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Identification of new genera of fungi associated with the mobile phones of biology students

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Abstract

Sixty samples were taken from the covers and displays of phones, and 2 samples from the headphones of biology students in the College of Science, Salahaddin University. Fungal genera were diagnosed phenotypically based on the color and shape of the colony from the front and reverse sides in the Petri dish, and diagnosed microscopically. Twenty-one fungal genera belonging to 29 species were isolated. The highest genera of fungal isolates were Aspergillus spp. Four new genera, *Kutilakesopsis* sp., *Myrothecium verrucaria*, and *Thanatephorus Cucumis*, and two new species, *Dreschlera bisepta* and *Tritrachium oryzae*, were recorded for the first time from mobile phones of biology students in the College of Science, Salahaddin University-Erbil. In addition, yeast was identified on CHROM Agar based on the formation of a colony color, such as *Candida albicans*, *C. glabrata*, and *C. parapsilosis*. The sensitivity test by the Agar Well Diffusion Method was performed for six species of Aspergillus against four sterilized agents: Dettol, Ethanol (%70%), Sanitizer, and Wet wipes on Sabouraud Dextrose Agar (SDA). Compared to the control, Aspergillus species were shown to be fairly sensitive to each of the tested sterilizing agents based on the zone of inhibition of growth, except that the sanitizer was resistant to all species of Aspergillus. This means it is necessary to sterilize a phone with sterilizing agents, as it can be a source of disease transmission.

1. Introduction:

A mobile phone, often known as a cell phone, is a portable, long-range electronic device used for private communication in day-to-day. It is often kept close to the body of the human. Since the majority of adults and many youths now own mobile phones, they have surpassed landlines in most countries [1], [2]. Numerous germs that are often found on the skin thrive in the heat produced by phones and the continual handling, according to microbiologists. Additionally, users' frequent handling of mobile phones creates an environment conducive to the spread of germs and illnesses linked to hospitals [3], [4], [5]. Due to their portability, mobile phones can be kept in a variety of locations, including dining tables, restrooms, kitchens, and even pants. This may pose a health risk and harbour numerous bacteria that inhabit every square inch of the mobile phone screen [6], [7]. Microbes dwell in every part of mobile phones, which makes them harmful. These microorganisms, particularly fungi that infect the skin and respiratory tract, can increase the risk of infection. Mobile devices are contaminated by numerous common fungi [8]. The kingdom Myceteae includes fungi, which are among the most common living things on Earth. There are around 144 thousand species of fungi, including Molds, rusts, yeasts, and fungi with ecological and therapeutic significance [9]. The following are the most common fungi linked to cell phones: *Aspergillus*, *Candida*, *Cladosporium*, *Fusarium*, *Penicillium*, and *Rhizo-*

pus. Overuse of Bluetooth or conventional headphones fosters the perfect habitat for the growth of fungus. Furthermore, any foreign body in the ear might result in a yeast infection and an auditory canal disease, both of which impede hearing [10]. It is recognized that several fungal genera, including *Fusarium* sp., *Penicillium* sp., *Candida* sp., *Cladosporium* sp., *Aspergillus* sp., and *Rhizopus* sp., can be harmful to humans and other hosts to varying degrees. These fungi can cause a variety of illnesses, especially in immunocompromised people, ranging from minor infections to serious, potentially fatal invasive mycoses [11], [12]. To identify the most common genera of fungi found in mobile phones and earphones, the goal of the current investigation was to separate and characterize fungi from phones and earbuds of a sample of biology students from all classes, both medical and general. and assess how well certain sterilizing agents work to stop or lessen the growth of fungal isolates.

2. Material and Methods:

2.1 Media:

2.1.1 Sabouraud dextrose Agar (SDA):

Prepared by dissolving 63 grams in one liter of D.W. and autoclaving for 15 minutes at 121 degrees Celsius and 15 pounds per square inch.

2.1.2 CHROMagar Candida (bioMérieux, France):

Dissolve 47.7 g in 1 Liter of D.W. to prepare. Heat and bring to a boil (100 ^{o}C), stirring or swirling often until the agar has completely melted. Avoid heating to over 100 degrees Celsius.

2.2 Collection of samples:

The research was carried out in the Salahaddin University College of Science. A Total of sixty mobile phones and two headphones were randomly sampled from (30 females and 30 males) students of the biology department (Medical and general group), 15 samples from each stage (1^{st}, 2^{nd}, 3^{rd}, and 4^{th}), during two months from October to December, 2024. These samples differed in terms of gender, grade, duration of mobile use, frequency of cleaning, method of cleaning, quality of the mobile, and use of headphones. The samples were collected by carefully passing a cotton swab moistened with saline over each mobile device (screen and cover) and headphone (if present). Each swab was first inoculated onto SDA medium, enriched with chloramphenicol to inhibit bacterial growth, and then incubated at 25 ^{o}C for five to seven days, during which the isolates were monitored for growth and colonial description [13].

2.3 Fungal diagnosis:

The colour and shape of the colony on the front and back sides of the Petri dish were used to diagnose the fungi phenotypically. A small sample of the colony was placed on a sterile glass slide and treated with one drop of Lactophenol Cotton Blue (LPCB) to facilitate microscopic diagnosis of the fungi. A light microscope was then used to examine the slide at a 40X magnification, and the results were recorded. The taxonomic keys of fungi determine the texts (books) needed for their identification, such as: [14], [15], [16], [17], [18]. The slide culture is the best method for preserving and observing the actual structure of a fungus. It is not a rapid technique, but it is unsurpassed as a routine means of studying the fine points of the microscopic morphology of fungi [19]. The identification of some mold, such as *Penicillium* sp., was carried out in a similar way to that of *Aspergillus*, where the diameter of the grown colonies, colony color, and the pigmentation of the fungi were observed. Fungal structures were measured using a stage and an ocular micrometer [20].

2.4 Chromogenic medium (CHROM Agar Candida):

All yeast cultures were cultivated on CHROM Agar (BioMérieux, France) following incubation (48 hours at 37 ^{o}C), and the identification of yeast was based on colony colour [21].

2.5 Antifungal Sensitivity Test:

The sterilizing agents include: Dettol, Ethanol (70%), Sanitizer, and Wet wipes were tested against *Aspergillus* isolates. Five days of fresh colony cultures cultivated on SDB were used to create the Aspergillus species inoculum, which was then adjusted to 1x106/ml using a bright-line hemocytometer (Hausser Scientific, Horsham, PA). In short, each isolate was suspended in 100µL of SDA, and 6 mm diameter wells were punched in the culture media using a sterile corkborer. Each well was then filled to the brim with 100µL of each drug. For twenty-four hours, the treated plate was incubated at 37 ^{o}C. Using a ruler, the widths of the zones of inhibition for each sterilizing agent were measured in millimetres [22], [23].

3. Results and Discussion:

A total of sixty mobile phones, in addition to headphones, were randomly collected from four stages of students (30 female and 30 male) in the Biology Department of Science-Salahaddin University. Fifteen students were randomly chosen from each of the following grades: 1^{st}, 2^{nd}, 3^{rd}, and 4^{th}. Fungal genera were identified phenotypically based on macroscopic and microscopic examination (Figure 1). The stage, Sex, type of mobile, type of cover (smooth or rough), duration of mobile use, frequency, method of cleaning, use of headphones, colonies of fungal isolates, and other factors are summarized in Table 1. The data in this table illustrates the impact of cleaning the phone by the students on the percentage of fungal growth, with a few exception, it was revealed in general that the students who never cleaned their phones can lead to an increase in the colonies of fungi, such as, sample 47, the colony of fungi was 30 colonies, followed by sample 3 (23 colonies), sample 49 (22 colonies), sample 55 (20 colonies), and sample 51 (18 colonies), while fungi did not appear on the phones of the students who cleaned them daily, such as samples 21, 24, and 36.

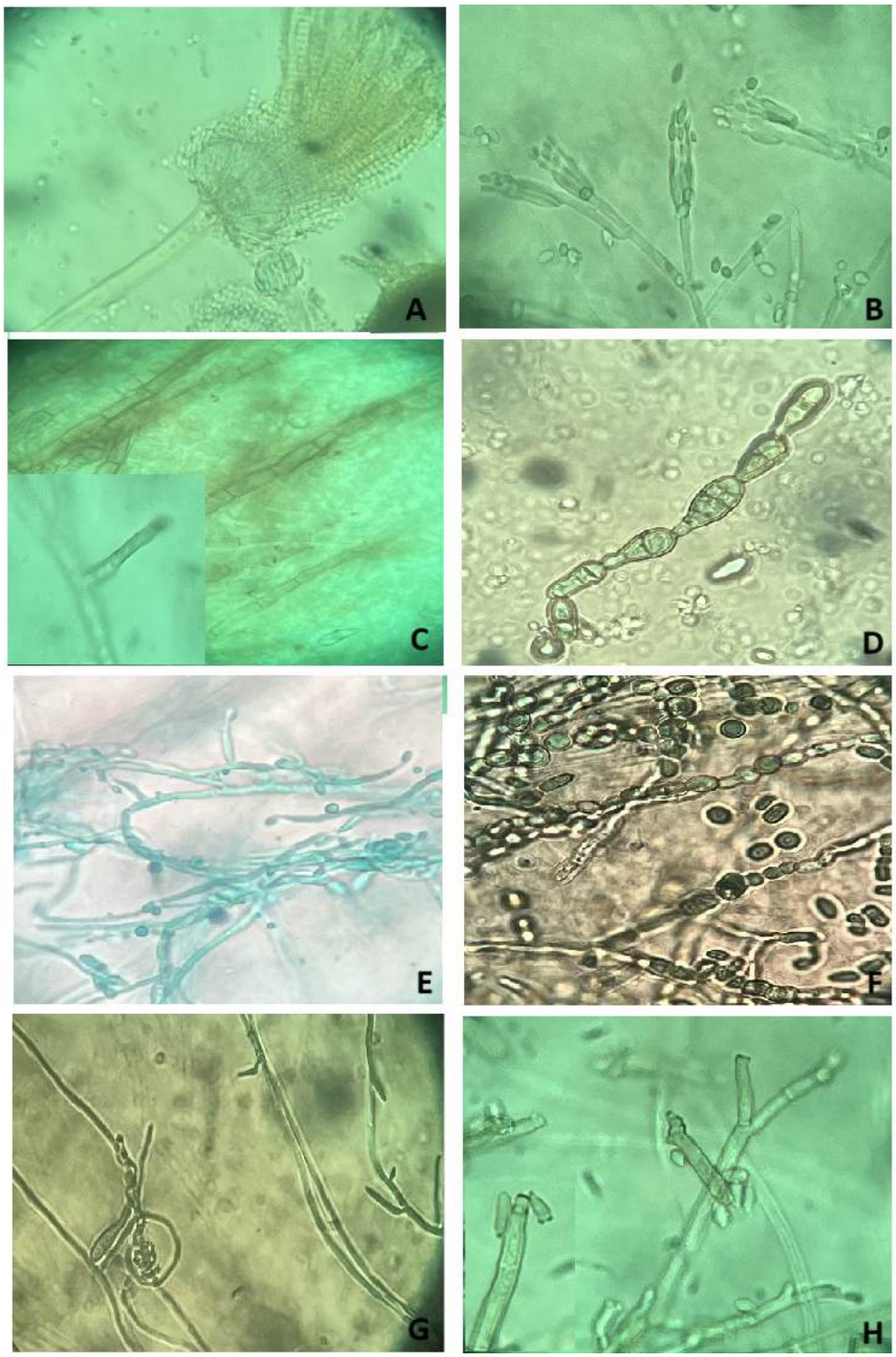

Figure 1. Microscopic features of fungi genera and species stained with lactophenol cotton blue (40X) A. *Aspergillus* B. *Paecilomyces* sp. C. *Chalara* sp., D. *Alternaria alternata* E. *Tritrachium oryzae* F. *Geotrichum candidum* G. *Epidermophyton* sp. H. *Cladosporium* sp.

Table 1. Questionnaire taken from the students about their mobile phone samples and colonies of fungal isolates.

S	Ge	Gr	DOUP	FOC	WOC	Mo	H	CFI
1	M	1st class	5 h	A few times a week	Tissue paper	S	Nil	4
2	M	1st class	7-8 h	once a week	Wet wipes	S	Nil	11
3	M	1st class	4 h	Never	—	S	Nil	23
4	M	1st class	8 h	Once a month	Wet wipes	S	Nil	5
5	F	1st class	9 h	Twice a week	Tissue paper	S	Nil	7
6	F	1st class	7 h	Once a week	Tissue paper	S	Nil	16
7	F	1st class	5 h	Twice a day	Tissue paper	S	Nil	4
8	F	1st class	6 h	Once a day	Tissue paper	S	Nil	4
9	M	1st class	10 h	Once every few days	Tissue paper	S	Nil	12
10	M	1st class	11 h	Once a week	Tissue paper	S	Nil	11
11	F	1st class	6 h	Every day	Tissue paper	S	Nil	10
12	F	1st class	10 h	Once a month	Tissue paper	S	Nil	4
13	F	1st class	8 h	Once a week	Tissue paper	S	Nil	15
14	M	1st class	3 h	Once a month	Tissue paper	S	Nil	9
15	M	1st class	6 h	Once a month	Tissue paper	S	Nil	10
16	F	2nd class	5 h	Twice a week	Wet wipes	S	Nil	12
17	M	2nd class	16-17 h	Never	—	S	Nil	5
18	F	2nd class	5-6 h	Once a day	Wet wipes	S	Nil	1
19	F	2nd class	5-6 h	Once a day	Tissue paper	S	yes	3
20	F	2nd class	4-5 h	Once a week	Alcohol	S	Nil	1
21	F	2nd class	3-4 h	3-4 days a week	Wet wipes	S	Nil	0
22	F	2nd class	5h	Once a day	Wet wipes	S	Nil	3
23	F	2nd class	5h	Once a day	Tissue paper	S	Nil	6
24	F	2nd class	5-6 h	Twice per day	Alcohol	S	Nil	0
25	M	2nd class	5h	Once a month	Tissue paper	S	Nil	5
26	M	2nd class	8 h	Once a 3-month	Wet wipes	S	Nil	11
27	M	2nd class	4-5 h	Never	—	S	Nil	6
28	M	2nd class	3-4 h	Once a week	Alcohol	S	Nil	4
29	M	2nd class	15-16 h	Never	—	S	Nil	3
30	M	2nd class	4-5 h	Twice a week	Alcohol	S	Nil	10
31	M	3rd class	4 h	Never	—	S	Nil	1
32	F	3rd class	6-7 h	Once a week	Wet wipes	S	Nil	5
33	F	3rd class	7-8 h	Once a day	Wet wipes	S	Nil	3
34	F	3rd class	7-8 h	Once every 2 days	Wet wipes	S	Nil	9
35	F	3rd class	7-8 h	Once every 2 days	Alcohol	S	Nil	13

36	F	3^{rd} class	6-7 h	Once a day	Wet wipes	S	Nil	0
37	F	3^{rd} class	5-6 h	Never	—	S	Nil	6
38	F	3^{rd} class	6 h	Once every 2 days	Alcohol	S	Nil	5
39	F	3^{rd} class	8-10 h	Once a week	Alcohol	B	Nil	9
40	M	3^{rd} class	8 h	Never	—	S	Nil	8
41	M	3^{rd} class	6 h	Every day	Wet wipes	S	Nil	2
42	M	3^{rd} class	8 h	Once a month	Alcohol	S	Nil	4
43	M	3^{rd} class	9h	Once every 3 weeks	Tissue paper	S	Nil	2
44	M	3^{rd} class	3-4 h	3-4 per day	Alcohol	S	Nil	11
45	M	3^{rd} class	5-6 h	Once a month	Wet wipes	S	Nil	12
46	M	4^{th} class	4-6 h	Once a week	Wet wipes	S	Nil	16
47	M	4^{th} class	8-10 h	Never	—	S	Nil	30
48	F	4^{th} class	4 h	Every day	Wet wipes	S	Nil	4
49	F	4^{th} class	12 h	Never	—	S	Nil	22
50	F	4^{th} class	6 h	Once a month	Tissue paper	S	Nil	16
51	F	4^{th} class	6 h	Never	—	S	Nil	18
52	F	4^{th} class	3 h	Once a week	Wet wipes	S	Nil	10
53	M	4^{th} class	6 h	Once a week	tissue paper	S	Nil	2
54	F	4^{th} class	9 h	2-3 per day	Wet wipes	S	Nil	9
55	F	4^{th} class	10 h	Never	—	S	Nil	20
56	M	4^{th} class	10 h	Once a month	Tissue paper	S	Nil	7
57	M	4^{th} class	3-4 h	Never	—	S	Nil	3
58	M	4^{th} class	5 h	Never	—	S	Nil	2
59	M	4^{th} class	7 h	Never	—	S	Nil	1
60	M	4^{th} class	3-4 h	Never	—	S	Yes	7

Table 2 shows 11 genera of fungi belonging to 15 species, isolated from 1^{st}-class students, including *Alternaria alternata*, *Aspergillus flavus*, A. *fumigatus*, A. *niger*, A. *ochraceus*, A. *terreus*, *Beltrania* sp., *Cystobasidium* sp., *Gliocladium* sp., *Kutilakesopsis* sp., *Mucor* sp., *Mycelia sterilia*, *Penicillium* sp., *Rhizoctonia* sp., and Yeasts. The fungal isolates with the highest frequency and prevalence were Aspergillus species. (82 colonies), while *Alternaria alternata*, *Beltrania* sp., and *kutilakesopsis* were the lowest (1 colony) for each genus.

Table 3 reveals ten fungal genera, representing fifteen species, that were isolated from second-class students' cell phones. These include *Aspergillus flavus*, A. *niger*, A. *oryzae*, A. *terreus*, *Chalara* sp., *Cladosporium* sp., *Fusarium* sp., *Gliocladium* sp., *Mycelia sterilia*, *Epidermophyton* sp., *Penicillium* sp., *Rhizoctonia* sp., and *enzymes*. *Chalara* sp., *Fusarium* sp., *Epidermophyton* sp., and *Gliocladium* sp. had the lowest prevalence and frequency (1 colony) for each genus, whereas *Aspergillus* spp. had the highest frequency and prevalence among the fungal isolates (52 colonies). Furthermore, headphones were used to isolate two colonies of A. *fumigatus*.

Table 4 illustrates ten genera of fungi belonging to fourteen species isolated from the mobile phone of 3^{rd}-class students, including: *Alternaria alternata*, A. *raphani*, *Aspergillus flavus*, A. *niger*, A. *oryzae*, A. *terreus*, *Cladosporium* sp., *Drechslera biseptata*, Geotrichum *candidum*, *Mycelia sterilia*, *Paecilomyces* sp., *Rhizoctonia* sp., and Yeast. *Aspergillus* spp. had the highest prevalence and frequency among the fungal isolates (66 colonies), while *Geotrichum candidum* and *Rhizoctonia* sp. (1 colony), the lowest.

Table 5 shows ten genera of fungi belonging to fourteen species, isolated from the mobile phone of 4^{th}-class students, such as *Aspergillus flavus*, A. *fumigatus*, A. *niger*, A. *ochraceus*, *Myrothecium verrucaria*, *Paecilomyces* sp., *Penicillium* sp., *Rhizoctonia* sp., *Thanatephorus Cucumis*, *Tritirachium oryzae*, and Yeasts. The fungal isolates with the highest frequency and prevalence were Aspergillus species (107 colonies), while *Myrothecium verrucaria*, *Thanatephorus Cucumis Tritirachium oryzae* (1 colony for each), were the lowest. In addition to 1 colony of *Alternaria alternata* and 3 colonies of A. *flavus* were isolated from headphones.

In Tables 3, 4, 5 the species of Candida were identified on Chromagar medium, depending on colony color after 48 hours at 37 ^{o}C. Each of *Candida albicans* (11 colonies), C. *glabrata* (14 colonies), C. *parapsilosis* (1 colony) was identified.

Table 6 presents a comparison between females and males regarding the number of fungal colonies among all grades of biology students. The number of fungal colonies in both males and females is 472, female (235 colonies) and male (237colonies), indicating that the male phone samples had two more fungal colonies than the female phone.

In general, the new genera isolated from mobile phones include *Chalara* sp., *Myrothecium verrucaria*, *Thanatephorus Cucumis*, and *Kutilakesopsis*, sp., while the new species include *Dreschlera bisepta* and *Tritrachium oryzae*.

Table 7 shows all six species of Aspergillus that were studied against sterilizing agents: Dettol, Ethanol (%70%), Sanitizer, and Wet wipes, according to the growth inhibitory zone. SDA agar was subjected to the Agar Well Diffusion Method. In general, *Aspergillus* spp. was reported to be moderately sensitive to each tested sterilized agent compared to the control, except that the sanitizer was resistant to all species of *Aspergillus* (Figure 2).

These results agree with the results of [24], who examined the prevalence of high quantities of fungus from Brazilian public telephones contaminating cell phones. [10], indicated that a significant percentage of A. *niger* and a group of harmful fungi had been isolated. [25], discovered fungi that are known to cause irritation, allergic asthma, and respiratory infections include *Alternaria* sp., *Pencillium* sp., and *Aspergillus* sp. [26], isolated *Alternaria alternata*, *Aspergillus niger*, A. *flavus*, A. *fumigatus*, *Cladosporium* sp., *Penicillium* spp., and *Rhizopus stolonifera*.

Numerous experts have recently looked into the possibility of bacterial and fungal contamination of cell phone surfaces [27]. [9], gathered 13 samples from the screens of phones and headphones, then isolated multiple fungal species, and identified six different types of fungi. *Aspergillus* sp. was the most prevalent fungus in phones, while Penicillium sp. and *Aspergillus* sp. were the most prevalent fungi in headphones. [28], examined the microbiological colonization of cell phones used by Baqubah Technical Institute nursing students.

Alternaria spp., *Aspergillus fumigatus*, A. *niger*, *Cladosporium* spp., and *Penicillium* sp. were among the fungal species isolated. [29], [30], identified Candida spp. on CHROM agar medium, according to the colony's colour. [31], [32] identified *Candida albicans* and C. *krusei* on CHROMagar following a 48-hour incubation period at 37 ^{o}C.

According to the study, numerous fungus species were found on the students' cell phones, which may be a significant source of human cross-transmission [33]. A study conducted at Universitas Swadaya Gunung Jati's Faculty of Medicine examined the microbial contamination of cell phones and determined which fungal microbial species were most significant. The following fungal isolates were found: *Alternaria* sp., A. *flavus*, A. *Fumigatus*, A. *niger*, A. *ochraceus*, *Candida* sp., *Cladosporium* sp., *Mucor* sp., and *Penicillium* sp. Due to frequent handling, it was shown that public phones harbour a variety of fungi, including A. *niger* and *Rhizopus* sp. [1].

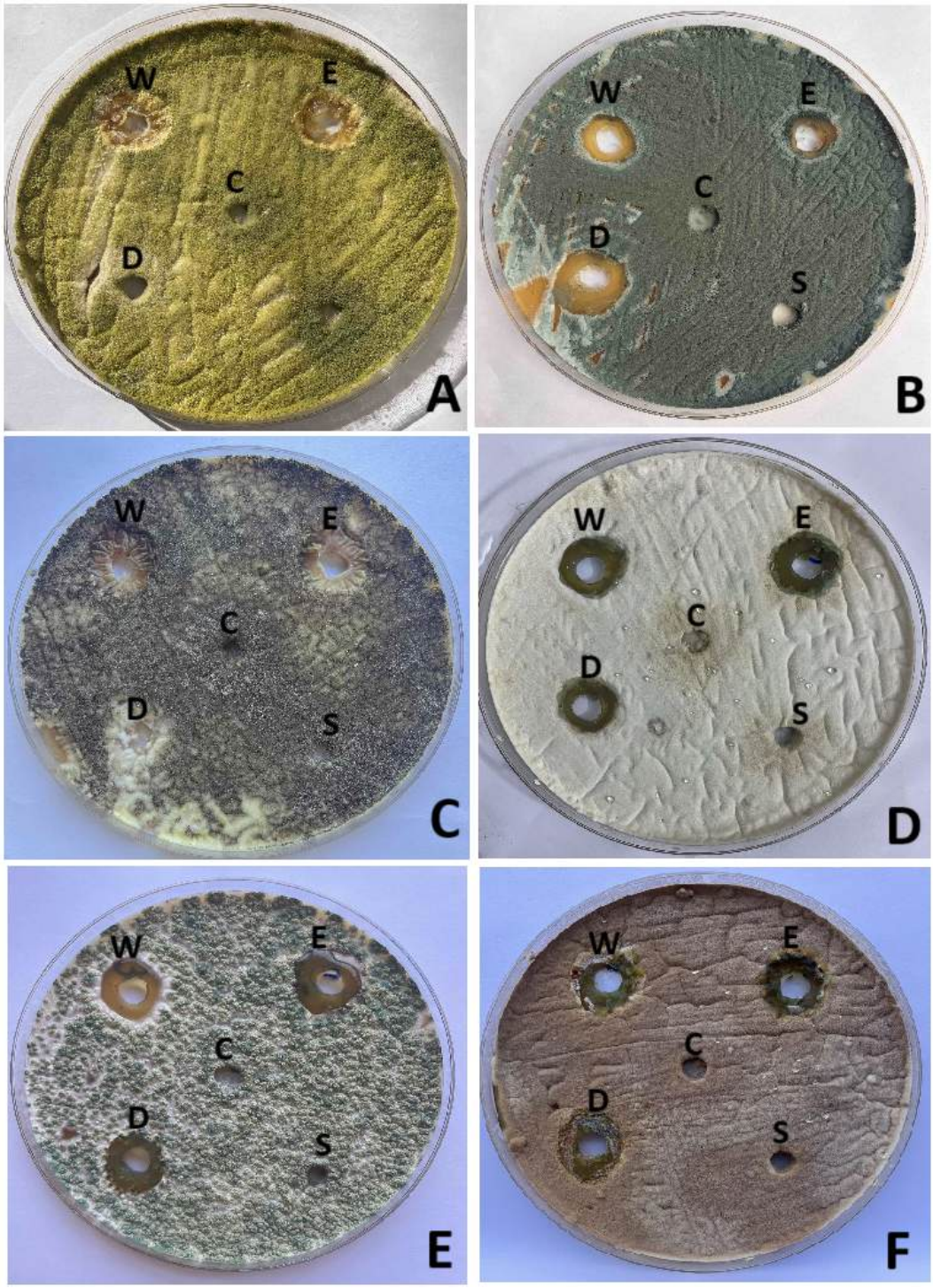

Figure 2. Antifungal sensitivity of sterilized agents: Dettol (D), Ethanol (E), Sanitizer (S), and Wet wipes (W), against A. *Aspergillus flavus* B. A. *fumigatus* C. A. *niger* D. A, *ochraceous* E. A. *oryzae* F. A. *terreus*.on SDA, after 4 days at 28±2 ^{o}C using agar Well Diffusion Method, well diameter (6mm), Petri dish size (9cm)

Table 2. Phenotypic identification of the fungal isolates from 1st class students.

	Samples															
Isolates	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Alternaria alternata	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Aspergillus flavus	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	**3**
A. fumigatus	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
A. niger	1	1	3	3	0	0	1	0	0	0	0	0	0	0	0	**9**
A. ochraceus	2	0	0	2	0	0	0	1	7	0	4	0	0	3	6	**25**
A. terreus	0	0	0	0	0	16	0	0	0	11	0	0	15	0	0	**42**
Beltrania sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Cystobasidium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	**2**
Gliocladium sp.	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
kutilakesopsis sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Mucor sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	**4**
Mycelia sterilia	0	0	2	0	2	0	0	0	0	0	0	3	0	70	0	**7**
Penicillium sp.	1	0	4	0	0	0	0	1	3	0	0	1	0	0	0	**10**
Rhizoctonia sp.	0	0	2	0	1	0	0	1	0	0	0	0	0	0	1	**5**
Yeasts	0	5	11	0	4	0	0	1	0	0	6	0	0	0	3	**30**
Total	**4**	**11**	**23**	**5**	**7**	**16**	**4**	**4**	**12**	**11**	**10**	**4**	**15**	**9**	**10**	**145**

4. Conclusions:

Numerous fungal species infected the mobile phones and earphones under examination, potentially causing illness and influencing pupils' behaviour. The fungal isolates with the highest frequency and prevalence were Aspergillus species. Everyone should receive hygiene education, follow thorough instructions, wash their hands frequently, and regularly decontaminate their mobile phones by properly cleaning them to lower this possible risk. Numerous fungal species were found on the students' cell phones, which may be a significant source of human cross-transmission.

5. Acknowledgment:

Our special thanks go to the biology students for participating in the study and the University of Salahaddin College of Science-Biology Department for providing the opportunity to carry out the work.

Table 3. Phenotypic identification of the fungal isolates from 2nd class students.

	Samples																
	19																
Isolates	**16**	**17**	**18**	**Mo**	**H**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**Total**
Aspergillus flavus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
A. fumigatus	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	**2**
A. niger	11	4	0	0	0	0	0	0	0	0	3	6	2	0	0	1	**27**
A. oryzae	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	**3**
A. terreus	0	0	0	0	0	0	0	0	2	0	1	4	1	3	2	6	**19**
Candida albicans	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
C. parapsilosis	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Chalara sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Cladosporium sp.	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**2**
Fusarium sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Gliocladium sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Mycelia sterilia	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	**4**
Epidermophyton sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Penicillium sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	**3**
Rhizoctonia sp.	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	**3**
Total	**12**	**5**	**1**	**1**	**2**	**1**	**0**	**3**	**6**	**0**	**5**	**11**	**6**	**4**	**3**	**10**	**70**

Table 4. Phenotypic identification of the fungal isolates from 3rd class students.

	Samples															
Isolates	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**Total**
Alternaria alternata	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
A. raphani	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Aspergillus flavus	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
A. niger	0	2	0	8	12	0	0	0	8	0	0	0	1	11	10	**52**
A. oryzae	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	**3**
A. terreus	0	0	0	1	0	0	0	0	0	5	0	3	0	0	1	**10**
Cladosporium sp.	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	**2**
Drechslera biseptata	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	**3**
Geotrichum candidum	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Mycelia sterilia	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	**2**
Paecilomyces sp.	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	**2**
Rhizoctonia sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Yeast	1	2	0	0	1	0	6	0	0	0	0	0	0	0	0	**10**
Total	**1**	**5**	**3**	**9**	**13**	**0**	**6**	**5**	**9**	**8**	**2**	**4**	**2**	**11**	**12**	**90**

Table 5. Phenotypic identification of the fungal isolates from 4^{th} class students.

	Samples																
															60		
Isolates	46	47	48	49	50	51	52	53	54	55	56	57	58	59	Mo	H	**Total**
Alternaria alternata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Aspergillus flavus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	**6**
A. fumigatus	6	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**15**
A. niger	2	0	0	22	15	18	6	0	2	11	7	0	1	0	0	0	**84**
A. ochraceus	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Candida albicans	0	0	0	0	1	0	0	0	0	9	0	0	0	0	0	0	**10**
C. glabrata	0	0	0	0	0	0	0	0	7	0	0	0	1	0	0	0	**8**
Myrothecium verrucaria	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Paecilomyces sp.	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**4**
Penicillium sp.	8	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**23**
Rhizoctonia sp.	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	**3**
Thanatephorus Cucumis	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Tritirachium oryzae	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**
Yeast	0	0	3	0	0	0	0	2	0	0	0	2	0	1	0	0	**8**
Total	**16**	**30**	**4**	**22**	**16**	**18**	**10**	**2**	**9**	**20**	**7**	**3**	**2**	**1**	**3**	**4**	**167**

Table 6. Comparison of the number of fungi between females and males.

Isolates	Female	Male	Total
Alternaria alternata	1	2	**3**
A. raphani	2	0	**2**
Aspergillus flavus	3	8	**11**
A. fumigatus	2	18	**20**
A. niger	116	56	**172**
A. ochraceus	5	22	**27**
A. oryzae	0	6	**6**
A. terreus	34	37	**71**
Beltrania sp.	0	1	**1**
Chalara sp.	1	0	**1**
Cladosporium sp.	2	2	**4**
Cystobasidium sp.	0	2	**2**
Drechslera biseptata	3	0	**3**
Fusarium sp.	1	0	**1**
Geotrichum candidum	1	0	**1**
Gliocladium sp.	1	2	**3**
Kutilakesopsis sp.	0	1	**1**
Myrothecium verrucaria	1	0	**1**
Mycelia sterilia	9	4	**13**
Mucor sp.	0	4	**4**
Epidermophyton sp.	1	0	**1**
Paecilomyces sp.	0	6	**6**
Penicillium sp.	2	34	**36**
Rhizoctonia sp.	8	4	**12**
Thanatephorus Cucumis	1	0	**1**
Tritirachium oryzae	0	1	**1**
Yeasts	41	27	**68**
Total	**235**	**237**	**472**

Table 7. Comparison of the number of fungi between females and males.

Isolates	**Sterilized agents**				
	Diameter of inhibition zone(mm)				
	Control	**Dettol**	**Ethanol (%70)**	**Sanitizer**	**Wet wipes**
Aspergillus flavus	**0**	**0**	**15**	**0**	**10**
A. fumigatus	**0**	**25**	**10**	**0**	**15**
A. niger	**0**	**4**	**15**	**0**	**20**
A. ochraceus	**0**	**10**	**15**	**0**	**18**
A. oryzae	**0**	**12**	**15**	**0**	**15**
A. terreus	**0**	**18**	**16**	**0**	**16**

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Data Availability Statement: All of the data supporting the findings of the presented study are available from corresponding author on request.

Declarations:
Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: This research did not include any human subjects or animals, and as such, it was not necessary to obtain ethical approval.

Author Contributions: Abdullah K.Tahseen and Ibrahem J.Aziz were responsible for collecting samples and doing most of the practical part. Nareen Q. FaqeAbdulla was responsible for supervising the research, identification of the fungi, and writing the manuscript.

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تحديد اجناس جديدة من الفطريات المرتبطة بالهواتف المحمولة لطلاب علوم الحياة

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الخلاصة

أُخذت ستون عينة من أغلفة وشاشات الهواتف، وعينتان من سماعات الرأس لطلاب الأحياء في كلية العلوم، جامعة صلاح الدين. شُخِصْت أجناس الفطريات ظاهريًا بناءً على لون وشكل المستعمرة من الجانبين الأمامي والخلفي في طبق بتري، وشُخِصْت مجهريًا. عُزِل واحد وعشرون جنسًا فطريًا تنتمي إلى 29 نوعًا. كانت أعلى أجناس الفطريات المعزولة هي *Aspergillus spp.* وسُجِلْت أربعة أجناس جديدة، *Kutilakesopsis sp.* و *Myrothecium verrucaria* و *Thanatephorus Cucumis* ، ونوعان جديدان، *Dreschlera bisepta* و *Tritrachium oryzae* ، لأول مرة من الهواتف المحمولة لطلاب الأحياء في كلية العلوم ـ جامعة صلاح الدين ـ أربيل. بالإضافة إلى ذلك، تم التعرف على أنواع الخميرة في أجار كروم بناءً على تكوين لون مستعمرة، مثل المبيضات البيضاء، والفطريات الجلابراتية، والفطريات البارابسيلوسيس. أُجري اختبار الحساسية بطريقة انتشار بئر الأجار لستة أنواع من فطر الرشاشيات مقابل أربعة عوامل معقمة: الديتول، والإيثانول (70%)، والمعقم ، والمناديل المبللة، في أجار سابورو دكستروز (*SDA*). وبالمقارنة مع المجموعة الضابطة، أظهرت أنواع فطر الرشاشيات حساسية جيدة لكل عامل معقم مُختبر بناءً على منطقة تثبيط النمو، باستثناء أن المعقم كان مقاومًا لجميع أنواع فطر الرشاشيات. هذا يعني ضرورة تعقيم الهاتف باستخدام عوامل معقمة لأنه مصدر لانتقال الأمراض.

الكلمات الدالة : *Myrothecium verrucaria* ؛ وسط كروموجيني و *Thanatephorus Cucumis* .

التمويل: لايوجد.

بيان توفر البيانات: جميع البيانات الداعمة لنتائج الدراسة المقدمة يمكن طلبها من المؤلف المسؤول.

اقرارات:

تضارب المصالح: يقر المؤلفون أنه ليس لديهم تضارب في المصالح.

الموافقة الأخلاقية: لم يتضمن هذا البحث أي تجارب بشرية أو حيوانية، وبالتالي، لم يكن من الضروري الحصول على موافقة أخلاقية .

مساهمات المؤلفين: تولى عبد الله تحسين وإبراهيم ج. عزيز جمع العينات والقيام بمعظم الجزء العملي. وأشرفت نارين ق. فقيه عبد الله على البحث وتحديد الفطريات وكتابة المخطوطة.