anthonia, O.C., Assessment Of Bacterial Colonization Of Office Door Handles And Palms Of Students In A University Faculty Building.

[22] Bueno de Mesquita, P.J., Delp, W.W., Chan, W.R., Bahnfleth, W.P. and Singer, B.C., 2022. Control of airborne infectious disease in buildings: Evidence and research priorities. Indoor Air, 32(1),

p.e12965.

[23] Riesute, R., Salomskiene, J., Moreno, D.S. and Gustiene, S., 2021. Effect of yeasts on food quality and safety and possibilities of their inhibition. Trends in Food Science & Technology, 108, pp.1-10.

[24] Brambilla, A. and Sangiorgio, A., 2020. Mould growth in energy efficient buildings: Causes, health implications and strategies to mitigate the risk. Renewable and Sustainable Energy Reviews, 132, p.110093..