ISOLATION OF MICROORGANISMS ON THE SURFACE OF MOBILE PHONES

[1]*Anibijuwon I.I., Odaibo D.* O., *Omojasola P.F. and Ibrahim, F. R*
[1] *Public Health Laboratory Unit, Department of Microbiology, Faculty of Life Sciences, University ofllorin, P.M.B 1515,Ilorin, Kzuara State, Nigeria.*

Abstract: This study was conducted to determine microbial contamination of mobile phones in the university of Ilorin campus, in the central north region of Nigeria, and identify the most important microbial species associated with these phones in order to take the necessary remedial measures. The analysis of a total of 202 samples was done to identify fungal and pathogenic bacteria isolates. Sterile swabs were firmly passed on the handset, the buttons and the screens of mobile phones, and then inoculated into media of bacteria and fungi. Frequency distributions of isolates were calculated. The organisms consistently isolated in this research, with their percentage frequency of occurrence, based on colonial morphology and biochemical characteristics comprised of *Staphylococcus aureus* (60%), *Bacillus subtilis* (95%) , *Enterobacter aerogenes* (30%) *Aspergillus niger* (90%), and *Rhizopus* spp. (50%). The mean bacterial viable count recorded was 4.93 x 10^6 CFU/g, 2-12 x 10^6 and 3.22 x 10^6CFU/g This is influenced by the number of users in case of business mobile phones. Less busy phone, had lower bacterial count. Consequently, these mobile phones could serve as a vehicle for the transmission of pathogenic organisms. The study showed that all mobile phones under consideration were infected by several microbes, most of which belonged to the natural flora of the human body as well as airborne fungi and soil. This means that it is necessary to practice good personal hygiene by sterilizing hands after contact with a phone to reduce the incidence of microbial transmission especially at call centers since it is a source of disease transmission

Keywords: Mobile phones, Microorganisms, Personal Hygiene.

Introduction

A mobile or cellular telephone is a long-range, portable electronic device for personal telecommunications over long distances. Until the late 1980s most mobile phones were sufficiently large in that they were permanently installed in vehicles as car Dhones (Ehaise *et al.,* 2008).

With the advancement in technology lowever, leading to the miniaturization of :ircuitry, the vast majority of mobile phones ire hand held. In addition to the standard foice function of a telephone, a mobile)hone can support many additional services ;uch as SMS does text messaging, email, pocket switching for access to the internet, and MMS for sending and receiving photos and video,

In fewer than 20 years, mobile phones have gone from being rare and expensive pieces of equipment used primarily by the business elite, to a pervasive low cost personal item. In many countries, mobile phones is now more than landline telephones with most adults and many children now owning mobile phones (Ehaise *et al,* 2008).

At present, Africa has the largest growth rate of cellular subscribers in the world with African markets. The availability of prepaid or pay as you go services, where the subscriber does not have to commit to a long term contract, has helped fuel this growth on a monumental scal^ nQt Qnly ^ Afdca but Qn other continents as well.

'Corresponding author:
unkdoexploit@gmail.com ^*Anibijuwon I. I.,*
bright© 2015 Nigerian Society for Microbiology

Nigerian Journal of Microbiology 2015, 28: 2821-2828
'ublished online at www.nsmjournal.org

With high level of mobile phone penetration, a mobile culture has evolved, where the phone becomes a key social tool, and people rely on their mobile phone address book to keep in touch with their family and friends. Mobile phones serve as clocks, organizers, reminders, calculators etc., depending on the mobile phone accessories. In Nigeria, this is a business boom and is found in almost every nook and cranny of towns and villages(Ehaise *et al.*, 2008).

With all the achievements and benefit of the mobile phones, it is easy to over look the health hazard it might pose to its many users. This is against the background that many users may not have regard for personal hygiene coupled with the location of call centre and the likely number of users per day. The constant handling of the phone by different users makes it open for arrays of microorganisms, making it a harbour and a breeding ground for microbes especially those associated with the skin, and, from this phone, different microorganism are spread from user to user (Ehaise *et al.*, 2008).

Research has shown that the mobile phone could constitute a major health hazard. With tens of thousands of microbes living on each square inch, they harbour more bacterial than a man's lavatory seat, the sole of a shoe or the door handle. Microbiologists say that the combination of constant handling and the heat generated by the phones creates a prime breeding ground for all sorts of microorganisms that are normally found on our skin. The human surface tissue (skin) is constantly in contact with environmental microorganisms and become readily colonized by certain microbial species (Willey *et al.*, 2008). The adult human is covered with approximately $2m^2$ of skin, with surface area supporting about 10^{12} bacteria ((Gunasekara *et al.*, 2009). The normal microbiota of the skin include among others; coagulase negative Staphylococci, *Diptheroids, Staphylococcus aureus, Streptococci spp., Bacillus spp., Mallassesia furfur* and *Candida spp.* Others include *Mycobacterium spp* (occasionally), *Pseudomonads* and *Enterobacteriaceae* (occasionally) (Roth *et al.*, 1998). The normal microbiota is harmless and may be beneficial in their normal location in the host in the absence of coincident abnormities. They can produce disease condition if introduced into foreign locations or compromise host.

This study was conducted to determine microbial contamination of mobile phones in the university of Ilorin campus, in the central north region of Nigeria, and identify the most important microbial species associated with these phones in order to take the necessary remedial measures.

MATERIALS AND METHODS

The samples were collected from the mobile phones of 220 devices during a three-week period from December, 2010 and January 2011, in University of Ilorin campus, North Central Nigeria with sterile cotton swab sticks. Each swab was immediately streaked on three plates of Nutrient agar and Sabouraud Dextrose agar, and Glucose yeast agar. The plates were incubated at 34-37°C for 48 hours and observed for growth and colonial description of the isolates

Characterization and identification of isolates

Morphological description of colonies, gram stain, (Ramos, 2004; Krakane and Igeleke 2007;) mobility tests and identification keys[Ainsworth *et al.*, 1973] were used for bacterial identification.

Isolation of Bacteria

Bacterial isolation was carried out using the pour plate method. A known volume (0.1ml) of the sample was introduced into sterile petri dishes after which freshly prepared Nutrient Agar was poured aseptically into the plates.

Isolation of Fungi

Isolation of Mixed Cultures

Also using the pour plate method, (0.1ml) of the sample was introduced into sterile petri dishes and freshly prepared Sabouraud Dextrose Agar was then poured aseptically into the plates swirled gently and left to set. The plates were then incubated at room temperature (25°C) for 48-72hours.

Isolation of Pure Cultures

This was carried out using the streak plate method where in distinct colonies were observed and counted. They were then repeatedly sub-cultured onto solidified Sabouraud Dextrose Agar plates to obtain pure cultures. These pure cultures were then maintained in SDA slants and kept in the refrigerator at 4°C.

RESULTS

TABLE 1: Total Aerobic Count (On Nutrient Agar)

Samples	Dilution 10^5
1	129×10^5
2	36×10^5
3	156×10^5
4	64×10^5
5	70×10^5
6	40×10^5
7	250×10^5
8	97×10^5
9	85×10^5
10	127×10^5
11	142×10^5
12	105×10^5
13	126×10^5
14	136×10^5
15	156×10^5

TABLE 2: Coliform Count (On MacConkey Agar)

Samples	10^5
1	40×10^5
2	13×10^5
3	19×10^5
4	52×10^5
5	41×10^5
6	50×10^5
7	15×10^5

With high level of mobile phone penetration, a mobile culture has evolved, where the phone becomes a key social tool, and people rely on their mobile phone address book to keep in touch with their family and friends. Mobile phones serve as clocks, organizers, reminders, calculators etc., depending on the mobile phone accessories. In Nigeria, this is a business boom and is found in almost every nook and cranny of towns and villages(Ehaise *et al.*, 2008).

With all the achievements and benefit of the mobile phones, it is easy to over look the health hazard it might pose to its many users. This is against the background that many users may not have regard for personal hygiene coupled with the location of call centre and the likely number of users per day. The constant handling of the phone by different users makes it open for arrays of microorganisms, making it a harbour and a breeding ground for microbes especially those associated with the skin, and, from this phone, different microorganism are spread from user to user (Ehaise *et al.*, 2008).

Research has shown that the mobile phone could constitute a major health hazard. With tens of thousands of microbes living on each square inch, they harbour more bacterial than a man's lavatory seat, the sole of a shoe or the door handle. Microbiologists say that the combination of constant handling and the heat generated by the phones creates a prime breeding ground for all sorts of microorganisms that are normally found on our skin. The human surface tissue (skin) is constantly in contact with environmental microorganisms and become readily colonized by certain microbial species (Willey *et al.*, 2008). The adult human is covered with approximately $2m^2$ of skin, with surface area supporting about 10^{12} bacteria ((Gunasekara *et al.*, 2009). The normal microbiota of the skin include among others; coagulase negative Staphylococci, *Diptheroids, Staphylococcus aureus, Streptococci spp., Bacillus spp., Mallassesia furfur* and *Candida spp.* Others include *Mycobacterium spp* (occasionally), *Pseudomonads* and *Enterobacteriaceae* (occasionally) (Roth *et al.*, 1998). The normal microbiota is harmless and may be beneficial in their normal location in the host in the absence of coincident abnormities. They can produce disease condition if introduced into foreign locations or compromise host.

This study was conducted to determine microbial contamination of mobile phones in the university of Ilorin campus, in the central north region of Nigeria, and identify the most important microbial species associated with these phones in order to take the necessary remedial measures.

MATERIALS AND METHODS

The samples were collected from the mobile phones of 220 devices during a three-week period from December, 2010 and January 2011, in University of Ilorin campus, North Central Nigeria with sterile cotton swab sticks. Each swab was immediately streaked on three plates of Nutrient agar and Sabouraud Dextrose agar, and Glucose yeast agar. The plates were incubated at 34-37°C for 48 hours and observed for growth and colonial description of the isolates

Characterization and identification of isolates

Morphological description of colonies, gram stain, (Ramos, 2004; Krakane and Igeleke 2007;) mobility tests and identification keys[Ainsworth *et al.*, 1973] were used for bacterial identification.

Isolation of Bacteria

Bacterial isolation was carried out using the pour plate method. A known volume (0.1ml) of the sample was introduced into sterile petri dishes after which freshly prepared Nutrient Agar was poured aseptically into the plates.

solation of Fungi

solation of Mixed Cultures

Also using the pour plate method, 0.1ml) of the sample was introduced into terile petri dishes and freshly prepared Sabouraud Dextrose Agar was then poured septically into the plates swirled gently nd left to set. The plates were then ncubated at room temperature (25°C) for 8-72hours.

Isolation of Pure Cultures

This was carried out using the streak plate method where in distinct colonies were observed and counted. They were then repeatedly sub-cultured onto solidified Sabouraud Dextrose Agar plates to obtain pure cultures. These pure cultures were then maintained in SDA slants and kept in the refrigerator at 4°C.

RESULTS

ABLE 1: Total Aerobic Count (On Nutrient Agar)

amples	Dilution 10^5
	129 x10^5
	36 x 10^5
	156 x 10^5
	64 x 10^5
	70 x 10^5
	40 x 10^5
	250 x 10^5
	97 x 10^5
	85 x 10^5
)	127 x 10^5
l	142 x 10^5
2	105 x 10^5
3	126 x 10^5
4	136 x 10^5
5	156 x 10^5

ABLE 2: Coliform Count (On MacConkey Agar)

Samples	10^5
	40 x 10^5
	13 x 10^5
	19 x 10^5
	52 x 10^5
	41 x 10^5
	50 x 10^5
	15 x 10^5

TABLE 3: Staphylococcal Count (On Mannitol Salt Agar)

Samples	10^5
1	27×10^5
2	40×10^5
3	80×10^5
7	40×10^5
8	30×10^5
9	55×10^5
10	20×10^5
11	90×10^5
13	36×10^5
14	82×10^5
15	60×10^5

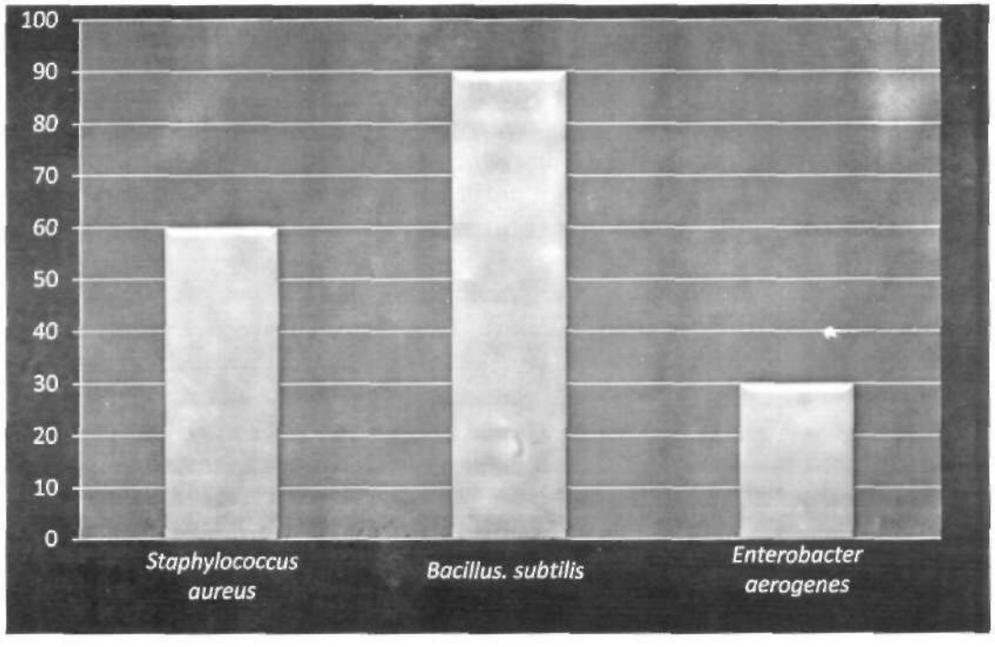

Fig 1:Percentage occurrence of Bacterial isolates

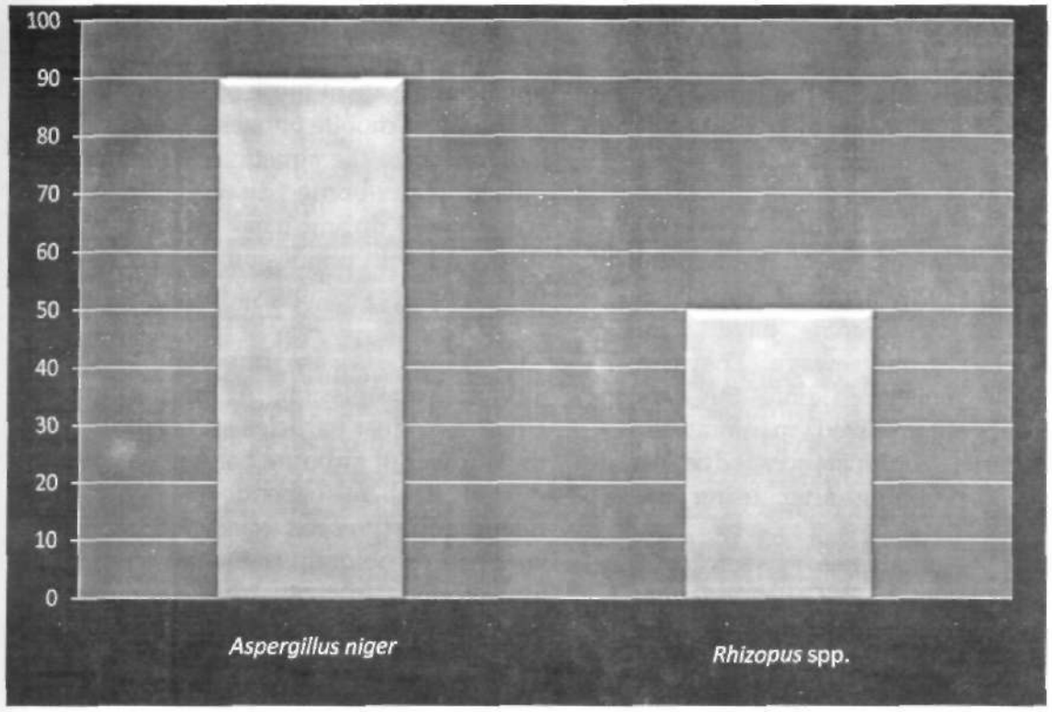

Fig 2: Percentage occurrence of fungal isolates

DISCUSSIONS

In the world over, microbiological standards in hygiene are prerequisite for a healthy living. It is not uncommon however to observe shifts in hygienic practices that deviate from standards in developing and developed world. This investigation confirms such deviation as arrays of microbes are found associated with private and public mobile phones. Also important in the investigation are the factors of location and possible number of users.

The research findings indicate that *Staphylococcus aureus, Bacillus subtilis* and *Enterobacter aerogenes* are the main bacterial isolates frequently associated with mobile phones as shown in Tables1, 2, and 3 These organisms may probably have found their entry to their phone through the skin and hand to hand mechanism. This is because the isolate bacterial are subset of the of the normal microbiota of the skin as advanced be earlier researchers (Roth *et al.*, 1998). Frequent handling by many users of different hygiene profile having regular skin contact with the phones may have resulted in the frequency and the degree of population of the isolates. This has a lot of health implication.

Gram-positive cocci found on the mobile phone samples like *Staphylococcus aureus* and *Staphylococcus epidermides* are opportunistic pathogens which are normal flora of the skin, glands, nose, nasopharynx, gastrointestinal tract that can cause various infections in human. *Staphylococcus aureus* is the most important Staphylococcal pathogen that causes boils, abscesses, wound infections, impetigo, toxic shock syndrome, Pneumonia and meningitis which are not unlikely as corroborated by the high population of colonies even at low dilutions. *Staphyloccocus epidermidis* can also cause serious wound infections. Staphylococcus haboured either by an

asymptomatic carrier or person with disease and can be spread by the hand expelled from the respiratory tract or transported in or on animate or inanimate objects(Willey *et al.*, 2008) like phones, rings, wristwatches etc.

Proteus vulgaris and *Enterobacter aerogenes* exist as members of the normal intestinal flora of humans, these organisms including *Alkaligenes feacalis* have been isolated from faeces, and sewage. They can accidentally be transferred onto the skin through feacal contaminated, inanimate or animate material for instances, due to improper hand washing after using the toilet.

Certain organisms such as *Streptococcus pyrogenes* and *Corynebacterium diptheriae* which are inhabitants of the nasopharynx are often propelled from respiratory tract into the air during an individual's coughing, sneezing, or vocalization (Willey *et al.*, 2008) and eventually settles on the skin of the hand and eventually transferred to surface of mobile phone surfaces

The presence of the gram negative rod, *Enterobacter aerogenes*, a member of the coliforms indicates the possibility off the presence of feacal contaminating on these public handsets. Gram negative sepsis is most commonly caused by *E. coli. Klebsiella spp., Enterobacter* spp.(Bone, 1993).

Gram negative cocci such as *Neisseria* sp and *Moraxella* as were also isolated from the phone samples. This is as a result of the fact that they are frequent inhabitants of the upper respiratory tract therefore; they can come in contact with the skin and other inanimate materials on the body via respiratory droplet.

Pseudomonas aeruginosa, aside the fact that it is the epitome of opportunistic pathogen (Kenneth *et al.*, 2008). It is primarily a nosocomial pathogen meaning that it could be transmitted through vehicle (for example surgical instrument, bedding and wristwatch) transmission. *Micrococcus* sp is a normal flora of the skin, it can be dispensed into the air during human activities thereby incriminating such organism as one of those organisms likely to be found on mobile phones. *Aeromonas* sp is indigenous to the aquatic environment and causes water-borne diseases, it can be encountered during hand washing without soap, and with phones on thereby resulting in inadequate cleaning of the skin.(Emine *et al.*, 2006).

Dust is an important route of airborne transmission. At times a pathogen adheres to dust particles and contributes to the number of airborne pathogens when the dust is re-suspended by some disturbances(Prescott *et al.*, 2008). *Bacillus* species are ubiquitous in nature, they are also found in soil, dust and so on. Inanimate materials like wristwatch often come in contact with dust particles containing spores of *Bacillus* species thereby contributing to the types of microorganisms in wristwatches and can lead to infection.

Bacillus subtilis with a 95% frequency occurrence has been identified as an important organism in food spoilage(Jay, 2000). This in no doubt would contribute immensely to food spoilage and food infections if infected hands are used in the preparation or eating of food.

Table 1, 2 and 3 indicate total Aerobic count (on Nutrients Agar), coliform count (on MacConkey Agar) and Staphylococcal count (on Manitol Salt Agar) respectively. All the sample showed significant growths on the Nutrient Agar with significant growth shown by only seven samples and ten samples showing Staphylococcal count on the Mannitol salt Agar. This is a strong indication that these microbes are consistently associated with the investigated mobile phones.

Figure 1 reveal, the percentage frequency of occurrence in which *B. subtilis* was isolated in all samples, *S. aureus* occurred in 60% and 30% occurrence was recorded for *E. aerogens*.

Significantly present also are *Rhizopus* spp and *Aspergillus niger* as

Chandra, P. M., Venkata, S. M. and Jayarama, S. A (2005). Assessment of Microbial Concentrations of Ambient Air at Semi-Arid Urban Region: Influence of Meterological Factors. *App. Ecol. Environ. Res.* 3(2): 139-149.

Cheesbrough, M. (2006). Media Preparation, *Laboratory Manual for Tropical Countries* Cambridge University Press pp 62-70, 132-134.

David, O. (2003). *Microbes and You: Normal Flora Science Creative* Quarterly. http://www.scq.abc.ca vol 1. Pp 1.

Ehaise, F. O. Ighosewe, O. U. and Ajakpour, O. O.(2008). Hospital Indoor Airborne Microflora in Private and Government Owned Hospitals in Benin city, *Nigeria. Wld Jour. of Med. Sci.* 3(1) 19-23.

Ekrakene T, Igeleke CL. Micro-organisms associated with public mobile phones along Benin-sapele Express Way, Benin City, Edo State of Nigeria. *J Appl Sci Res.* 2007;3:2009–12

Emine, A. Diana, H. and Andreas, V.(2006). *Hand Hygiene Among Laboratory Workers. Infest. Control and Hosp. Epide.*, 27:978-980.

Fawole, M. O. and Oso, B. A. (2007). *Staining Method and Characterization of Bacteria Labouratory Manual of Microbiology.* Spectrum Book Ltd. Ibadan, pp. 15-22.

George, J. M. and Barbara, M. A. (2005). *Microflora and Bacterial Infections of the Skin. North American Center for Continuing Medical Education Vol 13,* Issue 4, pp. 122.

Jawertz, E. Melnick, J. L. and Addberg, E. (2007). *Normal Microbial Flora of the Human Body. Medical Microbiology 24th edition.* McGraw-Hill Companies Chapter 11.

Jay, M. J., (2000). *Modern Food Microbiology,* 6th ed. VanNostrand Reinhold Pub co. Berhire.

Jeans A. R., Moore, J., Nicol, C., Bates, C and Read, R. C. (2010). *Wristwatch use and Hospital acquired Infection.* Journal of Hospital Infection 74:16-21.

Mackowiak, P. A., (1982). The Normal Microbial Ecology of the Skin Annual. Review. microbial, 42

Martin, F. (1999). Isolation of Microorganism from the Environment. Laboratory Exercise. Pp. 1-6.

Mary, C. C. and Joycel, S. (1980). *Identification of Fungi.* Medical *Mycology Handbook,* John Witey and Sons Inc. New York. Pp 214-340.

Prescott, L. M., Herley, J. P. and Klein, D. A. (2008). Normal Microbiota of the Body. *Microbiology 7th Edition* McGraw Hill Press. New York, pp 415-920.

Snyder, O. P. (1998). *Hand washing for Retail Food Operations. Daily Food Environ 18(3)* 149-162.

Vandepitte, J. Verhaegen, J., Engbaek, K, Rohner, P., Piot P. and Henck, C.C.(2003). *Antimicrobial Susceptibility Testing.* World Health Organization, pp 103-105.

Wikler Matthew (2006). A. *Performance Standards for Antimicrobial Disk Susceptibility Tests, Approved Standard.* Ninth. MO2-Ag, *Clinical and Labourtory Standards Institute (CLSI);* p. 52.

Ramos J.,L, editor. Pseudomonas. New York: Kluwer Academic / Plenum Publishers; 2004. p. 2132.