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Impact of some common disinfectants on fungi Isolated from air conditioners

Dr. Zuhair Hameed Abboud[1*], Dr. Majid Kadhim Al-Shibly[2], Ihsan Ali Alzamily[3]

[1] Biology Department, College of Science, Kerbala University, Kerbala, Iraq.
EM: Zuhair.alharby@uokerbala.edu.iq
[2] Biology Department, College of Education, Al-Qadisiyah University, Qadisiyah, Iraq.
EM: majid.shibly@qu.edu.iq
[3] Genetic Engineering Department, College of Biotechnology , Al-Qasim Green University, Babil , Iraq.
EM: ihasa.bio@gmail.com

*Corresponding author: Dr. Zuhair Hameed Abboud (Zuhair.alharby@uokerbala.edu.iq)

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Abstract

Due to the frequent use of air conditioners in Iraq due to the hot weather, especially in the summer, and this is accompanied by the presence of many microorganisms in these devices, including fungi that may exist, grow and thrive on air filters and on other parts, and here the air conditioner becomes a source for the spread of fungal spores, some of which may cause various diseases for the human being the aim study included the isolation of some fungi from air conditioners which including 11 species belong to 10 genera: Aspergillus niger , Penicillium notatum ,Rhizopus stolinefer and Alternaria alternata with Frequency ratio (14.18, 14.42, 18.91, 16.31%) respectively, then Candida albicans, Cladosporium herbarum , Rhodotorula sp and Absidia with frequency ratio (4.01, 6.61, 10.16, 10.4%) as the two fungi found that they are the least visible, Trichophyton rubrum and Basidiobolus sp with ratio (0.94, 0.7) % respectively. Absidia and Basidiobolus, two fungi that cause black mold disease for Covid 19 patients. The traditional bracket air conditioners recorded the proportions and the largest number due to the fact that they contain a purification mechanism and their machines take the air directly from the surrounding environment followed by cars AC, while the means of isolation from split unit air conditioners came with the lowest isolation rate.

Keywords
air conditioners, Split unit, car AC, Fungi and disinfectant

Air conditioners (AC) of all kinds is an irreplaceable option in hot environments, especially in the relatively long summer in Iraq, families resort to the air conditioners from May until the end of September, during which time some fungi begin to gather on filters for air conditioners, whether split air conditioners (SAC), normal air conditioners AC or car AC. It is a moist, dark environment in AC suitable for fungus growth [1, 2]

Fungi live in almost all terrestrial environments. In this regard, the interiors of human housing and workplaces are no exception. There is a group of microorganisms adapted to living with humans in enclosed areas of living rooms, sleep, kitchens, etc. as they have adapted over time and have special qualities that enable them to survive and continue such as the enzymatic system, temperature gradation and other qualities. Carrying microbiology in the air and dust and as a result of the continuous filtering of organic and inorganic airborne particles that arise from multiple internal sources such as exhalation air, dust, clothing fluff, pets and external such as storms and factory smoke, house dust is a mixture of dust, dead cells and threads consisting mainly of fabric fibers, hair and

falling epithelial debris (dead cells of skin) [3, 4]

Fungi commonly isolated from indoor air include Alternaria, Aspergillus, Aureobasidium, Cladosporium and Penicillium [5, 6].Filters in air conditioners are a soft, porous insulator often used in air conditioning systems. Direct microscopy of air filters reveals pollen molecules, cellulose fibers, synthetic fibers, plant residues, decomposing leaves, insect parts, dust mites and many organic compounds, cellulose and synthetic fibers are likely to come from internal sources, while other components are likely to originate from external sources. Insulation also absorbs moisture and volatile organic matter and provides suitable substrates for the colonization of fungi (these organic substances are excellent nutrients for fungus growth, and as a result air filters contain an abundance of fungal threads and germs, dust and microorganisms may accumulate in ducts to a large extent become visible to the naked eyes[7] .

Fungi and dust atoms are collected in filters and in drainage places resulting from condensation and in the entry and exit openings of spores, one of the most dangerous things is that hospital lobbies are contaminated with fungi as they become a source of spread and direct threat to patients, especially those suffering from immunodeficiency such as patients with wounds, burns, diabetes, AIDS, cancer and others [8]

The outbreak and spread of Covid 19 disease in a global epidemic and due to various treatment methods requiring the use of immunosuppressant drugs, including long-term patients and the use of respiratory devices, have shown us many innate complications, including black fungus disease (Mucormycosis) , as fungi reach Covid 19 patients through the respiratory tract and cause serious diseases that cause death at very high rates of up to 80% [9]

Human infections caused by internal fungi are rarely caused by highly efficient defense mechanisms of human cells, such as cell-mediated response, yet spores and hypha may sometimes cause allergenic responses, and some receptors produced by fungi may be toxic or have immune activity in humans, which may lead to a decrease in the defense capacity of the host, whether due to Cancer, AIDS or transplantation.

Pollutants in closed environments can be divided into two categories: biota, including fungi, bacteria, parasites and their eggs, as well as insects such as mites and plant parts, especially pollen, small whiskers, and the second category is non-living substances of dust, wool, hair, lint and dead falling cells and smoke, whenever the amount of fungal vaccine that invades the body in numbers. The higher the likelihood of infection, as well as the body's meagre immunity, and the ferocity of the pathogen, some fungi are characterized by the production of large numbers of fungi and some of them are toxic and produce toxins such as aflatoxins and ergot, very few of which affect the patient's health [10, 11] .

Doctors use special medical disinfectants to wash their hands and the skin of their patients; To be sterilized before the operation surgical. They also spray serious wounds with antiseptic sprays; To prevent it from being contaminated, it should be used. Medical antiseptics in first aid for cut wounds and others. However, many doctors and others. Those concerned with health affairs are skeptical about the feasibility of using medical disinfectants, at a time when. It is sufficient to wash these wounds with soap and water, which takes the place of medical antiseptics that do not need to be obtained. It is subject to medical instructions or prescriptions, and the matter of serious injuries is left to medical treatment, and may cause. Antibacterial chemicals in medical disinfectants, causing side effects including infections. Local or other disorders, such as allergies or skin abnormalities, and specialists confirm the safety of medicinal disinfectants, if used correctly[12].

diagnosing fungi found in air conditioners and demonstrating their seriousness as well as their resistance by chemical methods.

The purpose of this study

The current study is one of the very few studies in Iraq aimed at isolating and

Materials and Methods

Isolation and Diagnosis

The practical part of this study was carried out in the research laboratory in the Department of Biology, Faculty of Education, University of Qadisiyah during the month of October 2020. Various samples of air conditioners were collected randomly, where they included fifty split devices, fifty air conditioners and randomly transmitted by cotton swabs that were taken and passed on the air exit nets and exit control wings and directed air in the above devices, after which the swabs were placed in an envelope and transported as soon as possible to the laboratory for the purpose of implanting them on the nutrient medium[13]

The nutrient medium used was petri dishes containing inside the Sabouraud Dextrose Agar contain an antibacterial Chloramphenicol (0.05)%. The medium was inoculated with cotton swabs in three replicates per sample while some plates were left inoculated for comparison ,then all plates were transferred to incubator in 27 ℃ for seven days after which growths were observed and examined for diagnosis by comparison with diagnostic keys, as the diagnosis included macroscopic features as shape, color, smell, nature and speed of growth as well as microscopic features such as hypha form and reproductive compositions such as sporangia , spores and others [14-19]

Disinfectants

Fungi have been tested against five types of disinfectants on the market: Formalin, Povidone, Povidone-Iodine, Chloroxylenol Hydrex. Three concentrations were used per disinfectant: (12.5-25-50)% and where disinfectants were softened with sterile distilled water and according to the following mathematical equation: N1V1=N2V2. The wells method was used , the test was conducted as follows: Attend the medium (SDA)and put in the incubator for 24 hours before inoculation make sure there is no contamination, then fungal suspension was banned by moving part of the fungal colony after it was activated on the medium (SDA) using flour tongs and placed in a sterile test tube container on 5 ml of normal saline solution and shaken by Max mixer and then calculated the preparation of fungal cells and spores using the Hemocytometer cell counting device for a concentration of 10^{10} spore/ml and then deployed by cotton swab and left plates after inoculation for 30 minutes , a 5 mm wells were made in medium by sterile corky drill, 0.1 ml of previously prepared disinfectants was added to each hole with micro pipette and incubate plates at a temperature of 27 ℃ for three days.

Results and discussion

Isolation and Diagnosis

The results showed a number of fungi in air conditioners including 11 species belong to 10 genera Aspergillus niger , Penicillium notatum ,Rhizopus stolonifer and Alternaria alternata With frequency (14.18, 14.42, 18.91, 16.31%) respectively, then Candida albicans, Cladosporium herbarum , Rhodotorula sp and Absidia sp with frequency ratio (4.01, 6.61, 10.16, 10.4%) as the two fungi found that they are the least visible Trichophyton rubrum and Basidiobolus sp with ratio (0.94, 0.7) % respectively. Absidia sp and Basidiobolus sp , two fungi that cause black mold disease for Covid 19 patients. [20, 21]

The traditional bracket air conditioners recorded the proportions and the largest number due to the fact that they contain a purification mechanism and their machines take the air directly from the surrounding environment followed by cars AC due to their continuous movement in contaminated environments, while the means of isolation from split unit air conditioners came with the lowest isolation rate, which may be due to the fact that most of the them contain a purification mechanism and filters prevent access to fungi also because they consist of two separate units as the air of the room becomes separated from the outer circumference [22] [23].

The results were nearly to Rocha et al.(2019) [24, 25] when they isolate 14 species, mostly belong to opportunistic fungi, they recorded lower rates of skin fungi such as Trichophyton rubrum. Air and soil fungi such as Rhizopus stolonifer, Aspergillus, Alternaria

and Penicillium can produce huge number of spores and can separate in air and may reach air conditioners, this fungus can survive in hard situations. Fungi located in many places especially in places to be contaminated as well as their tolerance to difficult and inappropriate conditions and exploitation of many food sources. It is known that most isolated fungi a large number of spores carried by air, which increases the likelihood of carrying various fungi causing infection in homes and hospitals, which confirms the role of contaminated air conditioners in the dissemination of medically important fungi in homes [25, 26] .

Table (1) Isolated fungi by type of ACs

Fungus	air con.	Cars	split	Total	Percentage
Absidia	9	3	5	17	4.01
Alternaria alternata	39	20	10	69	16.31
Aspergillus flavus	4	5	5	14	3.3
Aspergillus niger	12	25	24	61	14.42
Basidiobolus	1	2	1	4	0.94
Candida albicans	16	13	15	44	10.4
Cladosporium herbarum	19	16	8	43	10.16
Penicillium notatum	19	31	10	60	14.18
Rhizopus stolonifer	43	21	16	80	18.91
Rhodotorula sp	12	10	6	28	6.61
Trichophyton rubrum	1	1	1	3	0.7
Total	175	147	101	423	

Disinfectants

The results shown in table 2 indicated a variation in inhibition ratios where formalin disinfectant was the most efficient disinfectant, with the highest inhibition rate and a concentration of 50% for Basidiobolus 77 mm, and then this value is reduced by less concentrations (25%, 12.5%). To become (49,38 mm), Dettol showed a clear effect in inhibiting the growth of isolated fungi but by less than the first disinfectant, where the concentration of 50% was more influential, it recorded the highest inhibition rate of 70 mm of Cladosporium herbarum and then reduced this value by less composition (25% and12.5%) to become (63, 39) mm. It causes fungal cell protoplasm clotting as well as the breakdown of the cellular wall and its proteins. Povidone-Iodine varied in terms of their inhibition of fungi by fungal species. Fungi have recorded high resistance by fungi where the resistance rate was 100% by Absidia, Aspergillus flavus and Trichophyton rubrum and had the highest effect in Basidiobolus (29 mm) in a concentration of 50%. [27] .

Table (2) average inhibition zone for the growth of isolated fungi isolated from ACs.

Fungus	Average inhibition zone for fungus growth (mm)														
	Formalin			Dettol			Hydrex			Povidon			Povidon-Iodine		
	50 %	25 %	12.5%	50 %	25 %	12.5%	50%	25%	12.5%	50 %	25 %	12.5%	50 %	25 %	12.5%
Absidia	49	47	35	32	24	19	12	11	9	19	15	12	0	0	0
Alternaria alternata	50	40	23	47	43	28	28	26	23	16	15	12	18	10	0
Aspergillus flavus	60	43	33	39	32	30	16	13	11	11	8	0	0	0	0
Aspergillus niger	58	47	39	55	48	43	17	15	14	18	11	0	15	12	10
Basidiobolus	77	49	38	58	51	39	31	23	20	20	17	15	29	19	18
Candida abicans	38	36	24	38	30	29	20	19	15	11	15	14	24	22	19
Cladosporium herbarun	74	65	15	70	63	39	31	29	27	23	13	9	17	14	10
Trichophyton rubrun	51	49	44	49	44	39	15	12	10	9	0	0	0	0	0

Conclusions

1-Air conditioning systems and units constitute an optimal environment for the growth and gathering of fungi due to the high humidity, which is a suitable medium for their growth and reproduction in it. Accordingly, the air resulting from neglected air conditioning units' systems without cleaning is considered polluted air carrying many microbes that may pose a threat to human health.

2- Air conditioners are the most polluted, followed by cars and then the least polluted by fungi due to their installation and work mechanism

3- There are many medically important fungi present among the pollutants of refrigeration devices, some of which cause skin diseases, and

some of them cause systemic diseases, especially the black fungus.
4- Disinfectants are effective in cleaning cooling devices, especially formalin and Dettol.

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