Research Article

iMedPub Journals
http://www.imedpub.com

Journal of Pharmaceutical Microbiology

2018
Vol. 4 No. 1:5

Identification of Bacterial Contamination and Evaluation of Antimicrobial Solution on Mobile Phones

Anuradha SN[1], Arunkumar S[2], Tan chan W[3], Joyce heng WS[3] and Goh yi W[3]

1 Lecturer, Faculty of Pharmacy, Aimst University, Malaysia
2 Junior Scientist, IPDO, Dr. Reddys lab, Hyderabad, India
3 Faculty of Pharmacy, Aimst University, Malaysia

Corresponding author: Anuradha SN

anuharisiva@gmail.com

Lecturer, Faculty of pharmacy, Aimst University, Malaysia.

Tel: +91 9976415495

Citation: Anuradha SN, Arunkumar S2, Tan chan W (2018) Identification of Bacterial Contamination and Evaluation of Antimicrobial Solution on Mobile Phones. J Pharm Microbiol. Vol. 4 No. 1:5

Abstract

In this era, mobile phone is one of the significant technological advancement. These devices help individuals share information and stay connected with each other. The purpose of this study is to find out the microbiological contamination on mobile phones and determine the effectiveness of self-prepared antimicrobial solution. Hence a total of 30 mobile phones were randomly collected and analyzed with positive and negative controls for microbial contamination which is compared after application of solution. The results show a decrease of 81.40% after the application of antimicrobial solution in SDA. While in NA the average number has been decreased by 59.87%. Testing with ethanol as disinfecting agents for mobile phones significantly reduced the number of microbes on the surface of mobile phones. It is important to be aware about the reduction of microbes (both fungi and bacteria). Based on the study it was evident to conclude that the formulation is effectively inhibiting the growth of microorganisms found on the surface of mobile phones. Hence, it was suggested to the participant to follow and adhere to the simple hygiene measures by using the formulation for a healthy lifestyle.

Keywords: Mobile phones; Antimicrobial solution; Health hazard; Contamination

Received: December 16, 2017; **Accepted:** September 14, 2018; **Published:** September 19, 2018

Introduction

In June 29, 2007, Apple Inc. stunned the IT world by introducing the first generation iPhone which gathered the function of taking photos, playing music, send and receiving email and message, and connect to internet in one gadget. Running on iPhone Operating System (IOS) it changed the world's perspective of "Smartphones". In today's world, "smart phones" usually refer to that mobile phone with multi touch screen, including a virtual keyboard, running on specific operation system designed for mobile phone usage (IOS, Android OS, Symbian OS and etc.). End user is able to download applications and software's from the software manufacturer according to their own need [1]. According to the recent estimation by Statista, one of the world's largest statistics portals, there are as many as 4.4 billion mobile phones users worldwide and the number is increasing progressively. It was estimated that the number will achieve 5 billion in the end of 2015 [2]. In Malaysia, the first cellular network was introduced by Telekom Malaysia in 1985, based on NMT 450. The mobile phones were large and bulky [3]. Subsequently, 3G started in Malaysia in the second half of 1995. It is a packet-based transmission of text, digitized video and multimedia at data rates up to and possibly higher than 2 megabytes per second (Mbps). This offered a consistent set of services to mobiles, computers and phone users wherever they may be in the world. Once 3G is fully implemented, they can be constantly being connected to the internet and are given roaming capabilities by their service providers [4]. By Feb 2014, the number of mobile phone user surpassed 30 million in which 24% of them are among 15-34 years old. Most (65%) of the mobile phone are running on Android OS, followed by iOS and Windows [5]. A human body is usually a home for about 1014 bacteria [6] which plays different roles in our life. They may last for semi-permanent basis. Normal flora secretes secondary metabolite like vitamin B12 which is unable to be secreted by human body. They also trigger human body's immune system and helps in the development of immune system [7]. In gastrointestinal tract, normal floras help food digestion, the duodenal flora is in sparse amount (0 to 10^3/g of contents). The ileum contains a moderately mixed flora concentration. (10^6 to 10^8/g of contents). However, normal flora causes disease if it escapes from the normal location. For example, *Helicobacter pylori* potentially cause the formation of ulcer which appears in

stomach. In addition, the normal flora may impair the immune system of the host and result in failure of normal flora to prevent the transient pathogens or invasion of host by the normal flora themselves [8]. Microorganism that causes disease is called pathogen. They usually enter the body, multiply themselves and reach their target site in the body, attach themselves there so that they are not dislodged and multiple rapidly. Nutrients are obtained from the host [8]. Studies showed that mobile phones could be contaminated via source such as human skin or hand bag, phone pouch, bags, pockets, environment and food particles, these sources are links through which microorganisms colonize the phone, thus causing diseases that range from mild to chronic [9]. Research has shown that there can be significant interpersonal variation in human microbiota, including for those microorganisms found on the skin [10]. A study done on 2009 reported that 67 percent of men and 64 percent of women have slept with their cell phone or right next to their bed [11]. This increases the probability of pathogenic microorganism transmission when personal hygiene is not well taken care of under such circumstances mobile phones have been reported to be a reservoir for microorganism. It has been reported that a mobile phone can harbour more microorganism than a man's lavatory seat; the sole of a shoe or the door handle [7]. The combination of constant handling and the heat generated by phone as well as sweat from hands creates an optimum breeding environment for all kinds of microorganisms which are found on our skin. In 2009, Ulger [12] carried out a research to determine the contamination rate of the healthcare worker's mobile phone and hands in operation room and ICU. The result was eye-catching when 94.5% of phones demonstrated evidence of bacterial contamination with different types of bacteria. This shows that mobile phones can be a factor of microorganism transmission. Also, mobile phones used by health care workers' itself may be a source of nosocomial infections in hospital. However, there is no proper antimicrobial solution specifically for mobile phone in practice. The objective of this study is to introduce an antimicrobial solution preparation to clean the outer surface of mobile phones and evaluate the effectiveness by using microbial count approach. Thus disinfecting solutions of contact lenses [13] are used as references for antimicrobial solution preparation due to their similar actions and in nature both are use intimately with human skin. Santos [14] have done disinfection test against bacteria with each MPS. The investigation tests MPS which are commercially available on market. As per the results, Opti-Free® was capable of reducing cell concentration for 4-log. Thus, the ingredient of Opti-Free®, the diaminetriacetic acid is the preservative/disinfecting agents, sodium citrate is the buffer and propylene glycol is the surfactant while sodium chloride is the pH buffer. After considering the various factors, the self-prepared antimicrobial agent containing tween 80, 70% ethanol, flavoring and coloring agent. Alcohols groups were picked as testing agent in our study due to its ease of use and stability.

Materials and Method

Materials

1. Nutrient Agar
2. Sabouraud Dextrose Agar
3. Peptone Water
4. Antimicrobial Solution
5. Ethanol 70%
6. Tween 80
7. Flavouring Agent
8. Colouring Agent

Preparation of 70% Ethanol

74 ml of 95% alcohol to be taken and the volume made up to 100ml to produce 70% alcohol.

Method

- Collection of samples from 30 mobile phones.
- Incubation of samples in peptone water for 24 hours at 37 ± 0.2ºC.
- Inoculate the samples onto Nutrient agar and Sabouraud Dextrose Agar with Streak Plate Method.
- Serial Dilution Incubation for 24 hours at 37 ± 0.2ºC
- Calculation and tabulation of Results
- Application of ethanol on 10 tested phones for 1 week
- Step 2-6 were carried out on 10 tested phones after application of ethanol.

Result and Discussion

30 samples were collected and study. Throughout the study, positive and negative controls are used to minimize the effects of variables. Positive controls are the studies where a growth of microorganism is expected. E. coli and candida albicans were used as organisms for positive control. Also, negative controls are studies where no growth is expected. This helps to ensure when there is no growth of microorganisms and when there should be. It is done by putting a sterile swab as a sample and carried out simultaneously with the study. From the above (Table 2), it is observed that an average number of 1.79×10^8 CFU/ml is observed in Sabouraud Dextrose Agar at the beginning of the experiment. After application of the antimicrobial solution, twice a day for 1 week, the sample collected from the same phone shows an average of 3.33×10^7 CFU/ml count. The average number before and after the application of antimicrobial solution decreased by 81.40%. Among the 30 samples collected 90% (27) of mobile phones shows a decrease in number, 6.67% (2) shows increase in number, while 3.33% (1) show no change after the application of antimicrobial solution. Sabouraud Dextrose Agar provides an optimum temperature for the growth of fungi. From the result it is evident that, with the application of antimicrobial solution twice daily decreases the number in 90% of the mobile phones, ranging from 40% to 100%. For the 30th phone which shows no change in activity, before the formulation is applied, there is no growth of fungal and the result is the same as after the formulation is applied. Thus it is conclusive that the formulation is effectively inhibiting the growth of fungi.

However, there are few exceptions that show increased number of fungal after applying the formulation. 2 mobile phone shows increase of colony count after the application of the working solution. This may due to the resistance of fungal towards the formulation, or human error. On the other hand, bacteria grow in Nutrient Agar shows an average number of 3.19 x 10^8 CFU/ml growths at the beginning of the experiment. The average number comes down to 1.28 x 10^8 CFU/ml after one week of application of the same antimicrobial solution. The average number has been decreased by 59.87%. Among the 30 phones, 80% (26) of samples shows a reduced colony count, 20% (4) shows an increase in colony count. The **(Table 1)** above also shows 8 mobile phones which is approximately 26.67% of the samples show no growth after the formulation is applied on the mobile phone for one week. Besides this there are 2 samples among 30 samples that the bacteria aggregates in the nutrient agar before and after applying the formulation which indicate that no changes is seen. In the healthcare setting, "alcohol" refers to two water-soluble chemical compounds—ethyl alcohol and isopropyl alcohol—

Table 1 Results of colony count on Sabauroud Dextrose Agar before and after application of antimicrobial solution.

Phone no.	Before applying solution(CFU/ml)	After Applying Solution(CFU/ml)	Percentage Change
1	164 × 10^6	96 × 10^6	- 41.46%
2	140 × 10^6	32 × 10^6	-77.14%
3	68 × 10^6	0	-100.00%
4	16 × 10^6	244 × 10^6	1425.00%
5	108 × 10^6	0	-100.00%
6	136 × 10^6	79 × 10^6	-41.91%
7	218 × 10^6	0	-100.00%
8	608 × 10^6	8 × 10^6	-98.68%
9	244 × 10^6	184 × 10^6	-24.59%
10	68 × 10^6	144 × 10^6	111.76%
11	108 × 10^6	0	-100.00%
12	320 × 10^6	35 × 10^6	-89.06%
13	508 × 10^6	0	-100.00%
14	196 × 10^6	0	-100.00%
15	608 × 10^6	0	-100.00%
16	608 × 10^6	88 × 10^6	-85.53%
17	288 × 10^6	0	-100.00%
18	88 × 10^6	0	-100.00%
19	404 × 10^6	0	-100.00%
20	96 × 10^6	92 × 10^6	-4.17%
21	140 × 10^6	0	-100.00%
22	55 × 10^6	0	-100.00%
23	4 × 10^6	0	-100.00%
24	29 × 10^6	0	-100.00%
25	124 × 10^6	27 × 10^6	-78.23%
26	2 × 10^6	0	-100.00%
27	6 × 10^6	0	-100.00%
28	2 × 10^6	0	-100.00%
29	11 × 10^6	2 × 10^6	-81.82%
30	0	0	0%

*Negative sign indicate the decrease in number
**For plates that are too turbid to be measure, the highest count of that batch is used for percentage counting.

Table 2 Result of Colony Count on Nutrient Agar Before and After Application of Antimicrobial Solution.

Phone no.	Before applying solution	After Applying Solution	Percentage Change
1	652 × 10^6	28 × 10^6	-95.71%
2	316 × 10^6	424 × 10^6	34.18%
3	100 × 10^6	0	-100.00%
4	316 × 10^6	0	-100.00%
5	68 × 10^6	0	-100.00%
6	232 × 10^6	0	-100.00%
7	652 × 10^6	22 × 10^6	-96.63%
8	256 × 10^6	71 × 10^6	-72.27%
9	652 × 10^6	0	-100.00%
10	402 × 10^6	120 × 10^6	-70.15%
11	108 × 10^6	424 × 10^6	292.59%
12	320 × 10^6	0	-100.00%
13	508 × 10^6	236 × 10^6	-53.54%
14	196 × 10^6	424 × 10^6	116.33%
15	524 × 10^6	20	-100.00%
16	524 × 10^6	0	-100.00%
17	288 × 10^6	328 × 10^6	13.89%
18	88 × 10^6	264 × 10^6	200.00%
19	404 × 10^6	96 × 10^6	-76.24%
20	96 × 10^6	232 × 10^6	141.67%
21	92 × 10^6	0	-100.00%
22	100 × 10^6	22 × 10^6	-78.00%
23	336 × 10^6	82 × 10^6	-75.60%
24	180 × 10^6	140 × 10^6	-22.22%
25	524 × 10^6	45 × 10^6	-91.41%
26	296 × 10^6	220 × 10^6	-25.68%
27	76 × 10^6	60 × 10^6	-21.05%
28	524 × 10^6	72 × 10^6	-86.26%
29	524 × 10^6	424 × 10^6	-19.08%
30	228 × 10^6	126 × 10^6	-44.74%

*Negative sign indicate the decrease in number
**For plates that are too turbid to be measure, the highest count of that batch is used for percentage counting.

that have generally underrated germicidal characteristics [15]. These alcohols are rapidly bactericidal rather than bacteriostatic against vegetative forms of bacteria; they also are tuberculocidal, fungicidal, and virucidal but do not destroy bacterial spores. Their cidal activity drops sharply when diluted below 50% concentration, and the optimum bactericidal concentration is 60%-90% solutions in water (volume/volume) [16]. Many alcohol products include low levels of other biocides (in particular chlorhexidine), which remain on the skin following evaporation of the alcohol, or excipients (including emollients), which decrease the evaporation time of the alcohol and can significantly increase product efficacy [17]. In general, isopropyl alcohol is considered slightly more efficacious against bacteria and ethyl alcohol is more potent against viruses [18]. The most feasible explanation for the antimicrobial action of alcohol is denaturation of proteins [18]. At high concentration (100%), alcohol penetrate the cell wall of microbes and denature the protein, causing the inactivation of microbes but not death. However, this is reversible when there is feasible environment, microbes can be activated again due to

the denaturing of the protein blocks and the penetration power of alcohol thus only having good bacteriostatic ability. 70% is the more ideal and strong antimicrobial concentration because at this concentration the denaturation of protein is slower, thus allowing deeper penetration and cause cell death. Morton [19]. examined the bactericidal activity of various concentration of ethyl alcohol against a variety of microorganisms in exposure periods ranging from 10 seconds to 1 hour *seudomonasaeruginosa* was killed in 10 seconds by all concentrations of ethanol from 30% to 100% (v/v), and *Serratia marcescens*, *E, coli* and *Salmonella typhosa* were killed in 10 seconds by all concentrations of ethanol from 40% to 100%. The gram-positive organisms *Staphylococcus aureus* and *Streptococcuspyogenes* were slightly more resistant, being killed in 10 seconds by ethyl alcohol concentrations of 60%-95%. Isopropyl alcohol (isopropanol) was slightly more bactericidal than ethyl alcohol for E. coli and S. aureus. Ethyl alcohol (70%) was the most effective concentration for killing the tissue phase of *Cryptococcus neoformans, Blastomycesdermatitidis, Coccidioidesimmitis*, and *Histoplasmacapsulatum* and the culture phases of the latter three organisms aerosolized onto various surfaces. The culture phase was more resistant to the action of ethyl alcohol and required about 20 minutes to disinfect the contaminated surface, compared with <1 minute for the tissue phase [20].

Conclusion

Preliminary testing with ethanol as disinfecting agents for mobile phones gave evidence that a significant reduction of microbes on the surface of mobile phones. It is important to be aware of the reduction of microbes both fungi and bacteria. It is then conclusive that the formulation is effectively inhibiting the growth of microorganisms found on the mobile phone which has been already proved by the experimentation results. During this study, it was found that both fungi and bacteria are possibly contaminating the mobile phone surface. Mobile phones are the carrier of microorganisms because they are usually kept warm and snug in our pockets and handbags. Thus, it is suggested that mobile users should adapt these simple hygienic measures for a safe and healthy living by applying the formulation as the cell phones could serve as vehicles of diseases. Hence it is suggested that further studies with higher number of samples should be performed to establish more satisfactory results and proceed to the next stage. The efficacy of alcohol should be studied together with its possible damage to different surfaces.

References

1 Warren T (2014) iPhone: A Visual History.

2 Statista (2015) Number of mobile phone users worldwide from 2012 to 2018.

3 Mohd AO (2012) A Study of the Treand of Smartphone and its Usage Behavior in Malaysia International J on Ne Compu Archit and App 276-277.

4 Avaxx (2011) Mobile Technologies History.

5 Ondevice (2014) Mobile Malaysia: ahead of the pack.

6 Boulder, University of Colorado, Be Boulder.

7 Davis CP (1996) Normal Flora. In Medical Microbiology, Galveston: The University of Texas Medical Branch.

8 Microbiology Online (2015) Microbes and the human body.

9 Ilusanya (2012) Personal Hygiene and Microbial Contamination of Mobile Phones of Food Vendors in Ago-Iwoye Town, Ogun State, Nigeria. Pakistan Jof Nutri 11.

10 James FM(2014) Mobile Phones Carry the Personal Microbiome of Their Owners.

11 Anuradha (2016) The awareness of Microbial Contamination through Mobile Phones, Asian Pac J Health Sci 3: 313-323.

12 Fatma U (2009) Are we aware how contaminated our mobile phones with nosocomial pathogens? Ann Clin Microbiol Antimicrob 1-4.

13 Allen LV, Popovich NV, Ansel HC (2013) Parenterals. Ansel's Pharmaceutical Dosage Forms and Drugs Delivery System 431-493.

14 Santos L, Rosario, Oliveira (2011) Lens Material and Formulation of Multipurpose Solutions Affects Contact Lens Disinfection. Contact Lens & Anterior Eye 34: 179-182.

15 Rutala WA, Weber DJ (2008) Disinfection In: Guideline for Disinfection and Sterilization in Health Care Facilities USA: Department of Health Service 38.

16 Ali, MJ (2001) Disinfection, Sterilization, and Preservation In: Alcohols Philadelphia: Lippincott Williams & Wilkins 229-254.

17 Mcdonnel G, Russell AD (1999) Antiseptics and Disinfectants: Activity Action and Resistance In: Clinical Microbiology Reviews 12: 147-179.

18 Klein M, Deforest A (1983) Disinfection Sterilization and Preservation In: Principles of Viral Inactivation, Philadelphia 422-434.

19 Morton HE, Alcohols (1983) In: Block SS ed, Disinfection, sterilization, and preservation, Philadelphia 225-239.

20 Kruse RH, Green TD, Chambers RC, Jones MW (1963) Disinfection of aerosolized pathogenic fungi on laboratory surfaces 1 Tissue phase Appl Microbiol 11: 436-45.