.

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Assessment of Bacterial Contamination on Mobile Phones

تقييم التلوث الباكتيري على الهواتف النقالة

A dissertation submitted in partial fulfillment for the requirements of M.Sc. in Medical Laboratory Science (Microbiology)

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الآية

قال تعالى:

(اللَّهُ لَا إِلَهَ إِلَّا هُوَ الْحَيُّ الْقَيُّومُ ۚ لَا تَأْخُذُهُ سِنَةٌ وَلَا نَوْمٌ ۚ لَهُ مَا فِي السَّمَاوَاتِ وَمَا فِي الْأَرْضِ ۗ مَنْ ذَا الَّذِي يَشْفَعُ عِنْدَهُ إِلَّا بِإِذْنِهِ ۚ يَعْلَمُ مَا بَيْنَ أَيْدِيهِمْ وَمَا خَلْفَهُمْ ۖ وَلَا يُحِيطُونَ بِشَيْءٍ مِنْ عِلْمِهِ إِلَّا بِمَا شَاءَ ۚ وَسِعَ كُرْسِيُّهُ السَّمَاوَاتِ وَالْأَرْضَ ۖ وَلَا يَؤُدُهُ حِفْظُهُمَا ۚ وَهُوَ الْعَلِيُّ الْعَظِيمُ)

صدق الله العظيم

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Dedication

I dedicate this work to ……

My lovely parents……..

My husband……

My friends and my colleagues…..

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ACKNOWLEDGEMENT

Firstly, thanks to Almighty **ALLAH** for giving me patience and strength to complete this work.

Secondly, I would like to acknowledge my supervisor **Prof. Humodi Ahmed Saeed**, for his encouragement and follow up through the study.

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ABSTRACT

The Mobile phones are one of the most important devices which can transfer infectious agents. The objective of this study was to assess the bacterial contamination of mobile phones used by students of Sudan University Science and Technology. The study was conducted during the period from October to December 2017.

The samples were collected by sterile cotton wool swab from the surface of the mobile phone. The swabs were labeled, inserted in sterile nutrient broth medium and immediately transported to the Research Laboratory for processing. Then the samples were cultured and processed according to standard microbiological procedures. The growth was observed and assessed identification of isolated bacteria was done by Gram's stain and biochemical tests.

Of the fifty samples obtained from the surface of mobile phones, growth was obtained from 43 (86%) samples while 7 (14%) samples showed no growth. The isolates prepared for staining and identification.

According to the results of the biochemical tests performed, the bacteria isolated were 38(88.4%) of examined growth. The identified bacteria were *Bacillus* spp was 15(39.4%), coagulase -negative staphylococci were 11(29%), *Staphylococcus aureus* were also 11(29%), and one sample was *Klebsiella pneumoniae* (2.6%). The fungal contamination was detected in 5(11.6%) of total collected samples.

The findings of this research indicate that bacteria isolated from mobile phones are known to cause infections in human beings; therefore personal hygiene is very important. Further study using large numbers of samples are required to validate the results of the present study.

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المستخلص

الهاتف النقال واحد من اهم الادوات التي تنقل مسببات العدوى، الهدف من هذه الدراسة تقويم التلوث البكتيري للهواتف النقالة لطلاب جامعة السودان للعلوم والتكنولوجيا. هذه الدراسة أجريت خلال الفترة من أكتوبر إلى ديسمبر 2017 م .

العينات جمعت بواسطة مسحة معقمة من اسطح الهواتف النقالة ، المسحة رقمت ووضعت في وسط بكتيري ونُقلت في الحال الى معمل البحوث للمعالجة، العينات زرعت وعولجت اعتمادا على الخطوات الأساسية لعلم الاحياء الدقيقة، ودرس النمو وقُوِّم .تم التعرف على البكتريا المعزولة بواسطة صبغة جرام والإختبارات الكيموحيوية.

خمسون عينة جمعت من أسطح الهواتف النقاله ، كان النمو في43 (86%)من مجموع العينات بينما 7(14%) لم تنمو. العينات المعزولة حضرت للصبغ والتعرف.

إعتماداً على نتائج الاختبارات الكيميائية الحيوية التي أجريت، البكتيرياالمعزولة كانت تمثل 38 (88.4%) من مجموع العينات ، انواع العصويات كانت 15(39.4%) ، المكورات العنقودية السالبة للتجلط كانت11(29%) المكورات العنقودية كانت 11(29%) ، وعينة واحدة من الكليبسيلة الرئوية(2.6%). التلوث بواسطة الفطريات كان يمثل5 (11.6) من مجموع العينات.

نتائج هذا البحث أشارت الى أن البكتيريا المعزولة من الهواتف النقالة يمكن أن تسبب عدوى للإنسان لذلك الممارسات الصحية الشخصية مهمة جداً. وأيضا يتطلب عمل دراسات لاحقة بإستخدام عدد أكبر من العينات لتدعيم نتائج هذه الدراسة.

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TABLE OF CONTENTS

الاية……. I

Dedication…… II

Acknowledgement……. III

Abstract …… IV

Abstract (Arabic)…… V

Table of contents…… VI

List of tables…….. IX

CHAPTER ONE

INTRODUCTION AND OBJECTIVES

1.1. Introduction……. 1

1.2. Rationale……. 2

1.3. Objectives…… 2

1.3.1 General objective……. 2

1.3.2. Specific objectives……...… 2

CHAPTER TWO

LITERUTURE REVIEW

2. Literature review……...…….. 3

.

CHAPTER THREE

MATERIALS AND METHODS

3.1. Study design…… 8

3.1.1. Type of study……..…….. 8

3.1.2. Study area……. 8

3.1.3. Study duration……. 8

3.2. Ethical consideration……... 8

3.3. Sampling technique and culture……..…… 8

3.4. Identification…….…….. 9

3.4.1. Gram smear…….. 9

3.4.2. Biochemical test…….. 9

3.4.2.1 Oxidase test…….…….. 9

3.4.2.2. Citrate utilization test…… 9

3.4.2.3. Indole test……. 9

3.4.2.4. Urease test……. 10

3.4.2.5. utilization of sugar, production of H_2S and gas test……. 10

3.4.2.6. Catalase test…….. 10

3.4.2.7. Coagulase test……... 10

3.4.2.8. Deoxyribonuclease test (DNase test)…… 10

3.4.2.9. utilization of manitol test…….. 11

3.4.2.10. Novobiocin test……... 11

.

3.5 Data analysis…… 11

CHAPTER FOUR

RESULTS

4. Results…….. 12

CHAPTER FIVE

DISCUSSION

5.1. Discussion……... 15

5.2. Conclusion**…….** 16

5.3. Recommendations…….. 16

References……. 17

Appendixes …… 21

.

LIST OF TABLES

Table 1	Distribution of participants according to the gender	12
Table 2	Bacterial growth after overnight incubation	13
Table 3	Frequency and percentage of isolates	13
Table 4	Types and frequency of the isolated bacteria	14

CHAPTER ONE

INTRODUCTION AND OBJECTIVES

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CHAPTER ONE

1. INTRODUCTION AND OBJECTIVES

1.1 Introduction

Mobile or cellular telephone is a long-range, portable electronic device for personal telecommunication (Deshmukh, 2016). Today mobile phones have become widely spread accessories in today's life. In 2013, more than 1.6 billion smart phones were in use worldwide, and it is estimated that this number will approximately double within the next 4 years. In addition to the standard voice function of a telephone, mobile phones can support many additional services such as SMS for text messaging, email, pocket switching for access to the Internet, but it is easy to overlook the health hazard it might pose to its many users and it acts as fomites as they are carried with their owner to places such as toilets, hospitals and kitchens, which are loaded with microorganisms (Elmanama *et al*., 2014).

The colonization by potentially pathogenic organisms on various objects such as duster, marker, pen, computer, keyboards and mobile phones has been reported and these materials are implicated in transmission of pathogens, in recent times there has been an increase in the use of mobile phones by academic and non-academic staff of educational institutions (Deshmukh, 2016).

Despite the potential benefits of mobile phone in facilitating communications, this device has been considered as one of the most important factors that threaten human health, e.g. transmitting microbial germs from one person to another. This is especially important in health centers because the constant handling of the mobile phones by hospital staffs facilitates gathering various types of nosocomial germs that can become an important source for transmission of these infections (Sedighi *et al*., 2015). And they could be contaminated through many sources such as human skin or hand, bag, phone pouch, bags, pockets, environment and food particles, these sources are links through which microorganisms colonized the phone, thus causing diseases that range from mild to chronic (Shahaby *et al*., 2012).

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Mobile phones serve as a perfect habitat for the microbes to breed providing higher temperature and humid conditions (Srikanth *et al*., 2008).

In some studies have shown that the bacteria isolated form users' hands and cell phones are the same. In another study which was conducted by Ebrahim Badr *et al*. in 2012, it is shown that the contamination of hospital personnel's hands has increased by 93.7% after using cell phones (Jalalmanesh *et al*., 2017).

People rarely disinfect mobile phones and they are cumbersome to clean. As a result, these devices have the potential for contamination with various bacterial agents (Zakai *et al*., 2016).

Sources of infection may be exogenous such as air, equipment, environment, or endogenous such as the skin flora (Elmanama *et al*., 2014).

1.2 Rationale

Many people take their phones with them everywhere they go, at any given point in time. Phones and their owners are exposed to similar environmental microbes, which can lead to overlapping bacterial contamination.

1.3. Objectives

1.3.1. General Objective

1- To assess bacterial contamination on mobile phone among university students.

1.3.2. Specific Objectives

a) To collect samples from mobile phones.
b) To isolate and identify bacteria found on mobile phones.

CHAPTER TWO

LITERUTURE REVIEW

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CHAPTER TWO

2. LITERATURE REVIEW

A mobile phone is a wireless handheld device that allow user to make calls and text massages among other features (Technopidia, 2017).

The global system for mobile telecommunication was established in 1982 in Europe with a view of providing an improved communications network. Nowadays, mobile phones have become one of the most indispensable accessories of professional and social life. This device is used routinely in every location in universities by teacher, students and hospitals by patients, visitors and health workers, as a means of communication and a source of information, Increasing functionality and affordable prices for cell phones have resulted in a global reliance on staying connected everywhere. These factors and the heat generated by cell phones contribute to bacterial growth on the device at alarming rates. Given daily contact of cell phones with the face, hands, and different surfaces in the hospitals, the dire health risks of using them become obvious (Haghbin *et al*., 2015).

In 2000, World Health Organization (WHO) described the electromagnetic radiation emitted from phones and base stations as a threat to lives, as it damages the DNA producing sperm cells (Elmanama *et al*., 2014).

It is also focused to show the necessity of cleanliness in handing personal objectives like cell phones carefully with proper cover which would prevent the multiplication of microorganisms both pathogenic and nonpathogenic.

In other research has shown that the combination of regular handling and the heat generated by the phones creates a prime breeding ground for all sorts of microorganisms that are normally found in our skin and environment, the human body surface is constantly in contact with environmental microorganisms and become

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readily colonized by certain microbial species. Because of the achievements and benefits of the mobile phones, it is easy to overlook its hazard

To health; this is against the background that many users may have to regard for personal hygiene, and the number of people who may use the same phone. This constant handling of the phone by different users exposes it to an array of microorganisms, and makes it good carrier for microbes living on each square inch of the phone (Verma *et al*., 2015).

Nosocomial infection is an important problem in all modern hospitals and the bacteria were transmitted to patients by contaminated hands of health care workers (HCW). Hospitals, labs, and Intensive Care Units (ICU) are the work places that need highest hygiene standards. Personnel working there and the equipment used by them should also meet the same requirements (Lakshmi and Lakshmi, 2014).

Several studies were done in different countries around the world by many scientists and microbiologists to see if there was mobile phones contamination;

A study was conducted to determine microbial contamination of mobile phones in the Deulgaon Raja city in India. A total of 174 colonies belonging to 10 genera were isolated from the mobile phones. The isolated genera were. *Staphylococcus* sp, *Klebsiella* sp, *Enterococcus* sp, *Bacillus* sp,*Acinetobacter* sp, *Corynebacterium* sp, *Pseudomonas* sp, *Proteus* sp ,*Serratia* sp, and *Escherichia coli* (*E.coli*). When their morphological, Gram staining and biochemical characteristics were compared with known taxa. The study showed that all mobile phones under consideration were infected by several microbes, most of which belong to the natural flora of the human body. This means that it is necessary to sterilize hands after contact with phones since it is a source of disease transmission (Deshmukh, 2016).

one of these studies was conducted between March 25 to May 30, 2015 at Department of Biotechnology, University of Gondar, which is located in Gondar town in Amhara Regional State, Ethiopia .Out of 59 samples collected from mobile phones 20, 17, 13 and 9 samples belongs to students, staff members, cleaners and health professionals

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respectively. Mobile phones of students and employees were randomly sampled by taking written and oral consents from all the participants included in this study. Total 50 mobile samples included in this study for isolation of bacteria and 17 selected colonies of bacteria isolated from mobile phones were further processed. Out of these colonies, it were found *E. coli*, *E. aerogenes*, *Streptococcus* spp. and *S. aureus* in the percentage of (23.53%), (23.53%), (17.65%) and (35.30%) respectively. The finding of this research indicates that bacteria isolated and characterized from mobile phones are known to cause infections in human beings; therefore sharing of mobiles, usage of mobile during eating should be discouraged. Personal hand hygiene is very important and also washing of hand before and after handling of food and phone decontamination should be adopted by people to prevent cross and self-contamination by these bacteria (Verma *et al*., 2015).

Other study was done in Nigeria, (2015) a total of 350 mobile phones were examined for the presence of bacteria, 300 were owned and used by medical personnel, whereas 50 were owned and used by non-medical personnel. Out of the 300 examined 242 had growth with an overall percentage prevalence rate of (80.6%). Out of the 50 non-medical personnel 25(50%) had growth, The percentage occurrences of isolated bacteria from phones of medical personnel were: Coagulase negative Staphylococci (35.3%), *Staphylococcus aureus* (20.7%), *Streptococcus* spp. (14.3%), *Pseudomonas aeruginosa* (6.0%), and *E. coli* (4.3%)respectively. For the non-medical personnel; Coagulase negative Staphylococci 20%, *Staphylococcus aureus (*10%) *Streptococcus spp* (10%), *Pseudomonas* (6.0 %) and *E. coli* (4.0%)respectively (Amala and Ejikema, 2015).

In Italy, 2013 Fauci and his colleagues conducted a study in the University Hospital in Messina between April 1 and June 31which was aimed to determine the extent of contamination of the hands and mobile phones of healthcare workers and inpatients. The study comprised 200 Health care workers and 100 inpatients.

The bacterial contamination was detected on 230 mobile phones (76.6%) and on 250 hands (83.3%). The most frequently isolated bacteria belonged to the *Staphylococcus*

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genus. For hospital staff, 78% of mobile phones and 86% of hands were found to be contaminated. Similar results were obtained for inpatients whose mobile phones tested positive in (74%)of cases, while for hands the rate was(78%), on positive cultures testing, mobile phones were found to be colonized as follows: (64.1%) by *Staphylococcus aureus*, (33.3%) by Coagulase-negative Staphylococci, (2.5%)by Enterobacter (*Serratia* spp.) and (15.3%) by *Enterococcus faecalis*. The overall contamination rate for hands was (86%) where the following microorganisms were isolated: *Staphylococcus aureus* in (67.4%) of cases, Coagulase-negative *Staphylococcus aureus* (co-ns) in (32.5%), *Pseudomonas* spp. in (2.3%) and *Enterococcus faecalis* in (13.9%). The co presence of *Staphylococcus spp*. and *Enterococcus faecalis* was detected on 6.0% of mobile phones and (7.0 %) of hands (Lakshmi, 2014).

A similar percentage (74%) of mobile phones of inpatients tested positive. The following rates of microorganisms were detected: *Staphylococcus aureus* (62.1%), Coagulase-negative Staphylococcus aureus (51.3%), *Pseudomonas* spp (2.7%) and *Enterococcus faecalis* (13.5%) (Fauci *et al*., 2013).

In Iran, 2013 Parhizgar and et al done study on Administrative and Clinical staff

From some hospitals for Identification of bacteria isolated from mobile phones.

Samples were collected from 170 Health Care Worker's mobile phones in Golestan, Emam Khomeini and Taleghani teaching hospitals. The samples consisted of Clinical personnel group and Administrative personnel group, in each group 85 mobile phones were investigated and bacterial isolates were identified with gram and spore staining and standard biochemical tests. The Bacteria were isolated from 90% of the examined mobile phones: coagulase negative Staphylococci (69%), *Bacilli* (20.6*%), Acinetobacter* spp. (6%), *Klebsiella pneumoniae* (1.8%), *Pseudomonas aeruginosa* (1.2%), *Staphylococcus aureus* (1.2%) and *Ecsherishia coli* (0.6%). From 18 isolated pathogenic bacteria, 13 bacteria isolated from group one and five were related to bacteria isolated from group two (Parhizgar *et al*., 2013).

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A study was conducted in India for Isolation and Identification of microbes associated with mobile phones, The study findings indicate that the percentage of *Staphylococcus aureus* (52.7%), *Staphylococcus epidermidis* (17.06%), *Pseudomonas aeruginosa* (12.2%), *Micrococcus luteus* (9.1%), and *Enterobacter aerogenes*(1.8%) and *Bacillus subtilis* (7.07%) ,which are the main bacterial isolates frequently associated with mobile phones (Dave and Shende, 2015).

Researchers conducted a pilot study aimed to examine the presence of pathogenic bacteria on the surfaces of cell phones that are used frequently by preclinical medical students. The cross-sectional study was identified both pathogenic and nonpathogenic bacteria on cell phones of 105 medical students at King Abdulaziz University, Jeddah, Saudi Arabia, using standard microbiological methods. Out of 105 cell phones screened, 101 (96.2%) were contaminated with bacteria. Coagulase-negative staphylococci were the most abundant isolates (62.9%). Seventeen (16.2%) cell phones were found to harbor *Staphylococcus aureus*, Gram-positive bacilli were isolated from 20 (19%) samples. *Viridans streptococci* and *Pantoea species* were also isolated but at lower levels (Zakai *et al*., 2016).

In 2014 other Sudanese study was conducted in Khartoum State by Enas Osma Out of 203 samples was investigated 34(16.7%) showed bacterial growth, the bacterial load mean was $59*10^6$ CFU\ml, Coagulase-negative staphylococci were represent 26(76.5%). Of these 17(65.4%) *Staphylococcus simulans*, 4(15.4%) *Staphylococcus lugdunensis* ,3(11.5%) *Staphylococcus warneri* and 2(7.7%) *Staphylococcus hominis* (Abd Elhrahim, 2014).

In 2014 other Sudanese study was conducted in Khartoum State by Einass Babikir out of 200 swabs cultured, 34(17%) contained bacterial growth. The rest 176(83%) showed no bacterial growth. The mean of bacterial load was $11.78*10^7$ CFU\ml. Eight (8) Gram-neggative bacterial species were identified. These were *Pseudomonas aeruginosa* 6(75%), *Klebsiella pneumonia*e 1(12.5%) and *Providencia sturtii* 1(12.5%) (Babikir, 2014).

CHAPTER THREE

MATERIALS AND METHODS

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CHAPTER THREE

3. MATERIALS AND METHODS

3.1. Study design

3.1.1. Type of study

This was a cross-sectional Descriptive study

3.1.2. Study area

The study was conducted among the students studied of Sudan University of Science and Technology (SUST). The practical part of this study was carried out in the Research Laboratory, SUST.

3.1.3. Study duration

The study was carried out the period from October to December 2017.

3.2. Ethical consideration

All the students enrolled were agreed to participate in the study before collecting samples from their mobile phone.

3.3. Sampling technique and Culture

The mobile phone was sampled by a sterile cotton wool swab. The swab was moistened with a sterile nutrient broth medium before rubbing the swab on the surface of the mobile phone, they were put in sterile containers which contain 2 ml of sterile nutrient broth medium. The collected swabs were labeled and immediately transported to the Research Laboratory within half an hour.

After that the content of tube was vortex for one minute, by using the pouring plate method add 1 ml from homogenized sample to 15 ml of sterile nutrient agar and, and mix it gently, The plate was incubated at 37 C˚ for 24hours(Brown and Poxton 1996).

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3.4. Identification

3.4.1. Gram smear

From culture single colony was isolated to prepare the smear on slide by using sterile wire loop emulsified in normal saline, dried by air and fixed by flame, then the smear was covered by crystal violet for 30-60 seconds then washed by clean tape water and then covered by lougal,s iodine for 30-60 seconds, washed by clean tape water, finally smear covered by saffranine for two minutes, washing by clean tape water and then examined the slides by using of oil immersion lens (100x).Gram negative; red color. Gram positive; violet color (Cheesbrough, 2006).

3.4.2. Biochemical test

3.4.2.1 Oxidase test

This test is used to detect the ability of the organism to produce oxidase enzyme, oxidase disk was placed inside the Petri dish, and small inoculums was taken by using wooden stick, and then smeared on the disk by opening the Petri dish partially. Blue-purple colour; oxidase test positive (within 10 seconds), no blue-purple colour, oxidase test negative (within 10 seconds) (Cheesbrough, 2006).

3.4.2.2. Citrate utilization test

The test based on the ability of organism to use citrate as sole source of carbon, the test was done by inoculating the organism on Simmon's citrate agar and incubated for 18-24 hours in 37˚ C. Bright blue;citrate test positive, no change in colour of medium; citrate test negative (Cheesbrough, 2006).

3.4.2.3. Indole test

Under aseptic condition the tested organism was inoculated in the test tube containing 3ml of sterile tryptone water then incubated at37˚ C for overnight, then add Kovac's reagent. Presence of red ring; positive, no change in color; negative (Cheesbrough, 2006).

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3.4.2.4. Urease test

This test used to identify some bacteria that produce urease enzyme which break down the urea into ammonia and carbon dioxid, the test was done by inoculating the urea agar with tested organism and incubated at 37C˚ for overnight. If color changed to pink; positive, no change in color; negative (Cheesbrough, 2006).

3.4.2.5. Utilization of sugar, production of H_2S and gas test

The tested organism inoculated on the Kliger Iron Agar (KIA) media by using sterile straight loop, by stabbing on the butt, then streaking the slope of the media then incubated for 24 hours in 37˚C The result depend on the ability of the organism to ferment the sugar which appear as change in color of the slope and butt, gas production appears as gap and cracking of the media and H_2S production as blacking on the media (Cheesbrough, 2006).

3.4.2.6. Catalase test

An organism was tested for catalase production by bringing it into contact with hydrogen peroxide. Bubbles of oxygen are released if the organism is a catalase producer. Active air bubbles indicate positive result (Cheesbrough, 2006).

3.4.2.7. Coagulase test

On clean slide a drop of distilled water was placed and emulsified a colony of the tested organism, then a loop full of plasma was added to the suspensions, and mixed gently, then examined the clumping of the organisms within 10 seconds. Clumping within 10 seconds; Positive Coagulase test, no clumping within 10 secs; negative Coagulase test (Cheesbrough, 2006).

3.4.2.8. Deoxyribonuclease test (DNase test)

The test organism was cultured on a medium which contains DNA. After overnight incubation at 37˚C, the colonies were tested for DNA-ase production by flooding the plate with a weak hydrochloric acid solution. The acid precipitates un hydrolyzed

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DNA. The DNA-ase-producing colonies were therefore surrounded by clear areas due to DNA hydrolysis, Clearing around the colonies; DNA-ase positive, no clearing around the colonies; DNA-ase negative result (Cheesbrough, 2006).

3.4.2.9. Utilization of manitol test

The tested organism streaking on MSA media, after overnight incubation at 37˚C observed the change of the color to yellow color (manitol fermenter colonies); MSA test positive, red color (non manitol fermenter colonies) MSA test negative (Cheesbrough, 2006).

3.4.2.10. Novobiocin

To a molten medium a filter-sterilized solution of novobiocin was added to the test organism witch inoculated in the media, then incubated aerobically for 24 hours in 37˚C and examine for the presence (resistant) or absence (sensitive) of growth (Baird, 1996).

3.5. Data analysis

Simple data analysis was done to form the result.

CHAPTER FOUR

RESULTS

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CHAPTER FOUR

4. RESULTS

4.1. Results

A total of fifty samples were collected from the surface of students' mobile phones. The students were 28(56%) females and 22(44%) males (Table 1)

Occurrence of bacterial growth was observed in 43(86%) from all collected samples and 7(14%) showed no bacterial growth (Table 2).

According to the result of the biochemical tests performed, the bacteria isolated from 38(88.4%) of examined mobile phones (Table 3). These were *Bacillus spp* represented 15(39.4%), coagulase negative staphylococci represented 11 (29%), *Staphylococcus aureus* also represented 11(29%0 and one sample (2%) *Klebsiella pneumonia* (Table 4). Fungal contamination was detected in 5(11.6%) of total collected samples.

Table 1.Distribution of participants according to the gender

Gender	**Number**	**Percentage**
Male	22	44%
Female	28	56%
Total	50	100%

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Table 2. Microbial growth after overnight incubation

Observed growth	**Number**	**Percentage**
Growth	43	86%
No growth	7	14%
Total	**50**	**100%**

Table 3.Frequency and percentage of isolates

The organisms	**Total number**	**Percentage**
Bacteria	38	88.4%
Fungi	5	11.6%
Total growth	**43**	**100%**

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Table 4.Types and frequency of the isolated bacteria

Species	**Number**	**Percentage**
Bacillus spp	15	39.4%
Coagulase-negative staphylococci	11	29 %
Staphylococcus aureus	11	29%
Klebsiella pneumonia	1	2.6%
Total	**38**	**100%**

CHAPTER FIVE

DISCUSSION

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CHAPTER FIVE

5. DISCUSSION

5.1. Discussion

This study aimed to assess bacterial contamination of mobile phones. In the present study38 (88.4%) of the total samples were positive for bacterial growth. This result is near to study conducted in Iran which was (90%) of the examined mobile phones (Parhizgar *et al*., 2013). Other study conducted at King Abdulaziz University, Saudi Arabia, out of 105 cell phones screened, 101 (96.2%) were contaminated with bacteria (Zakai *et al*., 2016).

In comparison with the study mentioned above and other studies there are relative differences in types and percentages of isolated bacteria , the highest percentage was *Bacillus* spp which represented (39.4%), coagulase -negative staphylococci represented (29%), *Staphylococcus aureus* also represented (29%)and (2.6%) *Klebsiella pneumoniae* while other study was conducted in Nigeria which include medical and non -medical personnel, the overall percentage occurrences of isolated bacteria from phones of medical personnel were; Coagulase negative Staphylococci 35.3%, *Staphylococcus aureus* (20.7%), *Streptococcus spp* (14.3%), *Pseudomonas aeruginosa* (6.0%), and *E. coli* (4.3%) respectively, For the non-medical personnel, Coagulase negative *Staphylococci* 20%, *Staphylococcus aureus* (10%), *Streptococcus* spp. 10%, *Pseudomonas* (6.0 %) and *E. coli*(4.0%) respectively (Amala and Ejikema, 2015).

Other study carried out in University of Sarajevo, *Staphylococcus epidermidi*s was the most commonly isolated microorganism (73.3 %), and *B. subtilis* was also isolated in great numbers (40 %), only three species of Gram-negative bacteria were recovered. *Pseudomonas aeruginos*a was detected in two samples (3.3 %), while *Escherichia coli* and *Acinetobacter calcoaceticus* were each detected in one sample, respectively (1.67 %) (Mujkić *et al*., 2013).

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In 2014 other Sudanese study was conducted in Khartoum State by Enas Osma Out of 203 samples was investigated 34(16.7%) showed bacterial growth, the bacterial load mean was $59*10^6$ CFU\ml, Coagulase-negative staphylococci were represent 26(76.5%). Of these 17(65.4%) *Staphylococcus simulans*, 4(15.4%) *Staphylococcus lugdunensis* 3(11.5%) *Staphylococcus warneri* and 2(7.7%) *Staphylococcus hominis* (Abd Elhrahim, 2014).

5.2. Conclusion

Although many bacteria were isolated but the infection was low. Mainly isolated bacteria were Gram -positive bacteria.

5.3. Recommendations

Most of these bacteria can cause morbidity and mortality in to humans; so that personal hygienic and sanitation measures are very important to prevent bacterial infections.

Further researches regarding the infectious diseases transmitted via mobile phones especially in medical staff are highly recommended.

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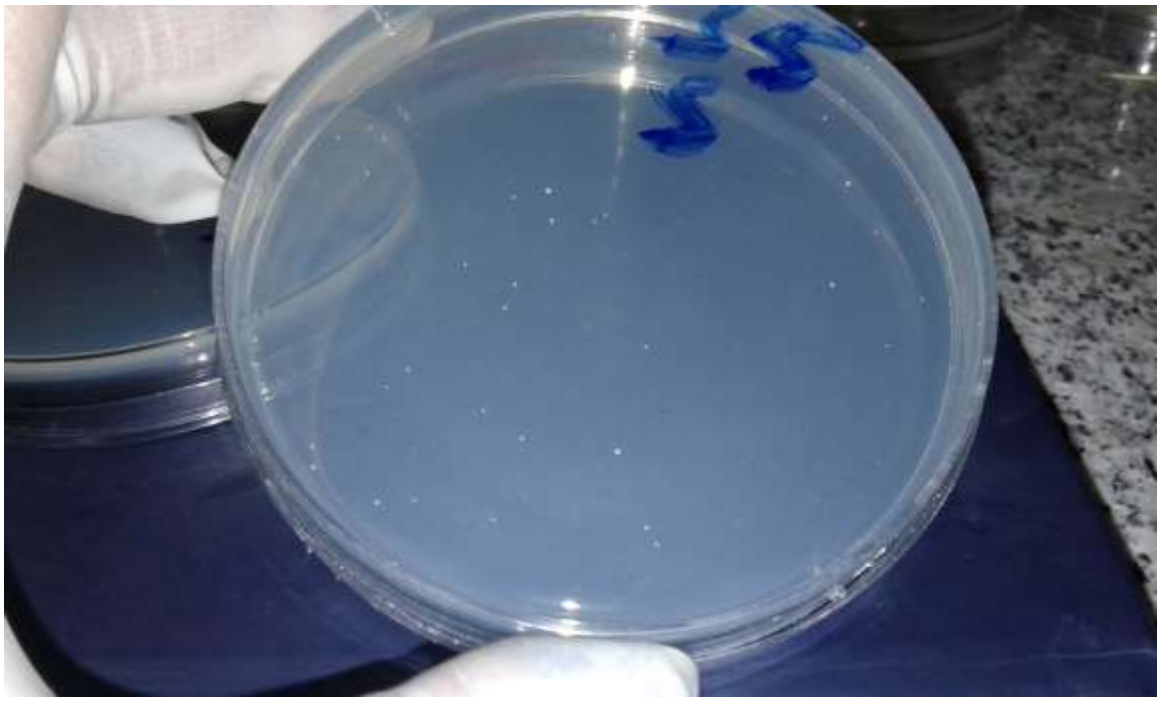
Appendixes



colony growth on nutirent agar

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coagulase test positive

Catalase test positive

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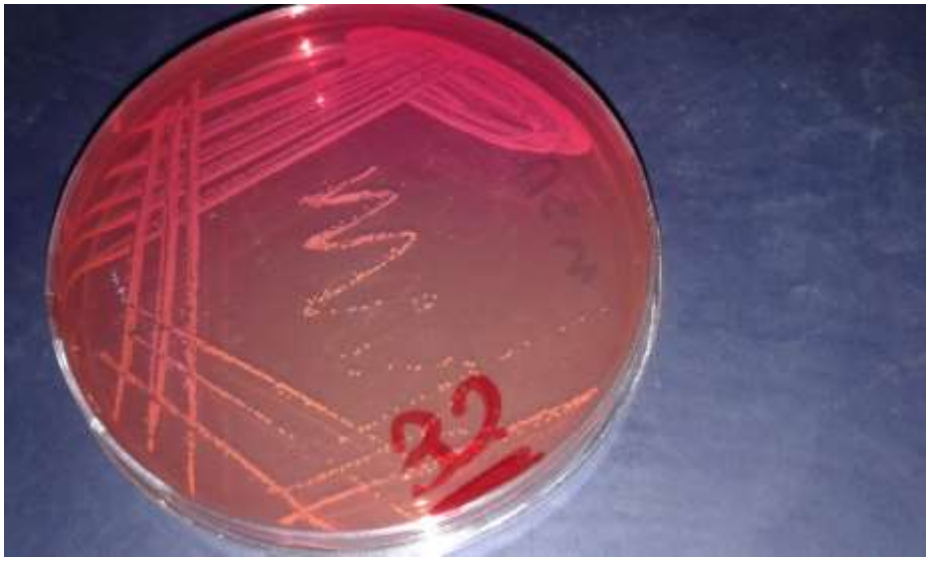
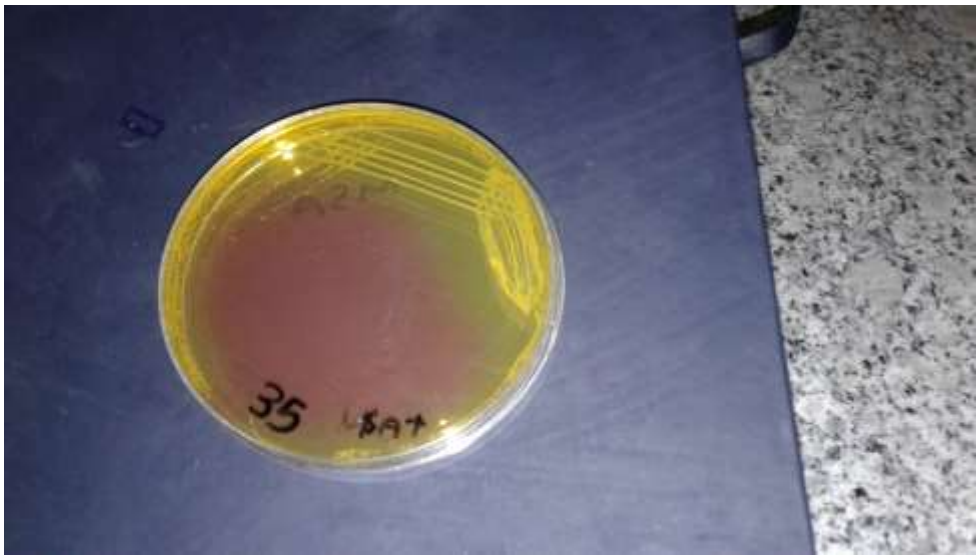


Non manitol fermenter



Manitol fermenter

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Growth of *Klebsiella pneumonia* on MacCokey agar

Biochemical test of *Kebsiella pneumonia*