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Review Article On "Biodiversity Study Of Airborne Fungi In Different Library Environment"

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Abstract

Bio-aerosol plays a fundamental role in the transmission of all diseases. It involved many different fields such as microbiology, mechanical engineering, air pollution, medical science, epidemiology, immunological science, biochemistry, physics, nanotechnologies and etc This review article aimed at evaluating all in door aerosol in library, cause of bio-deterioration of books and also cause of air pollution and health problem in library.

Key word : bio-aerosol, aeromycoflora , molds and Penicillium species

INTRODUCTION

Bio-aerosols are airborne particles that originate from living microorganisms such as bacteria, fungi and viruses. Their components have negative effects especially on the health of immuno-compromised people. The infectious aerosols are small and may remain suspended and viable in the air stream over long periods of time [1].Indoor air quality (IAQ) is recognized as a key factor for human health, due to the fact that people spend 80%- 90% of their time in indoor environments [2-5]. Biological, physical and chemical agents can affect the characteristics of the indoor atmosphere [6]. Biological agents relevant to health are widely heterogeneous, including pollen, allergens, plants spores, bacteria, fungi, algae and some protozoa. Moreover, activities like talking, sneezing, coughing, can generate airborne biological particulate, and this is considered a main factor contributing to the buildup and spread of airborne microbial contamination [7,8]. The exposure to microbial pollution can be associated with respiratory symptoms, allergies, asthma and immunological reactions [9]. During the last decades, studies on specific indoor environments have identified risk sources and threshold levels for different pollutants, proposing targeted control measures. However, the combined effects of biological agents and chemical mixtures still require further investigation, and innovative tools are needed to improve quality of indoor air [10, 11]. When it happens to specific facilities, as libraries, archives and schools, it needs further consideration to identify most appropriate markers to assess indoor air quality for people, paper materials and activities. Libraries are indoor facilities where air quality is influenced by both environmental and anthropic microorganisms, interacting with chemical and physical pollutants

[12].Libraries represent one of those public places where monitoring indoor air quality is relevant not only for people's health, but also for the preservation of materials, in this case the paper of the books and their appropriate storage or restoration [13, 14]. Therefore, even if libraries do not represent settings at high occupational risk, they are exemplificative indoor environments to test monitoring strategies and improve air quality over the minimal requirements for occupational safety. Several studies regarding indoor air quality in libraries have been reported, focusing on the different categories of risk factors [13, 15, 16, 17, 18].Microclimatic conditions influence the growth of several microorganisms (e.g. Aspergillus, Penicillium, Trichoderma, Alternaria, Rhizopus) that can attack library collections, eventually favouring the biodeterioration processes [4]. Several fungi, bacteria and actinomycetes were the microorganisms referred to as bio-deteriorating agents in the libraries and museums. [19,20,21]. Fungi in libraries, museums and their storage rooms can seriously threaten the health of the restorers, of the museum personnel and of the visitors due to their allergic potential, due to the production of mycotoxins but also due to their ability to cause systemic infections in humans [22]. The majority of the indoor airborne fungal population is derived from outdoor sources and is transferred inside through windows and doors [23, 24, and 25]. Fungal populations depend significantly on outdoor climatic conditions and meteorological factors, such as temperature and humidity [26,27,28]. Fungi are specialized micro-organisms which differ from the plant kingdom by the lack of chlorophyll and consequently cannot utilize energy directly from sunlight. The biodeteriorative role of fungi is due to its hydrolytic enzyme activity. The cellulytic activities cause maximum damage to paper as well as binding materials of the books like leather and glue. Fungal spores in the library not only deteriorate and degrade the quality of paper but also cause allergies and allied respiratory diseases to the reader.Among the fungal species Aspergillus niger, A. flavus, A. fumigatus, Penicilliumchrysogenum, Cladosporium herbarium, Chaetomiumglobosum were the most dominant species[29].

In this review, we describe the fungal characteristics and their effect in different library environment and human health.

2. Characterization of Airborne Fungiin different library

Libraries , as an institution open to the public, respect the rules of hygiene and sanitation designed to preserve the health of its occupants, particularly; circulation of air, protection against humidity and temperature variations. For this purpose, since 2011, the WHO requires institutions receiving public (ERP) to monitoring air quality according to Article L221-8 of the Environmental Code. Previously, the Grenelle law of July 2, 2010 recommends periodic microbiological controls, installation and maintenance of climate control and ventilation systems to limit unplanned microbial contamination. However, not all libraries have the financial means to install a ventilation and climate control system to limit microbial contamination and development. The Central Library of the University of Yaoundé I (CL-UYI) is no exception, given its low acquisition budget [30] . In tropical climates, the absence of these climatic control systems leads to a periodic reappearance of moulds in libraries [31].The most frequent fungal genera were aspergillus spp (24.40%) and penicilliumspp (17.32%). Aspergilusfumigatus is widely distributed in the environment and airborne asexual conidia serves as the main mode of transport for pulmonary lung infection [32,33,34].The common moldsmembers of genera Aspergillus(29.50%), Cladosporium(18.18%) and Penicillium(17.04%) found in all the libraries at Universities GadjahMada, Indonesia [35]. [36,37,38,39] also found that members of the genera Aspergillus, Cladosporium, and Penicillium were predominant indoor airbornemolds.[40] also found members of the genus Cladosporium

(12.4%) isolated from all studied sites and found almost every month.[41,40] also state that the three members of the molds are commonly found indoors and outdoors. [42,43] also found the genera Aspergillus and Penicillium in libraries but did not find genus Cladosporium. They didn't find other molds found in this study, namely members of genera Byssochlamys, Cadophora, Eurotium, Emericella, Xeromyces, etc. This shows that not all molds can be found in all rooms. The presence of airborne molds can be affected by the presence of substrate, temperature, and relative humidity [41,44]. According to [38], the most favorable conditions for microbial growth vary, depending on the species. The results obtained [29] throughout the year inside the library show maximum concentration of fungi during monsoon than in winter and summer. In summer the concentration of Aspergillus and Penicillium species were higher than the monsoon and the winter months.Aspergillus species were found to be dominant in this study. The predominance of Aspergillus species in libraries has been reported by [45] who made on aerometric survey of fungi in eleven libraries at the University of Michigan to ascertain the role of fungi as allergenic contaminants in book collections with Anderson sampler.[46] reported that spores of Curvularia, Helminthosporium, Bispora, Fusarium, Torula and Cladosporium are the common constituents in the library atmosphere of Aurangabad. Fungi such as Chaetomium, Rhizopus, Torula, Bispora, Fusarium, Cladosporium, Curvularia and Trichoderma which were reported to be common on books were observed in the present investigation. Isolation of Aspergillus, Penicillium, Cladosporium and Alternaria spp. are the most common isolated fungi inthis study was in agreement with the fungi reported by[47,48] in libraries, library materials and archives.

3. Different method used for isolation of fungi from library environment.

The sampling was done by settle gravity culture plate method. Two different media i.e. Saboraud's agar and Potato dextrose agar were used. The 9 mm Petri plates, containing the media were exposed for 5 minute at five different locations in the library at an interval of 15 days. The bioaerosol samples were collected before, during and after regular activities like cleaning, arranging books, loading & unloading of books with slight agitation in the book shelves. After the exposure to air, the Petri dishes were brought to the laboratory in the pre-sterilized polythene bags and incubated at 25oC for 5-7 days. Colonies were counted and identified[29]. The identification of colonies was based on their color, size, shape and other morphological features[49,50,51,52,53,54].Another study was conducted in UniversitasGadjahMada (GadjahMada University) or UGM, Yogyakarta, Indonesia. Sampling was conducted in January 2012 in six libraries at the university, ie. libraries of Food and Nutrition at Inter-University Center or PusatAntarUniversitas (PAU), Biotechnology at PAU, Faculty of Biology, Faculty of Mathematics and Natural Sciences, Faculty of Master of Management, and Faculty of Geography. Sampling and observation of the condition of the libraries were done during working hours (08.00-12.00 WIB).The parameters of environmental included temperature and relative humidity of the library measured in succession using thermometer and hygrometer at the time of sampling. The sampling method was conducted by non-volumetric air sampling [55] using two petri dishes containing Dichloran 18% Glycerol Agar (DG 18) media for each room. The petri dishes were opened for 30 minutes in each library with the aim that the media were contaminated by indoor airborne molds. One petri dish was placed on a reading table and the other on a bookcase in each library. The petri dishes were closed after 30 minutes, then incubated at room temperature in the laboratory for 1 week, then each growing mold was transferred to new media to be isolated and purified. Indoor airborne molds that have been taken from the library were further isolated by moving each mold from the growing colony to the appropriate purification media, namely Malt Extract Agar (MEA),

Dichloran 18% Glycerol.The purified mold isolates were further ide growing them on identification media: MEA, D CY20. Molds growing on the media were identified on macro-morphological characteristics, name shape, and colony structure on media in petri dish colony diameter[35].Bioaerosol sampling and air concentration were made by passive air sampling technique using petri dishes containing different culture media and exposed for 30, 60 and 90 min in the morning and afternoon. Sampling of surfaces and mouldy books were made by rubbing using sterile swab. The identification of the isolated microorganisms was based on macroscopic, microscopic and biochemical characters.The swabbing method was used to collect microorganisms from study tables, bookcases and surfaces. Dust was collected in a square of 25 cm^2 using cotton swabs. Subsequently, these swabs were carried to the laboratory where one swab was used for enumeration and the other for identification after enrichment of microorganismsOnce colony forming units (CFU) were enumerated after serial dilutions, microbial load (CFU/m^2) was determined, using the following Equation [56] .

$C=N\cdot V\cdot D\cdot(S)-1C=N\cdot V\cdot D\cdot(S)-1$

Where C = microbial CFU/cm^2; N = number of colonies in petri dish; V = volume of the stock solution; D = inverse of the dilution factor; S = total area sampled

The isolation of microorganisms on the books was carried out by swabbing and dust tapping method. Using a moistened sterile swab, we rubbed lightly on books with foxing and mold spots.After incubation, the various colonies observed on the plates were each introduced on new media for purification and well isolated colonies. Each pure isolate was stored at 4°C in creotubes containing 10% glycerinated BCC for identification[57].

4. The Effect of Atmospheric Particulate Matters (PM) on Airborne fungi

The fungi have variety of highest proportion in various stages under different regions and weather conditions (like sunny, cloudy or rain, etc.) Atmosphere 2020, 11, 919 4 of 16 [58,59]. The highest number of fungi with aerodynamic diameter ranging from 2.1 to 3.3 μm were associated with coastal areas of bioaerosols [60].Environmental parameters were also performed for air temperature, relative humidity and ventilation rates, while information on child care centers characteristics was collected via an inspection. Most commonly recovered fungi were Penicillium, Aspergillus, Geotrichum, Cladosporium and sterile mycelia with Geotrichum and sterile mycelia amounting to an average of 71.5% of the total airborne culturable fungi studied[61].

5. The Effect of Airborne fungi on the Environment

Numerous studies have focused on studying airborne microorganisms, as some of microbes in bioaerosols are considered as serious risk factor for health problems [62]. The presence of fungal spores in indoor environments is till date a major public health concern and economic importance [63]. The World Health Organization has declared that 4.3 million premature deaths are related to indoor air pollution [64].Five French composting plants studied, in which the dominated fungi werePenicillium sp., Aspergillus fumigatus, Thermomyceslanuginosus, etc[65].Aspergillus fumigatus, which is an opportunistic fungal pathogen, may cause invasive aspergillosis in immuno-weak individuals under long-term exposure [66,67].

The role of fungi as causative agents of allergenic rhinitis and bronchial asthma from library dusts and other book collections is well documented by [47,68,69] but information on air mycoflora of libraries, especially in Mumbai is less.The most contaminating microorganisms in the room which cause illness with sick building syndrome symptoms are molds whose number canreach

tens to thousands. Mold can be found in any place where organic material is present and it is easily carried into the room by wind because it has many spores or by the dust of clothing or other material or by insects and otheranimals from outdoors [70].

6. The Geographical Characteristics of Airborne fungi

There are various factors (relative humidity, temperature, season, special weather conditions: haze and dust, etc.) in the atmosphere, which have much possibility to influence microbial abundance. Thus, to study and figure out microbial composition and how it varies with different atmospheric factors, geographical characteristics has great significance.The concentration of total microbes in the atmosphere appeared to the highest quantity in winter and the lowest in summer [71], as serious hazy and foggy weather emerging with higher particulate matters becoming inhabitants for microorganisms.. However, relative humidity showed negative relationship with fungi [72], while there was no relationship of fungal concentration with solar radiation [73]. Nevertheless, the almost opposite conclusions and results in different reports may be because of various sampling locations and periods.

CONCLUSION

In conclusion, although the atmosphere is such an adversity environment for the growth of airborne microbes, the richness and abundance of microorganism is very high in the air.Therefore, these pathogens could lead to severe health problems to human, animals and even plants with greatly wide range in the air. In words, the more information of airborne microbes (especially pathogens) the more measures and studies we could conduct.

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