Survey of fungi found in books on the shelves of the libraries of the University of Qadisiyah – Iraq

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Abstract. The study included a survey of the fungal pollutants prevalent in the libraries of the University of Qadisiyah. The study included the Central Library and the Library of the Faculty of Science, Education, Literature, Veterinary Medicine, Law, Administration and Economics. For the purpose of study swabs were taking from Books on the library shelves. Wipes were cultured on the Sabouraud Dextrose Agar (SDA) medium and incubated at 25 °C for one week to observe and diagnose growth. The results showed that there was contamination in the books in the libraries mentioned above. The Faculty of Science library was the most polluted, followed by the Central Library. The dominant fungi were *Aspergillus*, followed by *Penicillium, Rhizopus, Alternaria* and *Fusarium*. The effect of antiseptics on this isolated exhibited in the libraries mentioned above was examined by using Formalin, Dettol, Hydrex, Povidon and Povidon-Iodine. The results show that there is a danger to the workers and those who return to the libraries, which confirms the existence of an urgent need to prevent the danger of these fungi and find effective solutions.

Key words: Libraries, books damage, Aspergillus, Penicillium, antiseptics

1. Introduction

Libraries are the most important source for students to obtain information. It is a quiet place for reading and supplying different sciences. Libraries are characterized by high organization. It provides a strict system in the order of books according to general and accurate disciplines. They are equipped with an electronic system that facilitates the process of accessing the nearest address for the reader or researcher[1]. It must have sufficient space and protected against fires, floods and other disasters. They must be furnished with furniture against damage and fire and should be well ventilated so that they do not become a suitable home to mold][2].

When the conditions are not appropriate for the library, it will become a place to collect dirt and mold and will be a suitable home for germs, insects and mold, the most important assets of the library are what contains books and manuscripts, which must be stored well to avoid damage, and paper is the main material that book consists of it and cellulose plant form the basis of the paper industry and this cellulose material is treated with a special treatments to obtain a good quality of paper, and whenever paper is silky, soft and Snow-white be much better and usually added to the paper industrial materials and preservatives to improve the quality and to keep paper from extinction and disintegration are inks, acids, dyes, colors and other materials[3].

Fungi are characterized by their ability to produce an abundance of enzymes. These enzymes analyze organic matter into simpler substances and then absorb it. The most important enzymes are proteinase, and lipase, as well as cellulose, especially the
cellulase enzyme, which breaks down the bonds of the cellulose molecule to be the end result of the glucose which is the essential material of fungi nutrition[4].

When searching for books stored in public and private libraries in an incorrect manner and in conditions of high humidity, darkness and temperature (25-28 m), they are vulnerable to attack by many pests, which include insect pests such as some licorice, mites, termite and some species of Staphylococcus. While fungi are more important than pests on books, especially fungal species with simple dietary requirements such as Aspergillus, Penicillium and Rhizopus, which exploit paper as a source of carbon to grow and spread, resulting in damage of books, documents and manuscripts and in some cases there are books and documents are valuable manuscripts cannot be replaced, for example, historical documents of great people who died long ago, or a particular statement recorded historical cases of ancient times or old law regulating the lives of people. Fungi can reach to the books through their portable spores in the air as the air currents are loaded with millions of volatile spores once they fall on a wet place, they start growth and germination especially spores of Ascomycetes, Oomycetes and zygomycetes, or contamination may come through the hands and clothing of users of books from workers, staff, researchers and readers[5].

Book borrowing can also increase the problem because the book moves from one environment to another, causing pollution by fungi, the problem is that the library is not ventilated or sterilized and the book itself becomes a source of pollution, another aspect to consider is that these fungi do not damage books only, but they are a danger to public health, it causes allergies and sneezing to users and is a source of toxins, especially aflatoxin, which is one of the most dangerous toxins at the present time also should not neglect the economic and scientific aspect of the subject we do not want scientific books damage and thus lose and we do not want to charge the country's budget for the purchase of books instead of those that are damaged. Therefore, we must establish controls and conditions for the purpose of prolonging the life of books and manuscripts and making use of them for as long as possible, We must purchase the best books that do not damage easily, Quality seminars and conferences should be held about the conditions and rules of health in the preservation of books Especially as the country is going through difficult economic conditions and needs to be concerted efforts by all, especially educated academics[6].

There are also many voices calling for the return of books and leave reading with electronic devices such as mobile and tablet because of the bad health effects on the eye and Psychological state as the pleasure of reading it becomes missing and here came the subject of our research, which focuses on an important problem in our life.

Research problem: Prevent, reduce or control fungi found in books in libraries
Aim of stud: Highlight of the fungal infections that cause damage of books in the libraries of the University of Al-Qadisiyah and combat those pests and the goal can be achieved by the following:
Collecting samples of books from the libraries of the faculties of QadisiyahUniversity.
Isolation of fungi from books on culture media. Diagnosis of fungi Depending on the phenotypic and microscopic characteristics. Antifungal use as an antiseptic for isolated fungi.

2.Materials and Methods :
The study included the taking of cotton swabs from the books displayed in the libraries of the University of Qadisiyah and included the Central Library and the Library of the Faculty of Education and the Library of the Faculty of Arts, Science, Veterinary
Medicine, Administration and Economics. The study included collected samples, twice a week for one month, (11/2017 to 1/12/2017) where the swabs were taken on the books suspected of contamination and were quickly transferred to the laboratory for cultivation on the same day as soon as possible[7].

The Sabouraud Dextrose Agar (SDA) medium was used for isolation of Contaminated fungi of the library and it is prepared According to the instructions of the producing company.

The method of direct culture of the samples was used on the SDA medium and in the planning method as the medium was irradiated and the bacterial antibiotic chloramphenicol 0.25 was added to remove bacterial contamination after culture in Petri dishes by three replicates for each isolation site and incubated at 28 ° C. Control dishes were not vaccinated, left dishes in the incubator until the emergence of fungal growths, which appeared after 3 to 7 days, where it was purified and diagnosed[8,9].

After the emergence of fungal colonies, each growth was transferred to a new plate containing SDA for pure farms. Microscopic slides were made for examination under the microscope and diagnosis. The diagnosis was based on the shape and color of the colonies, as well as the microscopic features such as the shape of the hyphae and their branches, and compare them with global taxonomic keys[10,11].

The fungal inoculum was obtained by transferring part of the fungal colony after activation to the SDA medium. The numbers of fungal cells and spores were then calculated by using the Hemocytometer to get a concentration of 1010 spores / ml. Three concentrations were used for each disinfectant (12.5% -25%-50%). The disinfectants were diluted with distilled water according to the following mathematical equation:

\[ N_1 V_1 = N_2 V_2 \]

The drilling method was used and perform the test as follows:

2-1: Add 0.1 ml of disinfectants previously prepared to each hole with a micro pipette and incubate the dishes at 28-25 ° C for 2 to 3 days.

2-2: Inhibition zones were measured in millimeters[11].

3. Results and discussion:

The results of the study shown in Table (1) below showed that there was a damage due to fungi in all the libraries under study and different fungi, which included a number of genera, which were distributed as follows: Central library showing Aspergillus, Penicillium, Alternaria, Fusarium, Rhizopus, Geotrichum, Mucor 41, 25, 12.5, 12.5, 8.3% Sequentially, whereas the same genera above but in more numbers appeared in the library of the Faculty of Sciences. In administration & economics and education, the presence of genera Penicillium, Rhizopus and Aspergillus, in the Faculty of Arts and Veterinary Medicine and the law was observed Penicillium, Aspergillus and Monillia.
Table (1) Fungal genera isolated from libraries distributed by faculty

| Faculty                  | Isolated genera | Number of fungi and their percentage | Total |
|-------------------------|-----------------|--------------------------------------|-------|
| Central library         | Aspergillus spp | 10(41%)                              | 24(16.4%) |
|                         | Penicillium spp | 6(25%)                               |       |
|                         | Rhizopus spp    | 3(12.5%)                             |       |
|                         | Alternaria spp  | 3(12.5%)                             |       |
|                         | Fusarium spp    | 2(8.3%)                              |       |
| Sciences                | Aspergillus spp | 33(57.8%)                            | 57(39%) |
|                         | Penicillium spp | 15(26.3%)                            |       |
|                         | Rhizopus spp    | 5(8.7%)                              |       |
|                         | Fusarium spp    | 3(5.2%)                              |       |
|                         | Geotrichum spp  | 1(1.7%)                              |       |
| education               | Aspergillus spp | 4(66.6%)                             | 6(4.1%) |
|                         | Penicillium spp | 2(44.4%)                             |       |
| Arts                    | Monilia spp     | 2(15.3%)                             | 13(8.9%) |
|                         | Aspergillus spp | 8(61.5%)                             |       |
|                         | Penicillium spp | 3(23%)                               |       |
| Law                     | Aspergillus spp | 1(25%)                               | 4(2.7%) |
|                         | Penicillium spp | 3(75%)                               |       |
| administration & economics | Aspergillus spp | 13(52%)                              | 25(17.1%) |
|                         | Penicillium spp | 5(20%)                               |       |
|                         | Cladosporium spp| 6(24%)                               |       |
|                         | Alternaria spp  | 1(4%)                                |       |
| Veterinary Medicine     | Aspergillus spp | 11(64%)                              | 17(11.6%) |
|                         | Penicillium spp | 5(29.4%)                             |       |
|                         | Fusarium spp    | 1(5.8%)                              |       |
| total                   |                 | 146                                  |       |

The results showed that there was contamination in the books of the libraries mentioned above. The Faculty of Science library was the most polluted, followed by
the Central Library. The dominant fungi were *Aspergillus*, followed by *Penicillium*, *Rhizopus*, *Alternaria* and *Fusarium*. The study also shows that there is a danger to the workers and those who apostates to libraries, which confirms the existence of an urgent need to prevent the danger of these fungi and find effective solutions.

Saprophytic fungi are considered the most common fungi spread and polluted of organic matter because they are fast growing and resistant to extreme conditions and their high ability to reproduce and adapt. It also produces a large number of spores that spread to all places, including books, and once there is little moisture. Makes it capable of germination and growth. Books should be placed in an appropriate place away from moisture, because they contain cellulose materials that are degradable by microorganisms, especially fungi[12].

The conditions of book storage in the library should be ideal, for example, the library must be completely dry and must have a ventilation system and must be subject to periodic inspection to ensure the absence of pests and through our knowledge and visits to the offices of the university of Qadisiyah we noticed that most libraries do not have all the health conditions on the contrary, we noticed that some buildings were turned into libraries and were not originally designed to be a library. We also noticed the absence of Technicians concerned with the restoration and maintenance of books[10]. The emergence of fungi *Aspergillus spp* and *Penicillium spp* intensively is expected because they are fungi with very simple nutritional needs. Once there is paper, humidity and darkness begin to grow. Paper is a suitable food source and a source of carbon.[13]

![Figure (1) some of the books study included it showed damage](image)

**Disinfectant effects:**

The results in table (2) showed the potency of Formalin as antimicrobial effects than other antiseptics and disinfectant with inhibition zones 49,50,60,58,77,69 mm for the fungi *Aspergillus spp*, *Penicillium spp*, *Alternaria spp*, *Fusarium spp*, *Rhizopus spp* and *Cladosporium spp* successivemenly. Dettol was the second in inhibition the same previous fungi with inhibition zone wealth 32,47,39,55,58,41,52 mm, may be resulted from several causes, first caused, the formalin and Dettol are broad spectrum antimicrobial activity, formalin preserves or fixes tissue or cells by irreversibly cross
linking primary - amine groups in proteins with other nearby nitrogen atoms in protein or DNA through a -2CH- linkage. While Dettol Its mechanism of antimicrobial action is by the denaturation of proteins and inactivation of enzymes in the microorganisms, alters the permeability of the cell membrane that could result in the uncoupling of oxidative phosphorylation, inhibition of active transport, and loss of pool a metabolites due to cytoplasmic membrane damage . mechanism of action of Formalin and Dettol makes the most of this material effective on the microbes more than other antiseptics and disinfectant[14,15].

### Table 2: The antiseptic effect on fungi isolated from books (mm)

| Isolated fungi      | Povidone-Iodine | Povidone | Hydrex | Dettol | Formalin |
|---------------------|-----------------|----------|--------|--------|----------|
|                     | Control 12.5 25 50 | 12.5 25 50 | 12.5 25 50 | 12.5 25 50 | 12.5 25 50 |
| Aspergillus spp     | 0 0 0 0 | 12 15 19 | 9 11 12 | 19 24 32 | 35 47 49 |
| Geotrichum sp       | 0 0 10 18 | 12 15 16 | 23 26 28 | 28 43 47 | 23 40 50 |
| Penicillium spp     | 0 0 0 0 | 0 8 11 | 11 13 16 | 30 32 39 | 33 43 60 |
| Alternaria spp      | 0 10 12 15 | 0 11 18 | 14 15 17 | 43 48 55 | 39 47 58 |
| Fusarium spp        | 0 18 19 29 | 15 17 20 | 20 23 31 | 39 51 58 | 38 49 77 |
| Rhizopus spp        | 0 0 9 10 | 12 15 20 | 13 15 19 | 37 40 41 | 53 57 69 |
| Cladosporium spp    | 0 12 19 21 | 0 10 13 | 18 19 24 | 43 48 52 | 33 55 69 |

### References

1. Al-Taweel, R.S. (2004). Survey of dust fungi from schools, hotels and mosques floors in Diwaniya city. Msc Thesis, Faculty of Science, Univ. of Babylon.
2. Al-Mutairy, D.K.; and Mohammed, B.T. (2018). Isolation and diagnosis of some fungi from the staff at the maintenance center of the manuscripts in the threshold of Husseiniya holy and impact of sensitivity. Journal of Babylon of science. vol.18.no.1:136-151.
3. Al-Waely, M.D. (2017). Characteristics of fungi associated with the manuscripts of the threshold of Husseiniya holy city of Karbala. Msc Thesis, Faculty of Science, Univ. of Babylon.
4. Alexender, M. (1977). Introduction to soil microbiology. John Wiley and sons. USA. PP: 467.
5. Alshibly, M. K. (2017). Molecular Identification of Two Species of Saprolegnia that Predominant in Diwaniyah River/Iraq and Studying Them Nutrition Preference. Journal of Global Pharma Technology. 9.10(9):68-73
[6] Ellis, M.B. (1993). Dematiaceas hyphomycetes. Common, mycol. Inst. Kew., Surrey, England, 608 pp.
[7] Sharma, G.; Pandey, R.R. (2010). Influence of culture media on growth, colony character and sporulation of fungi isolated from decaying vegetable wastes. Department of Life Science, Manipur University, Canchipur, Imphal-795 003, India.
[8] Al-Shibly, M.K. (2019). Molecular study of virulence factors influencing the pathogenicity of Trichophyton rubrum. Eco. Env. & Cons. 25 (1) 153-158.
[9] Cheng, G.; Shi, Y.; Sturla, S.J.; J alas, J.R.; McIn tee, E.J.; Villata, P.W.; Wang, M.; and Hecht, S.S. (2003). Reactions of formaldehyde plus acetaldehyde with deoxyguanosine and DNA: Formation of cyclic deoxyguanosine adducts and formaldehyde cross-links. Chem. Res. Toxicol., 16:145-52.
[10] Watanabe, T. (2007). Pictorial atlas of soil and seed fungus morphology of cultured fungi and key to species. Second edition. CRC press.
[11] Barnett, H.L. and Barry, B.H. (1989). Illustrated genera of imperfect fungi. 4th edition. McCarth press.
[12] Triki, M.A.; Hassairi, A. and ElMahjoub, M. (2006). Premieres observations de Verticillium dahlia sur Olivier en Tunisie. Bulletin OEPP, 36(1):69-71.
[13] Moss, R.B. (2005). Pathophysiology and immunology of allergic bronchopulmonary aspergillosis. Medical Mycology, 43 (1): 203-206.
[14] Levetin, E. and Vande Water, P. (2001). Environmental contributions to allergic disease current. Allergy and Asthma Reports. 1: 506-514.
[15] Heinrich, J.; Holscher, B.; Douwes, J.; Richter, K.; Koch, A.; Bischof, W.; Fahlbusch, B.; Kinne, R.W. and Wichmann, H.E. 2003. Reproducibility of allergen, endotoxin and fungi measurements indoor environment. J. of Exposure Analysis and Environment Epidemiology, 13 (2): 1-9.