Journal of Biomedical Sciences
Research Article Peer-review, Open Access

Microbial Isolation and Determination of Staphylococcus Aureus from the Screen Smartphones of Ten Ub Students

Gounou Tem. Michel [1]

Esoh Rene Tanwieh [2]

Ngomo Sharon Seni Itoe [3]

Dr Samgwa Osseiny [4]

Ketchem Dickson Nji [5]

ABSTRACT: Mobile phones are devices that come into contact with our sensitive body parts including hands, face, ears, most of the time. Although we know many bad aspects of the mobile phones, we are indifferent to its bacterial contamination. The purpose of this study was to isolate and determine bacteria (S. aureus) contamination from the screen of smartphones. A total of 10 mobile phones (MPs) of the participants of the university of Buea were screened for microorganism isolation from the month of April to May. The study was carried out using standard techniques to isolate and determine the bacterial contamination using the MPs. The lab-based work involved samples collection from the smartphone screens of the students by the use of sterile swabs moistened with normal saline water. The results provided evidence of MPs contamination.

Keywords: Mobile phone screen, bacterial contamination, Staphylococcus aureus.

[1, 2, 4] University affiliation: University of Buea-Cameroon Faculty: FS (faculty of sciences), Department: Microbiology, Specialty: Microbiologist, Cameroon

[3] University of Bamenda-Cameroon Faculty: FHS (faculty of health sciences), Department: Medical MLS Student

[5] Ebenezer Higher Institute of Science and Technology, Bamemda-Cameroon Faculty: Biomedical Sciences, Specialty: Medical Laboratory Sciences, Cameroon.

List of Abbreviations

MPs: Mobile Phones**, E. coli**: *Escherichia coli*, **GN;** gram negative, **GP;** gram positive , **H_2O_2;** Hydrogen peroxide, **ID;** identical number, **MPs**: mobile phone screen, **S. aureus***: Staphylococcus aureus*, **TMDs**: Technological mobile device screen, **UB**: University of Buea

INTRODUCTION

Mobile phones are devices that bring the whole world into our hands. Now, it is impossible to think of a day without a mobile phone (**Vivekananda *et al.*, 2017**). In this twenty first century, about 3.5 billion people are using smartphone around the world (**Vivekannanda *et al.*, 2017**). Mobile phone screens is carry over twenty-five thousand bacteria per square inch, which is much higher than the toilet seats (**Damani *et al.*, 2006**). We touch our phone screens more than other item in the single day, and we are often unaware of cleaning the phone screen with a specific screen cleaner. Due to continuous handling of the mobile phones, heat is generated, creating an ideal environment for the propagation of many microorganisms which is normally found on the skin (**Ekrakene *et al.*, 2007**).

We use mobile phone in markets, public gatherings, while eating and even in the bath, which are a common source of contamination (**Bhooderowa *et al.*, 2014**). Pathogens can easily be transmitted by sharing personal phones with one another and those pathogens can be dangerous for immunocompromise immune patients. Common bacteria found on phone screens are multidrug resistant *Staphylococcus aureus, Pseudomonas, Enterococcus spp and E-coli*.

Nonetheless, mobile phones hygiene is unquestionable (**Brady *et al.*, 2006**), it is a vital component of controlling the spread of infection. Furthermore, keeping the aforementioned fact in view, the present study aims to provide awareness on the importance of keeping cell phone clean to minimize microbial contamination. The present research work deal with the isolation and determination of bacteria such as *Staphylococcus aureus* from smartphones screens.

PROBLEM STATEMENT

The presence of bacteria and viruses that cause illness to humans can affect us by simply coming in contact with our body parts and entering the body system. Cell phones harbor infectious bacteria including *Staphylococcus, Streptococcus, Enterococcus faecalis* and *E-coli*. For people with the weakened immune system infection with these bacteria can be fatal. Germs from cold, flu and *Staphylococcus* ailments remain on your mouth or nose. Infection caused by *Staphylococcu*s, bacteria commonly found on the skin of healthy individuals, can result to minor skin infections but can turn deadly if the bacteria invade bone, bloodstream, lungs, or heart. To prevent microbe or eliminate microbes from the screen of your phone it is advisable to use a disinfectant wipe to clean the screen of your phone.

RESEARCH QUESTION

What are the major types of bacterial growth on the MPs?

RESEARCH HYPOTHESIS

Staphylococcus aureus strain will be isolated from the screen of mobile phones.

SIGNIFICANCE OF RESEARCH

Student use mobile phones for educational purpose as well as for their requirements. Studies have reported that some staphylococcus strain persist in powered infant formula. Currently, only a few full-scale and systemic studies have been performed on *Staphylococcus aureus* prevalence and contamination levels on smartphone screen of UB student and sensibilize to disinfection is necessary

RESEARCH OBJECTIVES

OVERALL OBJECTIVES

To determine the frequency and virulence of *Staphylococcus aureus* isolated from the MPs, and contamination among students of UB.

SPECIFIC OBJECTIVES

Bacteriological isolation of *Staphylococcus aureus*.

RATIONALE

Smartphones, as ubiquitous devices can serve as vector in the transmission of pathogenic microorganism, such as *staphylococcus aureus*, a common bacterium found on the skin and in the environment is known for causing various infections. By isolating and identifying this potentially harmful microbes from the screen of the phone, this research will help us to understand the importance of hygiene practices among students.

LITERATURE REVIEW

DEFINITION

A cell phone is a portable, usually cordless, telephone for use in a cellular system. It has emerged as an important gadget in today's society as there are almost as many cell phones as there are people on earth (**Meadow & Green 2014**). **HISTORY OF MOBILE PHONES**

The first global system for mobile telecommunication established in Europe. In India, the first use of mobile phones was in 1995, and today more than 287 million mobile phone users exist, accounting for 85% of all the telecommunication users (**Trivedi *et al.*, 2011**).

USEFULLNESS OF MOBILE PHONES

However, there is little awareness of the possible hazards of cell phones, which may carry microorganisms as well as important data. We use mobile phones for commercial, educational and personal purposes. The addition of mobile phones is becoming the newest addition for the young people (**Vivekanada *et al*., 2017**).

RISK OF CONTAMINATION OF MOBILE PHONES.

We use mobile phones in hospitals, markets, in public gatherings, while eating as well as in washrooms, which are a common source of contamination. The pathogens can be transmitted through sharing personal phones with others (**Koscova *et al.*, 2018**).

THE MICROBES THAT CAN CONTAMINATE THE MOBILE PHONE

Common bacteria find in phone screens are resistant *Staphylococcus*, coagulase negative *Staphylococcus, E. coli, K. pneumoniae, Staphylococcus aureus, Acinetobacter species, Pseudomonas spp. and Enterococcus spp*. etc (**Pal *et al*., 2015**).

MATERIALS AND METHOD

MATERIALS

- Glove,
- petri dishes,
- ruler,
- spreader,
- test tubes,
- pipette,
- microscopic slide,

- timer,
- Swab.

METHOD

The cross-section study was conducted among students of UB, from the month of March 2022. participants were given ID number to protect their confidentiality. We agree that our sample size is ten. Purposive sampling was use to select participants from the university of Buea. the student population.

STUDY AREA

- **JUSTIFICATION OF THE PLACE OF STUDY**

  This study was carried out in the south west region of Cameroon specifically at the university of Buea.

- **PRESENTATION OF THE PLACE OF STUDY**

Buea is a town located in the southwest region of Cameroon. It is 900 meters above the sea level. The town has a population of 300,000 inhabitants, as the headquarters of the southwest region. The study area of this research was in the university of Buea.

The university of Buea was founded as a university center in 1945 and became a full-fledge university in 1992.

STUDY METHOD

- **TYPE OF STUDY**.

  The study was prospective and quantitative

- **STUDY PEROID**

  This study was run from the month of march to June in the year 2022.

- **POPULATION OR SAMPLE**
- **TARGET POPULATION**

  Phones of students at the university of buea(UB).

- **INCLUSION CRITERIA**

  The inclusion criteria are undergraduate students in university of Buea campus, those who are willing to participate, those who own a mobile phone and completed questionnaire.

- **EXCLUSION CRITERIA**

  The exclusion criteria include incomplete questionnaires, not providing inform consent or those unwilling to participate.

SAMPLE SIZE

Ten phones

DATA

- **DATA TYPE**

Quantitative

DATA COLLECTION INSTRUMENT AND TECHNIQUE

- All samples were collected following aseptically microbiological techniques.
- Sterile cotton swabs were used to collect sample from mobile phone screens.

- Alcohol was used to by the students to disinfects their hands.
- Powder-free disposable gloves were used for each sample collection in other to prevent potential cross-contamination.
- Sterile saline was used to moisten the swabs before use and rotated firmly over the entire surface of the mobile phone.
- These swabs were then placed in mannitol salt agar (MSA), which is a selective and differential growth medium use for the isolation of *Staphylococcus aureus.*
- Swabs were cultured on growth media according to the instruction and incubated at 37 °C for 24 to 48 hours.

DATA ANALYSIS AND PROCESSING

PREPARATION OF CULTURE MEDIA FOR *Staphylococcus aureus*

Nutrient agar is a general purpose medium suitable for the cultivation of a wide variety of no fastidious microorganisms. The medium with a relatively simple composition, is used to subculture organisms for maintenance purpose or to check the purity of subcultures and for the enumeration of organisms. Preparation of culture media.

- According to the manufacturer instruction a measurable amount of nutrient agar with the help of an electrical balance was suspended with measurable amount of water.
- The mixture in the flask was heated to boil to completely dissolve the medium.
- The opening of the conical flask was tightly sealed.
- The mixture was sterilized in an autoclave at a pressure of 15 pascal (121 degrees) for 15 minutes. (BBL nutrient agar et al..2006)
- Once the autoclaving process was complete, the conical flask was removed fom autoclave and allowed to cool to the temperature of 40-45 degrees
- The media was then be poured into sterile petri plates under aseptic conditions.
- The petri plate was close immediately with the cover lip and allowed to solidified (https://mafiadoc.com/3-materials-and-methods-shodhganga_5ba00edc097c471a3).

PREPARATION OF MANNITOL SALT AGAR

Mannitol salt agar is a selective medium used for the isolation, enumeration and differentiation of staphylococcus from MPs samples. The medium is both selective and differential. The selectivity of the medium is based on the presence of sodium chloride, which inhibits most GN and GP bacteria. The differentiation is based on the ability or not to ferment the mannitol. (**Patricia *et al.*, 2006)**

- According to the manufacturer's instructions, a measurable amount of agar with the help of an electrical balance was obtained and suspended in a measurable amount of distilled or deionized water, using an electric balance.
- Make the mixture to be homogenous.
- The mixture was slightly heated for one minute shaking frequently until completely dissolved.
- The mixture was sterilized in an autoclave at 121degrees for 15 minutes.
- Once the autoclaving process was complete, the conical flask was removed from the autoclave and allowed to cool to the temperature of 40-45 degree
- The media was then be poured into sterile petri plate under aseptic conditions. (**Aryal *et al.*, 2018)**

BACTERIA ISOLATION AND IDENTIFICATION PROCEDURE ISOLATION OF *S. aureus*

STREAK PLATE METHOD OF ISOLATION

The streak plate method is a rapid quantitative isolation method. The streaking is done using a sterile tool, such as a cotton swab or commonly an inoculation loop. **(Western Nevada college *et al*., 2009)**

- The cotton swab was first sterilized.
- The swab was dipped in an inoculum such as a broth or patient specimen containing many species of bacteria.
- The cotton swab was then dragged across the surface of the agar back and forth in a zigzag motion until approximately 30% of the plate has been covered.
- The loop was re-sterilized, and the plate was turned 90 degrees.
- Starting in the previously streaked section, the swab was dragged through it two to three times continuing the zigzag pattern.
- The procedure was then repeated once more being cautious not to touch the previously streaked sector.
- Each time the swab gathered fewer and fewer bacteria until it gathered just single bacterial cells that could grow into a colony.
- The plate has the heaviest growth in the first section, the second section was had less growth and a few isolated colonies, while the final section has the least amount of growth and many isolated colonies. The plate was inverted and incubated at 37 degree for 24 hrs.
- This method did not allow obligate anaerobes to grow. (**Benson *et al.*, 2005**).

IDENTIFICATION

Colonial appearance

- *Staphylococcus aureus* usually grow as opaque, Golden, yellow, circular, convex and smooth colonies of 1 – 3mm in diameter within 36hrs in air at 37 °C, (**James *et al*.,2015**).

Gram staining procedure and microscopic appearance

- Gram staining comprises the tintorial method of greatest use and relevance in microbiology, which aims to classify pathogens by their size, shape, cell structure and color. Base on this methodology, bacteria can be organized into two group; GP and GN (**Silva *et al.*, 2005**)
- At first, a smear was prepared with a bacterial strain on the slide intended for microscopy, in which the smear is fixed using heat.
- Then, a dye such as the crystal violet was dripped on the slide, allowing it to react for one minute. Right after, washing with running water was carry out to remove the excess of crystal violet.
- Then, Iodine was added for one minutes which had the function of allowing the fixation of the primary dye, followed by washing. This was done when the iodine reacted with crystal violet to form a complex in the peptidoglycan layer of the bacteria cell.
- Afterwards, alcohol was used for 5-10 seconds.
- After which was rinse with water gently. Gram-positive bacteria can retain crystal violet, because their cell wall is quite thick with peptidoglycan, which forms a mesh. Gram-negatives, in turn, have a cell wall with a thin layer of peptidoglycan.
- Finally, the safranin was applied, allowing it to react for one minute, followed by washing.
- The slide was tilted is to remove excess water and allow drying.

- In addition, the slide was analyzed with immersion oil in the optical microscope in the 100x objective.
- Thus, as the Gram-negatives stain red or pink, while the Gram-positives remain purple (**Mori *et al*., 2009**)

Catalase test

Hydrogen peroxide (H_2O_2) is a reactive oxygen species synthesized by human metabolism. However, some bacteria produce an enzyme called catalase that works as a way of protecting the microbe against this mode of action of the immune system, as it promotes the degradation of H_2O_2 in water (H_2O) and oxygen (O**2**). (**fernandes *et al.*, 2021**)

- The catalase test consists of a qualitative method for identifying this enzyme in the bacterial species analyzed.
- Smear of the bacterial strain was prepared
- Three percent hydrogen peroxide was added.
- Blistering in the bacterial smear occurred.
- There was bubble or no bubble formation in the bacterial smear. (**Fernandes *et al.*, 2021)**

RESULTS 1

This study, conducted in the university of Buea, expected to show a variety of bacterial growth from MPs, such as *Staphylococcus species* being the most common results of this study. (**Bhoonderowa *et al*…, 2017**).

TABLE 1. Analysis of questionnaire forms. Habit of phone use among undergraduate student of the university of Buea [n=10]

LOCATION WHERE THEY KEEP THEIR PHONE	
From bottom pocket	
Handbag	4(44%)
Back pocket	3(29%)
Handphone sack	3(29%)
HABIT OF USING PHONE IN WASHROOM	3(29%)
YES	
NO	8(90%)
REASON FOR USING PHONES IN WASHROON	1(10%)
Browsing	
Taking pictures	4(39%)
Listening to music	1(10%)
Answer call	4(44%)
HABIT OF USING PHONE WHEN DINNING.	3(29%)
YES	
NO	7(73%)

HABIT OF SLEEPING WITH PHONE. YES NO	3(29%) 7(73%) 6(65%) Frequency[%]
Variable	Frequency[%]

According to this questionnaire form, 44% of the students responded that the location where they keep their phone is in their bottom pocket, 29% In their back pocket, 29% in their handbag and 29% in their handphone sac. Among all the participant(n=10), 90% of them use their phone the washroom while the remaining 10% do not use their phone in the washroom. Additionally, among the reason they use phone in washroom, 39% use their for browsing, 10% use theirs for pictures, 44% use their to listen music, 29% use their to answer call. Moreover 73% of the participant has the habit of using phone when denner and 29% of the participant did not.

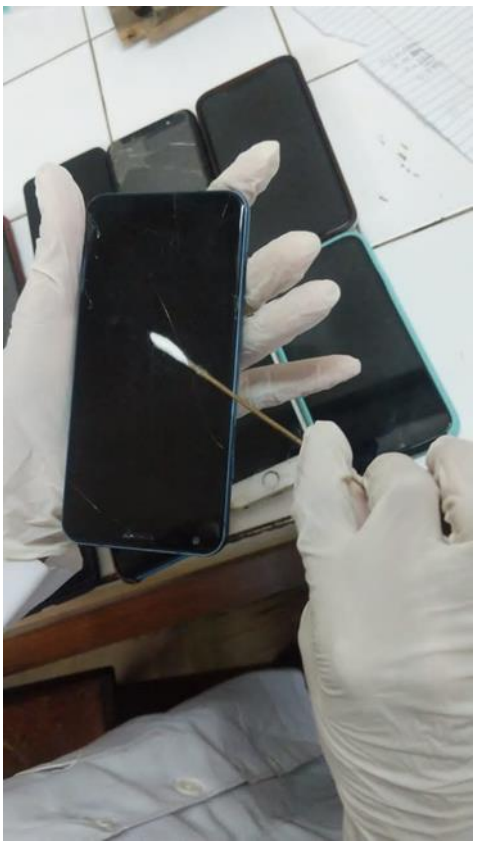

Fig 1: Sample collection from the screen of the phone with a sterile swab following all the aseptic technique

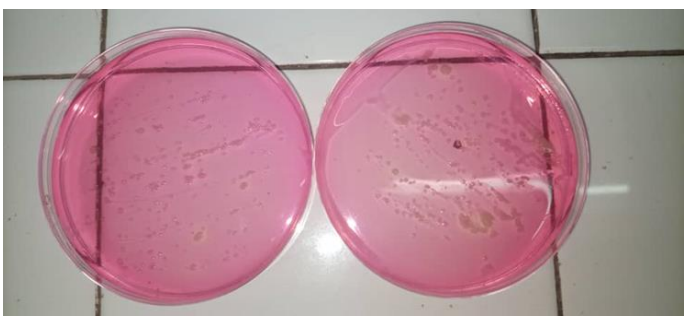

Fig 2: Microbial growth of bacteria on mannitol salt agar

Using streaking technique for inoculation on a mannitol salt agar follow by incubation for 24hrs at 37degrees in an incubator obtain from the sample indicate yellow colony growth showing the level of contamination of the mobile phone with *staphylococcus species.*

Fig 3: Catalase test showing bubble formation indicating the presence of *staphylococcus ssp*

Fig4 ; Coagulase test indicating the presence of *staphylococcus ssp*

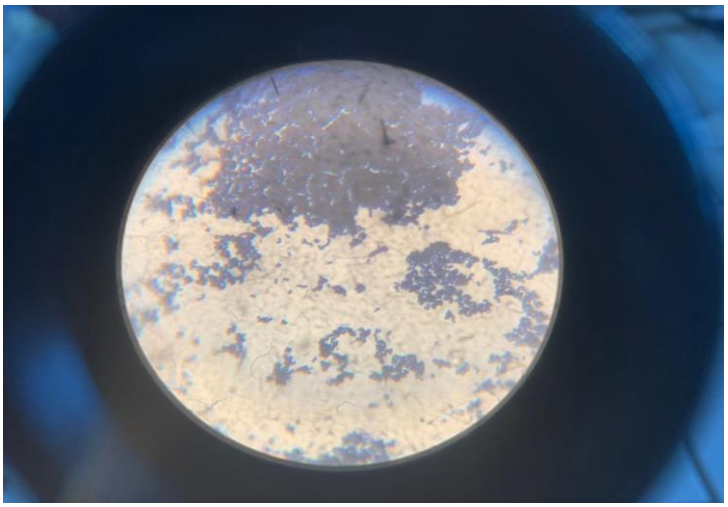

Fig 5: Gram staining observation under the microscope

DISCUSSION

Students from UB were the primary target population in these kinds of studies. A handful of reports showed that daily using devices like mobile phones have an important role in the transmission and spread of microorganisms. Smartphone screens is the endless reservoir of bacteria which posing health risks that are not present in any other items we use in our daily lives and work as a means of disease transmission (**Shahaby *et al*., 2012**). Moreover, studies conducted in UB show a variety of bacterial growth in MPs.

Staphylococcus ssp. Students use mobile phones for their educational purposes as well as for their requirements. The research aimed to raise awareness that their most useful smartphone can be a source of disease-causing bacteria. They used smartphones in the hospitals, in the public gatherings as well as in the washroom also, which is the source of bacteria. Those bacteria can attack us when our immunity becomes weak, in such an immune compromised condition, 88% students use smartphones. However, these studies give red flags regarding MPs contamination which may cause harms for the society. **(Husam *et al.*, 2013)**

CONCLUSION.

This study focuses on microbial contamination demonstrated through bacterial isolation, which involve the separation of a bacterial strain from a mobile phone. The isolate found are generally bacteria that are part of the human skin flora with medical significance. The growth of these bacterial flora can be control or inhibited by regular using of alcohol to wipe or clean the cell phone surface. Factor like irregular cleaning, presence of scratches, age of phone and sharing mobile phone with other tend to alter the occurrence of the different specie of bacteria on the MPs. However, the high-rate general microbial contamination and the lack of awareness among the population about disinfection procedure emphasize the necessity of education on universal disinfection protocol and maintaining a hand hygiene.

RECOMMENDATION.

Based on the findings of this study, the following are recommended-

- More wet-lab research is needed to investigate the increased prevalence of MPs contamination among medical college students, which may help increase awareness of the transmission of pathogenic organisms from colonized areas of healthy individuals to susceptible patients.
- Further research is needed to confirm whether mobile phones carry microorganism, as this study provide some insight, hence we advise more research on this aspect.
- Detailed information regarding the cleaning of MPs and maintaining MPs hygiene must be provided by Mobile companies before selling them, either through their special application or by reading materials included in the device.
- Investigation of the long-term contaminated effects of MPs use should be continued. . (**Sahlim *et al.*.2015)**

REFERENCES

1. Bhoonderowa A, Gookool S, Biranjia-hurddoyal SD. The importances of mobile phones in the possible transmission of bacterial infection in the community journal of the community health. 2014; 39(5):965-967. Doi;10.1007/s10900-014-9838-6
2. Vivekananda VA. (2017). Isolation and identification of common bacterial contamination in mobile phones owned by undergraduate student, journal of health, Medicine and Nursing, 35, 93-105.
3. Brady RR, Fraser Sf, Dunlop MG, Paterson- Brown S, Gibb AP. Bacterial contamination of mobile communication device in the operative environment. J Hosp infect. 2007;66;397-398.dol; 10.1016/ j.jhin.2007.04.015
4. Brady RR, son A, Stirling, McAllister C, Damani NN.in your phone bugged? The incident of bacteria known to cause nosocomial infection on health care worker' mobile phone. J Hosp infect. 2006; 62;123-125. doi; 101016/j.jhin.2005.05.005
5. Ekrakene T, Igeleke C. Micro-organism associated with public mobile phones along Benin-sapele Express Way, Benin city, Edo State of Nigeria. J appl Sci Res. 2007;3(12):2009-2012.

6. Wertheim HF, Melles DC, Vos MC, van Leeuwen W, van Belkum A, Verbrugh HA, et al. The role of nasal carriage in Staphylococcus aureus infections. Lancet Infect Dis 2005;5:751-62.
7. Foster TJ. The Staphylococcus aureus “superbug”. J Clin Invest 2004;114:1693-6.
8. Forbes BA, Sahm DF, Weissfeld AS. Bailey and Scott’s diagnostic microbiology. 12th ed. Maryland: Mosby; 2007.
9. James H. Jorgensen MAP, Karen C. Carroll, Guido Funke,. Manual of clinical microbiology 2015, 11th ed:354-422. B, III.
10. Western Nevada college biology251 laboratory manual; Three streak for bacteria isolation”;Dr. Steve Carman ;2009.
11. Benson, H. J.(2005). Bensons microbiological application; lab manual in general microbiology. Boston; Mcgraw-hill higher Education.
12. E.P. Silva, M.A. Carreiro, R.C. Gomes, Metodologia para a identificação de Staphylococcus sp. na superfície do colchão da maca no pronto socorro, Rev. Pró-univerSUS, 7(3).
13. W.G. Santos, R.S. Scurachio, D.R. Cardoso, Photochemical behavior of Safranine-Riboflavin complex in the degradation of folic acid, J. Photochem. Photobiol. A, 293, 32-39 (2014).
14. P. Silva, A.M.M. Carneiro, M.C. Carloni, M.I.C. Medeiros, J.O. Silva, S.H.C. Reche, et al., Isolamento, caracterização e resistência a antimicrobianos de bactérias Gram-negativas aeróbias e anaeróbias facultativas de amostras de solo, Rev. Inst. Adolf Lutz, 64(2), 245-251 (2005).
15. G. Fernandes-Queiroga-Moraes, L. Vilar-Cordeiro, F.P. de Andrade-Júnior, Main laboratory methods used for the isolation and identification of Staphylococcus spp., Rev. Colomb. Cienc. Quím. Farm., 50(1), 5-28 (2021).
16. Meadow, J. F., A. E. Altrichter, and J. L. Green. 2014. Mobile phones carry the personal microbiome of their owners. Peer J. 2:e447.
17. Koscova J, Hurnikova, Z & Pistl, J. (2018). Degree of bacterial contamination of mobile phone and computer keyboard surfaces and efficacy of disinfection with chlorhexidine digluconate and triclosan to its reduction, International j. of environmental research
18. Shahaby AF, Awad, NS, El-Tarras, AE & Bahobial, AS. (2012). ‘Mobile phone as potential reservoirs of bacterial pathogens’, African Journal of Biotechnology.
19. Selim HS, Abaza AF. Microbial contamination of mobile phones in a health care setting in Alexandria, Egypt. GMS Hygi Infect Control. 2015;10:Doc03.