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Investigation on the Comparative Diversity and Public Health Significance of Soil and Air Mycoflora of Federal University of Technology Campus, Akure, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author AKO designed the study, authors AKO and FOO supervised the study. Authors OIA, POF, TFA and LEI performed the statistical analysis and wrote the first draft of the manuscript. Authors OA, DOA, ABO, APO, ICA, AAA, HJA and JEO wrote the protocols and managed the analyses of the study. Authors OL, TAA, DM, AA, OBF and MOA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A descriptive cross-sectional study was carried out to comparatively investigate the soil and air mycoflora of selected densely populated locations within the Federal University of Akure (F.U.T.A) Campus. Isolation of fungi from soil and air was done for each sample point using pour plate and

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exposed air techniques respectively according to specified World Health Organization standards. The mean total mycelial counts (TMC) for soil (10.75±1.25 Sfu/ml) was significantly ($p<0.05$) different from that of air (6.25±1.75 Sfu/ml). Fungal isolates were identified by comparing the macro-morphological (cultural) and micro-morphological characteristics of different isolates obtained with the available literature. A total of 15 different fungal isolate types were identified from both soil and air across the sampling points, they include: *Fusarium avenaceum*, *Byssochlamys nivea*, *Candida albicans*, *Engyodontium album*, *Aspergillus flavus, Fusarium oxysporum, Alternaria infectora*, *Chaetomium globosum*, *Rhizopus oryzae*, *Mucor circinelloides*, *Aspergillus fumigatus*, *Aspergillus niger, Mucor racemosus*, *Acremonium strictum*, and *Aspergillus parasiticus* respectively with *Aspergillus niger* been the highest occurring fungal isolate of public health importance. The possible health implications of the findings of this study were fully discussed in relation to sample points where each isolate predominantly occurred as potential risks or threat of mycotoxicoses, subcutaneous mycoses and systemic mycoses in each sample point were fully discussed. Proper waste disposal habits are however recommended across different sample locations to reduce potential risk incidence of mycotic infections and food poisoning among respondents.

Keywords: Soil; air; mycoflora; mycotoxicoses; mycoses; public health.

1. INTRODUCTION

The system of the soils is extremely complex, having many constituent playing varied functions mainly due to the activity of soil organisms [1,2]. Different microorganisms are involved in several biochemical transformation and mineralization activities in soils due to which the soil fertility and plant growth increases [1-3]. In the activity of soil, micro flora along with the type of cultivation carried out and subsequent crop management can have profound effects [2,3]. For the soil ecosystem, resident fungi are very vital and play a key role in many essential processes such as elemental release by mineralization and organic matter decomposition [1,3]. The fungi also constitute major group of organotrophic organisms responsible for the decomposition of organic compounds and their activity contributes in the bio-deterioration and biodegradation of toxic substances in the soil [2-4].

Fungi are eukaryotic heterotrophic spore bearing organism which have no chlorophyll and they can reproduce asexually and sexually [3-5]. Most of the fungi producing diseases in human beings and animals directly arise from infected people (anthropophilic organisms), animals (zoophilic organisms), and soil (geophilic organisms), and indirectly from formites early in an environment as soil saprophytes [1-5]. The air however also serve great potential as a reservoir of fungal spore forms and thus much similarities and correlation usually exist in the aeromycoflora of different areas when compared with the soil mycoflora of the same areas [5-7]. It has also been discovered by many recent findings that while many more fungi vegetative forms are resident in the soil, only spore forming fungi types are naturally found in the air [6-8]; however, some studies also suggests that human activities may also lead to the suspension of non-spore forming vegetative fungal isolates units in the air [6-9].

Many recent findings have also suggested with wide ranging proofs the connection between observed soil and air mycoflora of different densely populated areas or converging points across many major cities and towns and the potential public health risks the arrays of fungi that constitute these mycoflora may constitute for the areas under study [1,3-5,7]. Much of these findings have been related more often than not with the sanitary practices of the areas which may be under study [1-3]; thus many recent research findings conduct air and soil mycoflora investigations by adopting comparative cross-sectional study designs in order to relate findings of research to public health significance and arrive valid conclusions [6,7].

The Federal University of Technology, Akure Campus is located on a vast expanse of land in Akure, Ondo State capital in Nigeria [10]; however, unwholesome sanitary practices of campus residents and poor waste disposal habits of food vending joints had spurred scientific interest into the investigation of soil and air mycoflora of selected strategic locations of public health importance across the campus. We aimed at proving by our findings whether these unwholesome health practices of respondents at these strategic positions play a role in the

comparative fugal biodiversity of these areas and to what extent our results will impact public health situations in the areas. Hence, this study aims at investigating the air and soil mycoflora of the Federal University of Akure Campus with emphasis on the public health implications of the findings of this research and to possibly raise awareness for improved sanitary levels and health practices across the different major densely populated locations of the campus that are of public health significance.

2. MATERIALS AND METHODS

2.1 Description Study Area

The Federal University of Technology, Akure is found in Ondo State, Nigeria with coordinates 7°16' N 7°18' N/ 5°9' E 5°11' E [10]. It is located at the extreme southern region of the Akure South Local Government Area of Ondo state, Ondo State capital with an estimated population of about 35,000 (students, staffs and inhabitants inclusive) [10].

2.2 Sampling Points in the Study Area

The densely populated areas, converging points and residential quarters (car parks, hostels, faculty complexes, Health center, food vending joints, lecture halls and walk ways) in the campus were considered as case studies for comparative study. A total of 10 densely populated and converging points were under study focus for this research, these are: Akindeko Hostel (A), Obakekere Shuttle Park (B), Obakekere Staff Quarters (C), Obakekere Food Canteen (D), Obakekere Central Mosque (E), School of Sciences/School of Agriculture complex (F), School of Management Technology/ School of Earth and Mineral Sciences complex (G), School of Postgraduate Studies/ School of Environmental Technology complex (H), Jibowu/ Abiola Hostels (I) and Students Union Building restaurant (J) respectively.

2.3 Study and Sampling Design

A descriptive cross-sectional study was adopted for the research as described in recent findings of [2,9]. Soil samples from walkways, building alleys and complex sites that served as major converging points for people at the sampling points (A-J) were collected via simple random sampling methods [2,9]; while exposed air culture technique described in [2,9] was adopted for estimating the air mycoflora of the same sampling points (A-J) to give a comparative study of the study areas. Random sampling technique was adopted for different sample collection points in the locations A-J to eliminate bias and get representative samples of the various target locations of study [2,9].

2.4 Sample Collection

A total of 90 soil samples were collected at the rhizosphere regions of soil from the specified points (A-J) listed above in August, 2017. The soil samples were collected into labeled sterile universal bottles using standard W.H.O guidelines and stored in ice packs before laboratory analysis were carried out [11,12]. All the samples collected were analyzed in the laboratory within 6hr of sample collection [11, 12].

2.5 Sterilization of Materials and Media Preparation

Glass wares were washed with detergents, rinsed and oven dried at 180°C for 2 h; forceps and wire loops were flamed to red-hot in a Bunsen flame, dipped in 70% ethanol [11,13]. Culture media, beakers, conical flasks, and other materials were autoclaved at 121°C for 15 minutes [11,13]. Incubators and inoculating chambers were fumigated with 40% formaldehyde, absolute ethanol and then irradiated with UV-lamp for 1 h [6,11]. Work benches were disinfected by cotton wool previously moistened with absolute ethanol [6,13]. Dehydrated potato dextrose agar (39 g) was dissolved in 1000 ml of distilled water in conical flasks; the mixture which was further dissolved on a hot plate for 3 minutes and then sterilized by autoclaving at 121°C for 15 minutes [6,13,14].

2.6 Sample Preparation, Standardization of Inoculum and Isolation of Filamentous Fungi

The methods described by [8,9] were adopted for soil sample preparation and Inoculum standardization in which sterile distilled water was used as diluents and a 1g of each soil sample stock was weighed into 10ml of sterile distilled water for a serial dilution procedure in sterile test tubes under aseptic conditions until four different dilutions were obtained for a pour plate culture technique [8,9]. Thereafter, a 1 ml each of the dilution factors 3 and 4 were used for inoculating already prepared Potato Dextrose

Agar seeded with 250 mg Chloramphenicol (for total filamentous fungi counts) incubated for fungal isolation at 26±2°C for 3-5 days [9,15,16]. Following incubation, the culture plates were observed for spore forming mycelia units and thereafter, the fourth dilution factor was established as the standard for the isolation of the fungi due to easy numerical estimation of different mycelia units [8,9,15,16].

2.7 Identification and Characterization of Fungal Isolates

The methods described by [1,2,17] were adopted for identification of the fungi isolates. The cultural characteristics (macro-morphology) and the microscopic morphological characteristics (micro-morphology) of the various distinct mycelia units obtained were compared with the available literature (Compendiums for Air, Soil, Food and Indoor fungi) [18]. The macro-morphological properties of the different mycelium clones were obtained by visual appearance of the mycelium units while micro-morphological properties of fungi mycelium clones were obtained via microscopic observations of stained mycelia with cotton blue in lacto phenol dye [12,17,18]. Photomicrographs of the different mycelium clones from sampling points A-J were screened, compared and juxtaposed for matching information contained in the available literature for air and soil fungi as described in [1,2,9,17].

2.8 Subculturing of Identified Fungal Isolates

A representative mycelium clone of each identified fungi isolate were picked aseptically and sub cultured on freshly prepared Potato Dextrose Agar (PDA) seeded with 250 mg Chloramphenicol in inoculating chambers already fumigated with 40% formaldehyde and absolute ethanol as described in [15,16]. Representative sub cultured clones of each identified fungal isolate were incubated for growth at 26±2°C for 3-5 days [9,15].

2.9 Data Analysis

Analyzed samples for soil and air isolation were in triplicates; data means obtained for fungi mycelium counts were subjected to a 2-way analysis of variance and the means were separated using Duncan's New Multiple Range test at P≤ 0.05 level of significance [3,6,19].

3. RESULTS

The total counts (SFU/ml) of soil and air mycoflora from the different sampling points are presented in Table 1. Identified fungal isolates obtained from the different sampling points by macro-morphological and micro-morphological characteristics respectively are represented in Tables 2 and 3. A total of 60 fungal isolates of *Fusarium avenaceum* (9), *Alternaria infectora* (10), *Chaetomium globosum* (8), *Rhizopus oryzae* (7), *Mucor circinelloides* (3), *Aspergillus fumigatus* (4), *Candida albicans* (8), *Engydontium album* (5) and *Aspergillus niger* (6) were identified from the soil samples collected across sampling points A-J (Table 4). Moreover, a total of 48 fungal isolates of *Mucor racemosus* (4), *Acremonium strictum* (7), *Aspergillus parasiticus* (5), *Aspergillus fumigatus* (3), *Byssochlamys nivea* (6), *Aspergillus flavus* (9), *Fusarium oxysporum* (6) and *Aspergillus niger* (8) were obtained from agar plates exposed to the air across the different sampling points A-J (Table 5). *Aspergillus niger* and *Alternaria infectora* have the highest occurrence rates in all the sampling points for both isolation types (soil and air), while *M. racemosus* and *M. circinelloides* respectively have the lowest occurrence rates across the same sampling points for both isolation types (soil and air). Several variations moreover exists in the distribution of the fungi isolates obtained: *F. avenaceum*, *A. infectora*, *Chaetomium globosum*, *R. oryzae*, and *M. circinelloides* were only found in soil samples across the sampling points; *M. racemosus*, *A. strictum*, *B. nivea* and *A. parasiticus* were only found in the air while *A. fumigatus* and *A. niger* were found in both soil and air isolations across the same sampling points (A-J). Generally, it was observed that more fungal isolates were obtained from the soil samples than the air across the same sampling points (A-J).

Furthermore, the total mycelial counts (TMC) of 80% of the soil samples across the sampling points (A-J) were above the specified standard of 8-10 spore forming units (SFU) per 10^{-4} dilution of 1 g of soil set in the findings of [6,8,13]; while the TMC of 50% of air isolation plates (exposed for 5 minutes) were higher than the specified standard of 5-7 SFU/5 minutes exposure set in the same findings of [9,12,13] as contained in Table 1. The results in Table 1 were expressed as means of the different spore forming units obtained across each sampling points (A-J).

Table 1. Total counts (SFU/ml) of soil and air mycoflora from the different sampling points

T.M.C (Sfu/ml)	Isolation type (Soil or Air)			
	S	R_S	A	R_A
A	6.00± 1.82[b]	-ve	7.26± 1.21[c]	+ve
B	12.00± 1.47[c]	+ve	3.32± 1.21[a]	-ve
C	14.33± 1.72[c]	+ve	6.00± 1.81[b]	-ve
D	13.58± 1.78[c]	+ve	8.52± 1.21[d]	+ve
E	5.33± 1.72[a]	-ve	7.98± 1.21[c]	+ve
F	17.10± 1.82[d]	+ve	6.00± 1.37[b]	+ve
G	17.00± 1.47[d]	+ve	4.89± 0.94[a]	-ve
H	11.67± 1.27[c]	+ve	5.89± 1.46[b]	-ve
I	12.33± 1.72[c]	+ve	9.25± 1.42[d]	+ve
J	18.33± 1.68[d]	+ve	8.26± 1.84[c]	+ve

Keys: T.M.C- Total Mycelium Count, S- Soil isolation, A- Air isolation, R_S- Risk incidence for soil mycelium counts obtained by Comparism of mycelium counts with standard of 8-10 spore forming units (SFU) per 10^{-4} dilution of 1g of soil, R_A- Risk incidence for air mycelium counts obtained by Comparism of mycelium counts with standard of 5-7 SFU/5minutes exposure, values with the same superscript have no significant difference at P≤0.05 level of significance. A- Akindeko Hostel, B- Obakekere Shuttle Park, C- Obakekere Staff Quarters, D- Obakekere Food Canteen, E- Obakekere Central Mosque, F- Faculty of Science/Faculty of Agriculture complex, G- Faculty of Management/ Faculty of Mineral Sciences complex, H- Faculty of postgraduate/ Faculty of Environmental Technology complex, I- Jibowu/ Abiola Hostels and J- Students Union Building restaurant, +ve: Positive Risk Incidence, -ve: Negative Risk Incidence.

Table 2. Morphological and cultural characteristics of fungi isolated from soil samples

RIC	Cultural characteristics	Morphological characteristics	CFI
1	Fastidious, yellowish spreading mycelium which turns dark velvety green with age	Unbranched but coiled and fusiform conidiophores appear with proliferated monophalides. Non-septate conidia also appears slender shaped	*Fusarium avenaceum*
2	Fastidious white wooly mycelium with aerial projections that turns brownish as culture ages	Smooth stolons with scattered Sporangiophores are attached to globose sporangia with spinulose wall having ovoid Columella	*Rhizopus oryzae*
3	Olive-grayish and fluffy mycelium that later turns stained white with brown edges	Appearance of a dark globose Ascomata with black hyphal appendages attached to septate unbranched but coiled rough walled hyphae	*Chaetomium globosum*
4	Fastidious white fluffy mycelium with dark green velvety centers	A globose rough edged, non-septate conidia observed with monoserate radiate head; phalides appear short necked attached to pigmented conidiophores vesicles	*Aspergillus fumigatus*
5	White wooly mycelium with grayish-brown centers with short and long tufts	Smooth, branched and chained conidia appear with vermiculate conidiophores and dark septa walls	*Alternaria infectora*
6	Grayish-green aerial mycelium with tall spreading tufts	Tall and short Sporangiophores appear branched in a sympodial manner but have slightly encrusted walls with suspended spores borne on obovoid Columella	*Mucor circinelloides*

RIC	Cultural characteristics	Morphological characteristics	CFI
7	Fastidious stained white mycelium with brownish black centers that spreads rapidly	Long thin walled hyaline conidiophores with globose radiate heads appear smooth with black bars; conidiophores are branched and lumped with cylindrical phalides	*Aspergillus niger*
8	whitish cream lobate colonies that spreads in a non-systematic matter with no true mycelium	colonies of loose budding cells that stains hyaline and appear globose with round edges	*Candida albicans*
9	white short wooly spreading mycelium which appear floccose with hyaline centers	hyphae appear submerged, coiled, hyaline and smooth walled; hyphae appear dichotomously branched with condigenous whorls and no observed chlamydospores	*Engyodontium album*

Keys: RIC- Representative Isolate Clones from different sampling points identified, CFI- Confirmed Fungal Isolate

Table 3. Morphological and cultural characteristics of fungi isolated from air

RIC	Cultural characteristics	Morphological characteristics	CFI
1	Fastidious white flattened mycelium which becomes brownish grey with age having tall and short projection centers	Sporangiophores branched in mixed sympodial and monopodial forms, appearance of non-septate hyphae with rough edged zygospores	*Mucor racemosus*
2	Slow growing, pale green mycelium with grayish-black and coarse centers	Hyaline and pigmented septate hyphae observed with fasciculate conidiophores which occurs in branches	*Acremonium strictum*
3	Fastidious stained white mycelium with brownish black centers that spreads rapidly	Long thin walled hyaline conidiophores with globose radiate heads appear smooth with black bars; conidiophores are branched and lumped with cylindrical phalides	*Aspergillus niger*
4	Fastidious white fluffy mycelium with dark green velvety centers	A globose rough edged, non-septate conidia observed with monoserate radiate head; phalides appear short necked attached to pigmented conidiophores vesicles	*Aspergillus fumigatus*
5	Fastidious, stained white mycelium with light green centers that contain floccose tufts	Smooth, biserate, long walled hyaline conidiophores with globose heads appear apically swollen	*Aspergillus parasiticus*
6	fastidious, powdery yellowish and creamy mycelium with loose furniculose tufts and large exudates droplets growing broadly on plates	Non septate, thin hyphae containing spores with globose thick walled Asci loosely linked at the apex that appear flattened at the base.	*Byssochlamys nivea*
7	fastidious grayish white mycelium with yellowish green centers and pinkish velutinous drabs that have floccose tufts	long coarse conidiophores with radiate conidial heads that appears apically swollen with cylindrical phalides. Conidial heads are biserate with branched hyaline conidiophores	*Aspergillus flavus*
8	peachy velvety spreading aerial mycelium with brown edges that appear dark yellowish as culture ages	Long thin walled conidiophores with fusiform conidia that appears convex at the apex. Hyphae is hyaline with branched monophalides	*Fusarium oxysporum*

Keys: RIC- Representative Isolate Clones from different sampling points identified, CFI- Confirmed Fungal Isolate

Table 4. Distribution of fungal isolates from soil samples for different sampling points A-J

Isolates	Sampling points										Number of isolates
	A	B	C	D	E	F	G	H	I	J	
Fusarium avenaceum	+	-	+	+	+	+	+	+	+	+	9
Alternaria infectora	+	+	+	+	+	+	+	+	+	+	10
Rhizopus oryzae	-	+	+	-	+	+	-	+	+	+	7
Chaetomium globosum	-	+	+	+	+	+	+	+	-	+	8
Aspergillus fumigatus	+	+	-	-	+	-	-	-	+	-	4
Mucor circinelloides	-	-	-	+	-	+	-	-	-	+	3
Aspergillus niger	+	+	+	-	-	+	-	+	+	-	6
Candida albicans	+	-	+	+	+	+	+	-	+	+	8
Engyodontium album	-	-	+	-	+	+	+	-	+	-	5

Keys: +: fungi isolate is present, - : fungi isolate absent, A- Akindeko Hostel, B- Obakekere Shuttle Park, C- Obakekere Staff Quarters, D- Obakekere Food Canteen, E- Obakekere Central Mosque, F- Faculty of Science/Faculty of Agriculture complex, G- Faculty of Management/ Faculty of Mineral Sciences complex, H- Faculty of postgraduate/ Faculty of Environmental Technology complex, I- Jibowu/ Abiola Hostels and J- Students Union Building restaurant

Table 5. Distribution of fungi isolates from air for different sampling points A-J

Isolates	Sampling points										Isolates number
	A	B	C	D	E	F	G	H	I	J	
Aspergillus fumigatus	-	+	-	-	+	-	-	-	-	+	3
Aspergillus niger	+	+	-	+	+	+	+	+	-	+	8
Mucor racemosus	+	-	-	+	+	-	-	-	-	+	4
Acremonium strictum	-	+	+	-	-	+	+	+	+	+	7
Aspergillus parasiticus	+	-	-	+	+	+	-	-	+	-	5
Aspergillus flavus	+	+	+	-	+	+	+	+	+	+	9
Fusarium oxysporum	-	-	+	+	+	+	+	-	-	+	6

Keys: +: fungi isolate is present, - : fungi isolate absent, A- Akindeko Hostel, B- Obakekere Shuttle Park, C- Obakekere Staff Quarters, D- Obakekere Food Canteen, E- Obakekere Central Mosque, F- Faculty of Science/Faculty of Agriculture complex, G- Faculty of Management/ Faculty of Mineral Sciences complex, H- Faculty of postgraduate/ Faculty of Environmental Technology complex, I- Jibowu/ Abiola Hostels and J- Students Union Building restaurant

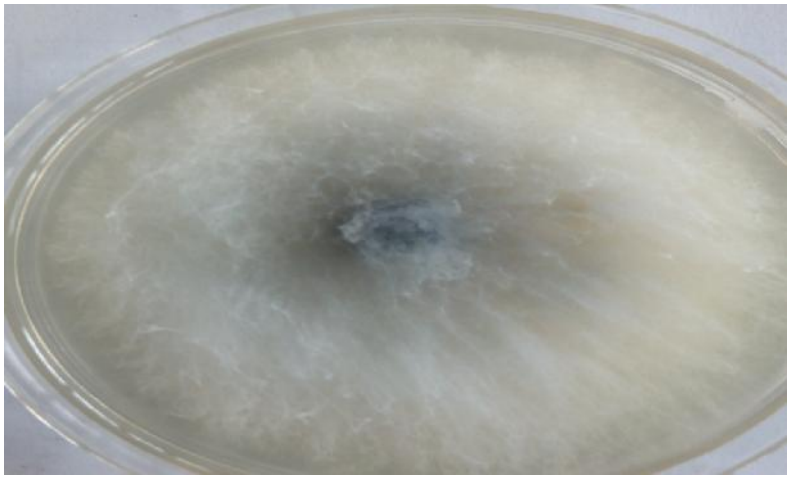

Plate 1. Culture of *Alternaria infectora* from soil

Plate 2. Culture of *Fusarium avenaceum* from the soil

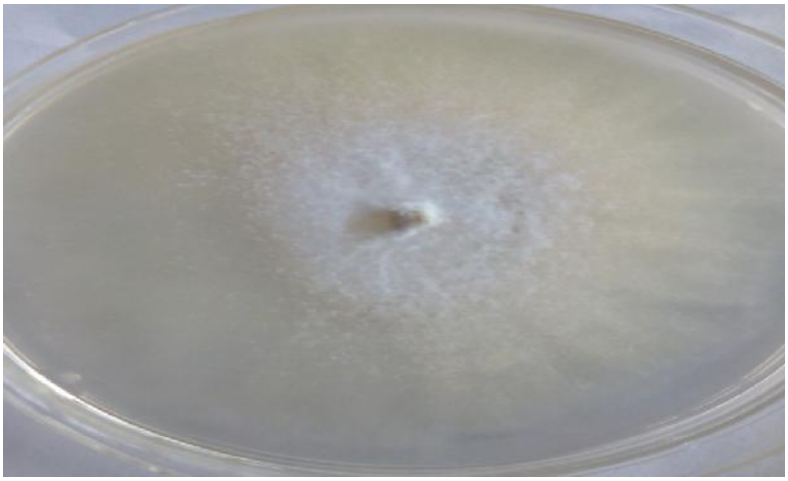

Plate 3. Culture of *Acremonium strictum* from air

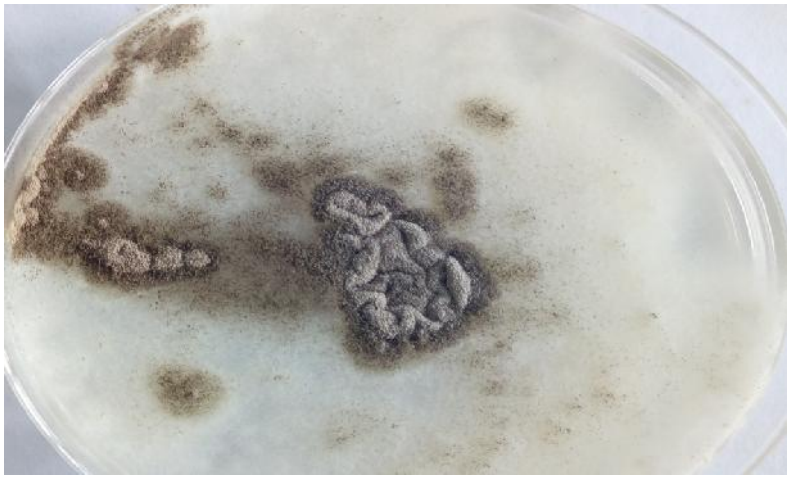

Plate 4. Culture of *Aspergillus niger* from air

4. DISCUSSION

It was observed from this study that filamentous fungal isolates of public health importance were obtained from all the sampling points A-J. However, while these isolates are part of the natural mycoflora of these location points (A-J), they still pose grave potential health risks when their spores are unduly exposed to individuals, food vendors, infants and immunocompromised adults; this was justified in recent findings of [1,2,6]. The result also gave an insight into the risks that different persons may be prone to across specific non-residential densely populated areas of the sampling points, the areas which include: Obakekere food canteen (D), Obakekere central mosque (E), School of Sciences/School of Agriculture complex (F) and Students Union Building restaurant (J). Fungal isolates of opportunistic mycotic importance such as *M. racemosus*, *M. circinelloides* and *R. oryzae* that have been implicated in recent studies to cause human mucor mycosis in immunocompromised adults and HIV patients as described in the findings of [6,13,17] occurred more abundantly at these points.

Fungal isolates of mycotoxic importance such as *B. nivea, A. flavus, A. fumigatus, A. niger* and *A. parasiticus* all of which are renowned producers of aflatoxins (A-G) [1,16,18,19], Fumagilin [1], Gliotoxin [2], Verruculogen [18], viriditoxin [18], fumigaclavines [6], ochratoxins [20], patulin [16] and fumitermorgins [21] respectively occurred more across areas that served as food vending joints and common restaurants in the university campus, the areas which include: Obakekere Shuttle Park (B), Obakekere Food Canteen (D), Obakekere Central Mosque (E), Faculty of Science/Faculty of Agriculture complex (F), Faculty of Management/ Faculty of Mineral Sciences complex (G) and Students Union Building restaurant (J); as similar observations were also reported in the findings of [4,20,21]. More importantly, these three isolates of *Aspergillus* were not the only isolate types obtained in abundance from these same sample points mentioned above, *F. avenaceum* and *C. globosum* are also fungi isolates of grave mycotoxic importance obtained across these points. Recent studies revealed that the isolates *F. oxysporum, F. avenaceum* and *C. globosum* are mycotoxin producers with strong emphasis on *Fusarin* by *F. avenaceum* and *F. oxysporum* [4,12,22] and *Chaetoglobosin* A and C produced by the isolate *C. globosum* as described in [21,22]. It was also revealed in the studies of [1,21,22] that the isolates (*A. fumigatus, A. niger*, *A. parasiticus, F. avenaceum* and *C. globosum*) are involved in food spoilage notably in cereals and nuts as they also cause mild to severe symptoms of food poisoning; their abundant occurrence however in food vending and restaurants even pose more grave public health risks to individuals across these areas.

Conversely, the findings of this study discovered that the fungi isolate types of cutaneous and subcutaneous mycotic importance such as *A. infectora* and *A. strictum* were more predominant in residential areas of the different sampling points, the areas which include Akindeko Hostel (A), Faculty of postgraduate/ Faculty of Environmental Technology complex (H) and Jibowu/ Abiola Hostels (I): as these isolates (*A. infectora* and *A. strictum*) have been implicated to cause fungal keratitis and contact dermatitis; this was also described in the findings of [1,2,6,19]. However, the findings of this study varies comparatively from a few other observations as these two isolates (*A. infectora* and *A. strictum*) were discovered to occur abundantly across busy walkways and food vending joints in the findings of [13,23]. However, this variation was explained in the findings of [9,19,21] and the result of this study suggests a correlation with the findings of [6,9,17,19,21] as the points (A, I, H) where these two isolates occurred more abundantly served as residential areas for students and staffs who roam the busy walk ways and food vending joints during the day of which these persons (staffs and students) may have aided the transportation of the spores of these organisms in large numbers from the residential areas to food vending joints; this was also explained comprehensively in the study of [1,2,19,21].

Consequently, arrays of fungi isolates of mycotic importance occurred across different sample points in the university campus, but the findings of this study also generally suggests the high occurrence rates of fungal isolates that pose greater public health risks in the non residential areas of the study area (i.e. sampling points B, C, D, E, F, G and J) may be due to the high influx of persons into these points; as explained in [4,6,17,19]. The isolates of dominant occurrence in the sampling points B, C, D, E, F, G and J (*Aspergillus spp*) have been implicated to be pathogens that cause wide range systemic mycoses when their spores inhaled or their vegetative parts are ingested accidentally; this was particularly described in [21,23] as different

species of *Aspergillus* were reported to have caused otomycosis, fungal balls of the lungs and systemic aspergillosis in children, adults and aged respondents [19,21-23].

Furthermore, careful observations of the areas prone to greater public health risk (sampling points C, D, E, F and J) revealed that proper sanitary practice were not imbibed by different persons across these areas as waste food items and other refuse materials are not properly disposed, thus abetting the sporadic spread of the spores of the fungal isolates of mycotic importance obtained across these areas mentioned above. Moreover, these abysmal sanitary practices across densely populated Nigerian and other foreign university campus centers were also observed in the findings of [2,3,6,8,13,16,23].

5. CONCLUSION

The findings of this research gave an adequate comparative overview of the soil and air mycoflora of selected densely populated areas of the Federal University of Technology, Akure Campus. A total of ten different isolate types are reported with wide range public health significances depending on where these isolate types predominantly occurred. The findings of this research related the diversity of different fungal isolate groups with emphasis on the activities predominant at different sampling points where they occurred for reasoned justifications to the cross sectional scientific survey adopted for this research. Proper sanitary practices and health surveillance are however recommended across different sampling points adopted for study in this research to reduce potential incidence of mycotic infections and food poisoning among respondents via spread of fungal spores or infective vegetative units by formites, rodents and other agents of infection transmission.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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