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# Microbial Pollution of Computer Keyboards in College of Sciences, Sirte University, Libya

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## ABSTRACT

The paper aims to investigate microbial contamination in computer keyboards within the work environment at the Faculty of Sciences sirte University, Libya. A total of 17 samples were collected by swabs from computer keyboards of work environments in some offices and departments at the College. The samples were distributed as follows: 6 computer keyboards from the Faculty administration, 6 computer keyboards from the offices of scientific departments, 2 computer keyboards from Faculty Registrar, and 3 computer keyboards from Department of studies and examinations these swabs revealed growth of facultative aerobic, facultative anaerobe opportunistic pathogens, positive and negative gram. The highest contamination rates were found in the samples of the Department of Studies and Examinations and the offices of scientific departments this indicates that the student frequently visits these sections these microbes can live for over 24 hours. Furthermore, they are more likely to spread the infection in the environment. In this study *Staphylococci aureus* (5 isolates), then *Staphylococcus epidermidis* (60 isolates) were isolated in great numbers from the keyboard, *Bacillus cereus* (4 isolates), *E-coli* (1 isolates) and Fungus (30 isolates) fungi were also detected, but without species specification. The user's hands create computer contamination, thus cleaning hands with a disinfectant will stop the spread of many dangerous microorganisms.

## التلوث الجرثومي للوحات مفاتيح الحاسوب بكلية العلوم - جامعة سرت - ليبيا

عائشة رحيل

يهدف البحث إلى دراسة التلوث الميكروبي في لوحات مفاتيح الحاسب الآلي داخل بيئة العمل بكلية العلوم جامعة سرت، ليبيا. تم جمع 17 عينة عن طريق المسحات من مواقع مختلفة لبيئات العمل في بعض مكاتب وأقسام الكلية. وقد تم توزيع العينات على النحو التالي: 6 عينات من إدارة الكلية، 6 عينات من مكاتب الأقسام العلمية، 2 مسحات من مسجل كلية، و3 من قسم الدراسة والامتحانات أظهرت هذه المسحات نمو مسببات الأمراض الهوائية الاختيارية واللاهوائية الاختيارية الانتهازية إيجابية وسلبية الجرام. . وقد وجدت أعلى معدلات التلوث في عينات قسم الدراسات والامتحانات ومكاتب الأقسام العلمية وهذا يدل على تردد الطلاب على هذه الأقسام. يمكن لهذه الميكروبات أن تعيش لأكثر من 24 ساعة. علاوة على ذلك، فهم أكثر عرضة لنشر العدوى في البيئة. في هذه الدراسة تم عزل (*Staphylococci aureus* (5)، *Staphylococcus epidermidis* (60)، *Bacillus cereus* (4)، *E-coli* (1) و*Fungus* (30)، تم اكتشاف الفطريات أيضاً، ولكن بدون تحديد الأنواع. تتسبب أيدي المستخدم في تلوث الكمبيوتر، وبالتالي فإن تنظيف اليدين بمطهر سيوقف انتشار العديد من الكائنات الحية الدقيقة الخطيرة.

## INTRODUCTION

Computers are one of the most important technologies of our time, and they are used extensively by all faculty personnel, students, professors, researchers, and administrators. Millions of individuals go to their offices every morning and spend hours typing on a keyboard in front of a computer screen, but few are aware of the health hazards associated with their fingertips. As a result, we decided to focus on computers in this study. According to the researchers' findings, a typical keyboard may contain more than 3,200 germs per square inch (Nasser et al., 2021; Anderson and Palombo, 2009). Eating on these devices also allows for food particles to settle between the keys of the plates and remain there for years. In public health settings such as hospitals, dental clinics, schools, and other gatherings, computer keyboards transfer germs. (Buers *et al.*, 2000). Gram-positive and pathogenic *Bacillus cereus* were isolated by 3% (Al-Ghamdi *et al.*, 2011), *Pseudomonas putida* (66.3%), and *Escherichia tarda* (30.6%). (Awe *et al.*, 2013), the contamination of 100 print computers of a group of (offices and Internet cafes, houses, buildings, and central markets) in the city of Jeddah in Saudi Arabia with the prevalence of Staphylococci and Bacilli bacteria (Rutala *et al.*, 2006).

Microbial hygiene requirements are required for a healthy life. People frequently believe that germs are exclusively found in research labs, hospitals, and clinics, giving them a false sense of security in other settings. A lack of understanding about where germs live could be the source of health issues. Hand contact with other people's hands or other items is responsible for 80% of all illnesses. (Al-Ghamdi, *et al.*, 2011). Bacteria can be found practically anywhere, including the air, water, soil, and food, as well as in plants and animals, including humans. It is widely accepted that inanimate items can harbor microbes originating in their surroundings. Gram-positive cocci (*Micrococcus*, *Staphylococcus*) as well as spore-forming rods (*Bacillus*) and Gram-negative bacteria, can be spread through gadgets like cell phones or computer keyboards. (Verran, 2013). These connected germs have the potential to be ingested by humans or transmitted to food, where they could contribute to the spread of bacteria. Additionally, the survival of different pathogens on the same surface might be impacted by the creation of a biofilm by one bacterial agent. (Tagoe, *et al.*, 2011) Many pathogenic microbes can last on surfaces for long periods if they are not removed through cleaning or sterilization procedures. (Neff and Rosenthal, 1957) Pathogens may stay infectious on surfaces for weeks after becoming contaminated, depending on the environment. (Kramer, *et al.*, 2006) Computers are not constantly disinfected, thus there is a chance that infecting germs could spread through computers. The environment surrounding the computer's keyboard and mouse is extremely dynamic. The majority of the time, the bacteria on our hands, skin, fingernails, and other body parts are likely to spread new bacteria to

the keyboard. Particularly in places where a lot of people come and go, like hospitals, schools, or offices, there are likely to be a lot of sick people. Through them, new bacteria are spread, and these bacteria eventually land on the keyboard through the air or by physical touch. The computer keys may be the source of microbial contamination, leading to the indirect spread of possible infections as a result of improper hand washing and unclean surfaces (Siegmond, 2010). Bacterial infection is also a result of eating close to computer keyboards. Food residue from spills that get between the keys and on them promotes the growth of millions of bacteria. Dust can retain moisture, allowing any bacteria already present on the keyboard to thrive (ASM, 2005). The purpose of this paper is to investigate microbial contamination on the computer keyboard within the work environment at the College of Sciences sirte University Libya.

## MATERIALS AND METHODS

Samples were taken using swabs from various work environments in some offices and departments at the College to look into the microbial contamination. Following is how the samples were distributed: Six samples came from the Faculty administration, six from the scientific department offices, two from the Faculty Registrar, and three from the Department of Studies and Examinations.

To cultivate, develop, and isolate bacteria, nutrient agar, blood agar, and McConkey media were employed in this investigation. These media were produced by manufacturer directions in 2012 (Abu Gharara *et al.*, 2010). By using a lumbar scanner, a swab was obtained within 1 cm<sup>2</sup> of two distinct locations on the keyboard and it was then placed in a specific tube (each swab was placed in a tube).

To find the bacteria, the samples were sent straight to the lab.

disposable sterile cotton swabs were used to capture the samples, which were then placed into and thoroughly swirled to ensure that the entire sample fell into the solution, as described in (Al-Shebani and Saber, 2012).

a. Bacterial isolation and culture: The nourishing agar media was made in sterile petri dishes, allowed to set, and then inoculated using a diffusion technique. The plates were then incubated for 48 hours at 37 ° C under growth control observation.

b. Identification: For identification, the bacteria were subcultured on McConkey and blood Agar medium using a needle transplant. To confirm the presence or lack of bacterial growth, the plates were incubated for 24 hours at 37 ° C (Monica, 1984). Noting that the growth or lack thereof between bacterial kinds in terms of morphology and cell arrangement was confirmed by incubating the plates with no growth for a further 24 hours (John *et al.*, 1994).

Using gram stain pigmentation, colony morphology, catalase, and coagulase testing, as well as further

novobiocin and bacitracin testing, isolates were identified using a standard microbiology approach.(Fawole and Oso,2004)

**RESULTS**

A total of 17 samples were collected by swabs from computer keyboards of work environments in some offices and departments at the College. The samples were distributed as follows: 6 computer keyboards from the Faculty administration, 6 computer keyboards from the offices of scientific departments, 2 computer keyboards from Faculty Registrar, and 3 computer keyboards from Department of studies and examinations. these swabs revealed growth of facultative aerobic, facultative anaerobe opportunistic pathogens, and gram-positive and negative as demonstrated in the table (1).

The highest contamination rates were found in the samples of the Department of Studies and Examinations and the offices of scientific departments. These bacteria can survive for longer than 24 hours. Additionally, they are more prone to spread the disease outside. In this study Staphylococci aureus (5 isolates), then Staphylococcus epidermidis (60 isolates) were isolated in great numbers from the keyboard, Bacillus cereus (4 isolates), E-coli (1 isolates) and Fungus (30 isolates) fungi were also detected, but without species specification.

**Table 1. Percentage evaluation of microorganisms isolated from computer keyboard surfaces.**

Bacterial types	Number of isolation	Percent
<i>Staphylococcus aureus</i>	5	5%
<i>Staphylococcus epidermidis</i>	60	60%
<i>Escherichia -coli</i>	1	1%
<i>Streptococcus spp.</i>	4	4%
<i>Fungus</i>	30	30%

**Discussion**

Different causes of machine keyboard contamination can cause varying degrees of keyboard contamination. In this scenario, typing on the keyboard and computer use promotes bacterial growth on the hands. (Al-Ghamdi et al,2011).

Individual sweating also results in a moist environment, which aids in the survival of bacterial infection. (Baker,2019)In general liquid drinks like coffee, and soda are usually acidic (4.0-5.0), (Michaelsen et al.2000)If a liquid is spilled on the computer keyboard, it will absorb a large amount of moisture. Although the

essential constituents, water, protein, and carbs, contribute significantly to the nutritional content of a beverage, the finished products contain only trace amounts of each (if milk is added). Lactose is the non-essential nutrient that bacteria use the fastest. Some bacteria will target and break down proteins for their purpose. (Michaelsen et al.2000 Poor hand hygiene can aid in the management of machine pathogens. Clorox disinfectants, such as Pseudomonas aeruginosa, as well as alcohol and Quaternium compounds, can be used to kill Pseudomonas organisms. In addition to washing hands before using the computer, daily disinfection is required to prevent bacterial contamination.(Rutala, and Weber, 2008).

The user's hands create computer contamination, thus cleaning hands with a disinfectant will stop the spread of many dangerous microorganisms .

This study suggests daily cleaning of the computer keyboard with suitable disinfectants In this study Staphylococci aureus (5 isolates) were isolated in great numbers from the keyboard, then Staphylococcus epidermidis (60 isolates), Bacillus cereus (4 isolates), E-coli (1 isolates) and Fungus (30 isolates) These isolates demonstrated that contamination of computer keyboards is caused by users' poor E-coli behavior, which can lead to contamination of the computer keyboard with harmful bacteria Microbial contamination can develop on computer keyboards at large colleges, with around (145) different types of isolates. While in internet centers, 392 distinct types of isolates were found. Anderson and Palombo (2009). In this investigation, the most common isolate was Staphylococcus aureus, which can cause pyogenic wound infection, pneumonia, and bacterial toxication if it enters the mouth and releases its toxin. (Taylor and Unakal, 2017). Endocarditis, septicemia, osteomyelitis, meningitis, several types of skin infections, gastroenteritis, and toxic shock syndrome are all illnesses caused by this organism. (Gnanamani,2017) Staphylococcus epidermidis is a coagulase-negative, gram-positive cocci bacteria that forms clusters and is also a facultative anaerobe that is catalase-positive. (Ezra and Fatima,2023) Staphylococcus epidermidis, long thought to be a harmless commensal bacteria on human skin, is now recognized as an important opportunistic pathogen. It is now the most common cause of nosocomial infections, with a rate roughly comparable to that of its more aggressive cousin Staphylococcus aureus (CDC,2004)( Michael,2009) Bacillus cereus is a facultatively anaerobic, toxin-producing gram-positive bacterium found in soil, vegetation, and food is usually responsible for intestinal ailments such as nausea, vomiting, and diarrhea. (Rachel et al,2023)(Dhotre et al ,2015) . E-coli is a gram-negative bacillus belonging to the Enterobacteriaceae family that can contaminate the hands and then enter the digestive tract, causing gastrointestinal issues. (Cabral, 2010). The identification of fungi on all keyboards is indicative of the ubiquitous nature of these fungi in the airborne environment and besides. (Altayar and Sutherland, 2006). Pressure, temperature, pH, moisture,

and other chemical variables all have an impact on the bacterial components. Though hand warmers can help germs grow faster, using hot ones while cooking results in a slight temperature increase. Bypassing your fingertips over the keyboard, you will adjust its pH. Sweat pH can range from acidic (below 5) to slightly alkaline as a result of sweating. (Koscova,2018) .

The highest contamination rates were found in the samples of the Department of Studies and Examinations and the offices of scientific departments this indicates that the student frequently visits these sections, Eating on these devices also allows for food particles to settle between the keys of the plates and remain there for years.

These isolates demonstrated that contamination of computer keyboards is caused by users' poor behavior, which can lead to contamination of the computer keyboard with harmful bacteria Microbial contamination can develop on health human body.

## CONCLUSION

The user's hands create computer contamination, thus cleaning hands with a disinfectant will stop the spread of many dangerous microorganisms. Computers are important things that we cannot do without and through the results of the study .The highest contamination rates were found in the samples of the Department of Studies and Examinations and the offices of scientific departments this indicates that the student frequently visits these sections ; we recommend educating users of the risks that can be caused by the toxic and dangerous elements or contaminated with microbes, taking care to deal with the computer keyboard, especially children. In addition to regularly cleaning the computer keyboard to remove microbes, avoid eating or drinking while using the computer because the surrounding environment is conducive to these microbes. After using the water, thoroughly wash your hands with soap and water before using the computer keyboard again.

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