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Isolation and Identification of Microorganisms from Mobile Phones of staff and students of Yusuf Maitama Sule University, Kano

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ABSTRACT

Mobile phones act as fomites turning these devices into ideal platforms for disease transmission either by means of self-inoculation when touching your own mobile phone and face or by simple microbial dissemination in the environment, public places, or professional sectors. The mobile phones of both staff and students were collected and swabbed using aseptic techniques. Nutrient agar and Potato dextrose agar were prepared according to manufacturer's instructions, for culturing bacteria and fungi respectively. The swabs were streaked on the solidified media and incubated in an inverted position at 37^{o}C for 24 hours for bacteria and 48-72 hours for fungal growth. Morphological description of colonies, gram stain mobility tests and identification keys were used for bacterial identification. Physiological and biochemical reactions of each bacterial isolate were verified using the standard kits API identification system (Biomerieux, Marcy L'etoil, France) for the identification of both gram positive and negative bacteria. Fungal colonies were studied macroscopically by observing the colony features (colour, shape, size and hyphae) and microscopically using a compound microscope with a digital camera using a lactophenol cotton blue- stain slide. *Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, Proteus mirabilis, Bacillus subtilis* and *Enterobacter aerogenes* were the obtained bacterial isolates, while *Aspergillus niger, Cladosporium spp, Penicillium spp, Rhizopus stolonifer* and *Aspergillus fumigates* were the fungal isolates. The study showed that the mobile phones were found contaminated with both bacterial and fungal microorganisms, some of which are indicators of feacal contaminants. There is the need for further studies to determine the survival time of pathogens on cell phones. Also, there is need for water system rest rooms for both students and staff in the city campus to improve hygiene. The importance of constant hand wash and decontaminating the phones using 70% alcohol cannot be over emphasized.

Keywords: Mobile phones, bacteria, fungi, YUMSUK, Kano

INTRODUCTION

Mobile phones act as fomites turning these devices into ideal platforms for disease transmission either by means of self-inoculation when touching your own mobile phone and face or by simple microbial dissemination in the environment, public places, or professional sectors (Tajouri *et al.,*2021). In less than 20 years, mobile phones have gone from being rare and expensive pieces of equipment used primarily by the business elite, to a common low-cost personal item. (Singh *et al*., 2010). Research has shown that the mobile phone could be a health hazard with tens of thousands of microbes living on each square inch of the phone (Ekrakene and Igeleke 2007).

However, because of the advantages of mobile phones, it is simple to ignore the health risks associated with them; this is especially true given the likelihood that many users may not care about personal cleanliness

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and the quantity of people who may share phones (Al-Abdullah, 2010).

This constant handling of the phone by different users exposes it to an array of microorganisms, and makes it a good carrier for microbes, especially those associated with the skin resulting in the spread of different microorganisms from user to user. Microbiologists say that the combination of constant handling with the heat generated by the phones creates a prime breeding ground for many microorganisms that are normally found on the skin. *Staphylococci*, particularly *S. epidermidis* are members of the normal flora of the human skin, respiratory and gastrointestinal tracts. Nasal carriage of *S. aureus* occurs in 20-50% of human beings. *Staphylococci* are also found regularly on clothes, bed linen, and other human environments (Melnick, 2004). Closely related to methicillin-resistant Staphylococcus aureus (MRSA), staphylococcus aureus is a widespread bacterium that can cause infections ranging from boils and pimples to pneumonia and meningitis. It can be found on the skin and in the noses of up to 25% of healthy individuals and animals (Hui et al., 2001).

The main reservoir of *S. aureus* is the hand from where it is introduced into food during preparation (Hui *et al.*, 2001). The hand serves as a major vehicle of transmission of various microbes including the enteric species—. (Brande *et al*., 1981). *Proteus mirabilis* is one of the most common Gram-negative pathogens encountered in clinical specimens. It can cause a variety of community- or hospital-acquired infections, including those of the urinary tract, respiratory tract, wounds and burns, *bacteraemia,* neonatal *meningoencephalitis, empyema* and *osteomyelitis* (O'Hara *et. al.,* 2000). After *Escherichia coli,* P. *mirabilis* is the member of the *Enterobacteriaceae* most often isolated in European clinical microbiology laboratories, (Liu *et al*., 1992) accounting for 3% of nosocomial infections in the United States. *Pseudomonas aeruginosa* is a metabolically versatile γ-*Proteobacterium,* which inhabits terrestrial, aquatic, animal-, human-, and plant-host associated environments (Ramos *et al*., 2004)

Majority of the mobile phones are hand- held hence they are potential carriers of a number of microorganisms. In developed countries and in many developing countries, the ease of using mobile phones and its added applications, made it widely used by all strata of people and so we generally overlook the health hazards associated with it (Ulger *et al.*, 2009). Investigations into the diversity of microscopic organisms found on mobile phones, and their distribution in public places such as schools, are highly desirable and will expose the health risk associated with having contact with mobile phones; create needed awareness on the importance of hand washing as a powerful public health preventive tool in the control of microbial infections.

MATERIALS AND METHODS

Study Site

Yusuf Maitama Sule University Kano, formerly Northwest University Kano is a Kano State Government-owned University with a temporary campus located at the center of the city of Kano and the main campus located along Gwarzo Road. The site is located at latitude 11.991546375 N and longitude 8.5319625 E. Maximum temperature varies between 27^{o}C and 35^{o}C, depending on the season (Hassan *et al*., 2013).

Study Design

This cross-sectional study was conducted at the Yusuf Maitama Sule University, city campus kofar Nasarawa, Kano. A total of 100 samples were collected from the cell phones

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of 100 volunteering students and staff of the university.

Sample Collection and Plating

The mobile phones were collected and swabbed using aseptic techniques. The samples were taken with a sterile cotton swab which was moistened with sterile saline solution and the target phone was wiped off the surface on both sides of the mobile, that is over the keypad and back of the mobile phones, in case of mobile phones with covers, swab was taken from the outer surfaces of the cover. Nutrient agar and Potato dextrose agar were prepared according to manufacturer's instructions, for culturing bacteria and fungi respectively. The swabs were streaked on the solidified media and incubated in an inverted position at 37^{o}C for 24 hours for bacteria and 48-72 hours for fungal growth.

Identification and Characterization of Isolates

Morphological description of colonies, gram stain (Romans, 2024) mobility tests and identification keys (Ainsworth, 1973) were used for bacterial identification. Physiological and biochemical reactions of each bacterial isolate were verified using the standard kits API identification system (Biomerieux, Marcy L'etoil, France) for the identification of both gram positive and negative bacteria. Fungal colonies were studied macroscopically by observing the colony features (colour, shape, size and hyphae) and microscopically using a compound microscope with a digital camera using a lactophenol cotton blue- stain slide.

Statistical Analysis

Occurrence/prevalence were calculated and presented in percentages. The difference observed between the groups was tested by Pearson Chi-Square test. Statistical significance level was confirmed at $p<0.05$.

RESULTS

All the100 samples collected showed different bacterial growth, *Staphylococcus aureus* occurred in 24(24%) samples,8(21.0%) samples among staff and 16(26.2%) samples from the students; *Staphyloccocus epidermidis* occurred in 21(21%) samples,10(25.6%) samples among the staff and 11(15.9%) among students. *Pseudomonas aeruginosa* occurred in 13(13%) samples 4(10.3%) sample among the staff and 9(14.8%) samples among the students; *Proteus mirabilis* occurred in 13 (13%) samples,3(7.7%) samples among the staff and 10(16.4%) samples among the students. *Bacillus subtilis* occurred in 11(11%) samples, 5(12.8%) samples among the staff, 6 while (9.8%) from the student's samples. *Enterobacter aerogenes* occurred in 18 (18%) samples 9(23.1%) among the staff and 9(14.8%) samples among the students. However, there was no significant difference ($p >0.05$ in the occurrences of the isolates between the staff and the students. These results are shown in table 1 below.

Table 1: Bacterial isolate from mobile phones of the staff and students of YUMSUK

S/N	BACTERIAL ISOLATE	STAFF	STUDENTS	TOTAL
1	*Staphylococcus aureus*	8 (21.0%)	16 (26.2%)	24(24.0%)
2	*Staphylococcus epidermidis*	10 (25.6%)	11(15.9%)	21(21.0%)
3	*Pseudomonas aeruginosa*	4 (10.3%)	9 (14.8%)	13(13.0%)
4	*Proteus mirabilis*	3 (7.7%)	10 (16.4%)	13(13.0%)
5	*Bacillus subtilis*	5 (12.8%)	6 (9.8%)	11(11.0%)
6	*Enterobacter aerogenes*	9 (23.1%)	9 (14.8%)	18(18.0%)
		39	61	100

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Out of the 100 sample only 27(27%) showed fungal growth, *Penicillium spp* was found in 5(18.5%)samples, in 2(28.6%) samples among staff and 3(15.0%) samples among the students; *Aspergillus niger* also occurred in 5(18.5%) 2(28.6%) samples of the staff while 3(15.0%) from the student's sample; *Rhizopus stolonifera* was found in 5(18.5%)samples, but absent 0(0.0%) in the samples of the staff and 5(25.0%) samples of the students; *Cladosporium spp* was found in 6(22.2%) samples, while 2(28.6%) samples were among the staff,4 (20.0%) were from the students samples; *Aspergillus fumigatus* was found in only1(14.3%) sample of the staff and 5(25.0%) samples of the students. No significant difference ($p > 0.05$) was observed in the occurrence of the isolates between the staff and the students. The results are shown on table 2 below.

Table 2: Fungal isolate from mobile phones of the students and staff of YUMSUK

S/N	Fungal Isolates	Staff	Students	Total
1	*Penicillium spp*	2(28.6%)	3 (15.0%)	5(18.5%)
2	*Aspergillu sniger*	2(28.6%)	3 (15.0%)	5(18.5%)
3	*Rhizopus stolonifer*	0(0.0%)	5 (25.0%)	5(18.5%)
4	*Cladosporiums pp*	2(28.6%)	4 (20.0%)	6(22.2%)
5	*Aspergillus fumigatus*	1(14.3%)	5 (25.0%)	6(22.2%)
	TOTAL	7	20	27

DISCUSSION

The percentage of bacterial contamination on the tested cell phones in the Yusuf Maitama Sule University, was 100% higher than the percentage found by Shadi *et al*., 2016 at King Abdulaziz University, Jeddah, Saudi Arabia. *Staphylococcus aureus* was found in 24% of the samples, which was lower than the finding by Shadi *et al.,*2016 and is also an alarming as *S. aureus* are known to be pathogenic and may show unhygienic condition as a results improper use of the toilet (Ajayi, 2014; Al-Abdalall, 2010). *Staphylococcus epidermidis* was the second highest accounting for 21% of the isolates, aside the health hazard posed by these organisms, they may probably have found their way onto the phones through the skin and from hand to hand. This is because they are a subset of the normal microbiota of the skin as described earlier by some researchers (Roth, 1998). *Staphylococci*, particularly *S. epidermidis* are members of the normal flora of the human skin, respiratory and gastrointestinal tracts (Al-Abdalall,2010). The presence of the gram-negative rod, *Enterobacter aerogenes*, a member of the coliforms, indicates the possibility of the presence of faecal contamination on the mobile phones.

These gram-negative bacteria have been implicated in sepsis commonly caused by *E coli, Klebsiella spp*, *Enterobacter spp* and *Pseudomonas aeruginosa* (Bone, 1993). Although *Bacillus subtilis* showed a 4% frequency of occurrence, but the bacteria have been identified as an important organism in food spoilage (Jay, 2000) and contributes a great deal to food spoilage and food poisoning (Mi-Hwa and Julian 2009) due to contamination of food during preparation or when eaten with infected hands. On the other hand, the fungal isolates including *Aspergillus niger, Cladosporium spp, Penicillium spp, Rhizopus stolonifer and Aspergillus fumigates* found in this study, can significantly influence food spoilage and food infection through the production of toxins (Karabay *et al*., 2007). Another study states that the colonies found on the mobile phone can also lead to nosocomial infections (Goldblatt *et al.,*2009). In this study, we also found fungal species

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such as *Pencillium spp, Aspergillus spp*, that are known to cause respiratory infections, allergic reactions, asthma, and irritations (Eduard, 2009). The implication of these results is that mobile phones which make communication easy and accessible also form good carriers of pathogenic agents capable of disease transmission.

CONCLUSION

Mobile phone of both students and staff of Yusuf Maitama Sule University, Kano were found to be contaminated with both bacterial and fungal microorganisms, some of which are indicators of feacal contaminants and pathogens of different diseases. Public Health and Biosecurity authorities should work 'hands in hands' to stop this silent 'third hand' driven pandemic and urgently implement regulations to actively decontaminate mobile phones as niches and reservoirs of viable microbes.

There is need for further studies to determine the survival time of pathogens on cell phones. Also, there is need for water system rest rooms for both students and staff in the city campus to improve hygiene. The importance of constant hand wash and decontaminating the phones using 70% alcohol cannot be over emphasized.

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