IJBPAS, July, 2022, 11(7): 3098-3106

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

BACTERIAL APPRAISAL OF SKIN FLORA FOUND ON THE SURFACES OF ELECTRONIC GADGETS

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Received 15th June 2020; Revised 20th July 2020; Accepted 23rd Oct. 2021; Available online 1st July 2022

https://doi.org/10.31032/IJBPAS/2022/11.7.6211

ABSTRACT

Nowadays electronic gadgets have become inevitable equipments. We carry them everywhere but disinfect them very occasionally. So it can harbor various kinds of bacteria. This study was conducted to investigate bacteria from three such types of gadgets and assess awareness about the extent of transmission via electronic gadgets. The gadgets taken for the study were power banks, mobile phones (touch screen), and pen drives. Samples were collected by swabbing the surface of gadgets by sterile cotton swab sticks before and also after the disinfection of these electronic gadgets. Identification was done based on morphological, cultural, and biochemical characteristics of isolates. A survey was also conducted to analyze the extent of awareness among users. Out of total thirteen isolates found, *Staphylococcus species* and *Bacillus species* were predominant followed by *Streptococcus species* and *Actinomycetes species.* After disinfection, the bacterial rate of contamination was found to be reduced. From the survey, it was observed that there is a clear lack of awareness about cleaning habits, sharing habits, etc among users. This study revealed that most bacteria were found to be normal flora of the human body and some were opportunistic pathogens. Thus, it implies that electronic gadgets serve as vehicles to transmit bacteria from one individual to another.

Keywords: Appraisal, Swabbing, Electronic gadgets, Normal flora, Opportunistic pathogens

INTRODUCTION

Nowadays, electronic gadgets have become integral part of our life style and inevitable equipment in day to day tasks **[1]**. An electronic gadget is an electronic machine that has a specific purpose **[2]**. In this study, three different gadgets power banks, mobile phones, and pen drives were taken. The power bank is a portable battery that is used to charge mobile phones, tablets, etc. **[3].** The mobile phone is a portable, long rangable electronic gadget which is used for various purposes like personal telecommunication, text messaging, email, access internet, etc. **[4 & 5]**. The pen drive is a small external data storage device which is used for storing information, transferring files, etc. **[6]**.

These gadgets give shelter to different kinds of bacteria which are pathogenic. According to some articles, mobile phones are more contaminated than the sole of the shoe, door handles, or lavatory seats **[7 & 8].** So it acts as a vehicle for the transmission of bacteria from one individual to another.

This study is aimed at isolating and identifying bacteria from three such types of frequently used electronic gadgets and to measure the awareness about how these gadgets could serve as vehicles to transmit bacteria from user to user. Therefore, personal hygiene and disinfection of these gadgets are very important to prevent fomites transmission.

The main objectives of this study include isolation of bacteria found on skin while using these electronic gadgets followed by their identification by morphological, cultural, and biochemical characteristics. In addition, a survey was also conducted to assess the extent of awareness among users of different age groups and concluded accordingly.

MATERIALS AND METHODS

Gadgets under study

Total three types of 30 electronic gadgets [05 power banks, 15 mobile phones (touch screen), and 10 pen drives] of different students and staff members of Smt. S. M. Panchal Science College, Talod, Gujarat were taken for the study.

Sample collection, Individuals under study, and time duration

Each gadget was collected from Individuals ranging from the age group of 20 to 47 in the period from March 2021 to April 2021. Every time swab samples were taken aseptically using sterile cotton swab sticks. The sterile cotton swab sticks were wetted into Normal saline (0.85%) and thoroughly wiped on the surfaces (the front, back, sides, & the cover of mobile phones) of these gadgets in order to collect surface microbes more efficiently. Swabs were

taken twice. First, the swab was taken directly- without disinfection of electronic gadgets. Second, the swab was taken after disinfection of gadgets with 70 % isopropyl alcohol then was dried for 10 min and swab was taken.

Isolation of bacteria found on electronic gadgets

All swabs were streaked on Nutrient agar plates. Plates were incubated at 37°C for 48 hours. Well isolated colonies were sub-cultured on Nutrient agar plates and plates were incubated at 37°C for 48 hours to get pure isolates. The plates were then observed for bacterial growth and colonial characteristics. These isolates were preserved on Nutrient agar slants for further process of characterization and identification.

Characterization and identification of the isolated colonies

The characterization was done by studying morphological characteristics like Gram's reaction, spore staining, capsule staining, and motility **(Table 2)**. Secondly, colony characteristics were observed which include size, shape, margin, elevation, surface texture, consistency, opacity, and pigmentation of the colonies **(Table 3)**. Finally, biochemical characterization was done which includes 13 different tests for tentative differentiation and identification of isolates **(Table 4)**.

Survey to analyze the extent of awareness among gadget users

It was conducted in form of a questionnaire on Google forms to collect information of respondents using such gadgets. The questions included information about the usage of electronic gadgets, cleaning habits, sharing habits, etc. This survey was further analyzed and concluded for the percentage of awareness and expressed in form of pie charts **(Figure 4)**.

RESULTS AND DISCUSSION

Out of the total three types of 30 electronic gadgets used in this study, the results revealed that all samples showed bacterial growth **(Table 1)**.

From the collected samples, it was observed that mobile phones were highly contaminated with bacteria as compared to power banks & pen drives because of the extensive usage of mobile phones than the other two gadgets. Mobile phones are mostly touched by the skin of our hands, ear, cheeks etc. Sometimes we sneeze or cough in front of mobile phones which can be the probable reason for more contamination. Pen drives were less contaminated because of less frequent usage.

It was also observed that there was a drastic decrease in the number of colonies after disinfection with 70% isopropyl

alcohol. But in case of mobile phones, the numbers of colonies were significantly high even after disinfection indicating towards high extent of contamination of mobile surfaces.

Isolates obtained

Total thirteen isolates were obtained from 30 gadgets during this investigation on the basis of different morphological and colony characteristics.

Characterization and identification of isolates

The selected 13 isolates were characterized on the basis of morphological characteristics, cultural characteristics, and biochemical tests.

i) Results of morphological studies

Morphological characteristics of isolates were done by performing different staining methods **(Table 2)**.

As shown in **Table 2,** all isolates were gram-positive. Seven isolates- PB1, PB2, PB5, PB8, MP10, and MP12 were cocci shaped; five isolates- PB3, PB4, PB9, MP11, and PD13 were rod-shaped (arranged in single and chain); and isolate PB6 was filamentous shaped (arranged in single and cluster). Spore staining revealed that 6 isolates were spore formers and 6 isolates were non-spore formers. Isolates PB8 and MP10 were found to be capsulated. Except isolates- PB2 and MP10, all were motile.

ii) Results of cultural characteristics

The colony characteristics of 13 isolates were noted down **(Table 3)**.

As shown in **Table 3**, colonies with different sizes, shapes, margins, surface textures, consistency, and opacity with various pigmentations- like lemon yellow, saffron, off white, light orange, chalky white, yellow, white, etc. of 13 isolates were observed.

iii) Results of biochemical tests

From the **Table 4**, the tentative identification of all 13 isolates was done and based on it; they were identified as shown in **Table 5**.

Table 5 shows that *Staphylococcus spp.* & *Bacillus spp*. were most predominantly found on the surfaces of electronic gadgets. Other bacteria such as *Streptococcus spp.* & *Actinomycetes spp.* were also found on the surfaces of these gadgets. Mobile phones were found to be the most loaded with bacteria followed by power banks and then pen drives.

Data Analysis of the Survey

The data from total of 69 individuals were collected on Google forms.

Table 1: Total no. of isolates found on electronic gadgets before and after disinfection

Sr. no.	Types of electronic gadget	No. of electronic gadget	No. of isolates	
			Before disinfection	After disinfection
1	Power bank	05	9	4
2	Mobile phone	15	11	7
3	Pen drive	10	3	1

Table 2: Results of morphological characteristics of isolates

Isolates code	Gram's staining				Spore staining	Capsule staining	Motility
	Size	Shape	Arrangement	Gram reaction			
PB1	Small	Round	Single, cluster	Gram- positive	-	-	+
PB2	Small	Round	Single, cluster	Gram- positive	-	-	-
PB3	Big	Rod	Single, chain	Gram- positive	Endospore	-	+
PB4	Big	Rod	Single, chain	Gram- positive	Endospore	-	+
PB5	Small	Round	Single, cluster	Gram- positive	-	-	+
PB6	Big	Filamentous	Single, cluster	Gram-positive	Exospore	-	+
PB7	Small	Round	Single, cluster	Gram-positive	-	-	+
PB8	Small	Round	Single, diplo, chain	Gram- positive	-	+	+
PB9	Big	Rod	Single, chain	Gram- positive	Endospore	-	+
MP10	Small	Round	Single, diplo, chain	Gram- positive	-	+	-
MP11	Big	Rod	Single, chain	Gram- positive	Endospore	-	+
MP12	Small	Round	Single, cluster	Gram- positive	-	-	+
PD13	Big	Rod	Single, chain	Gram- positive	Endospore	-	+

Where, += capsulated & motile, -= non-spore forming, non-capsulated & non-motile

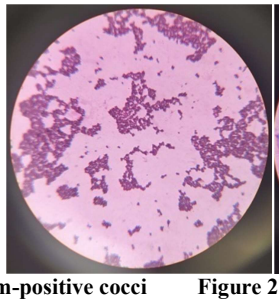

Figure 1: Gram-positive cocci

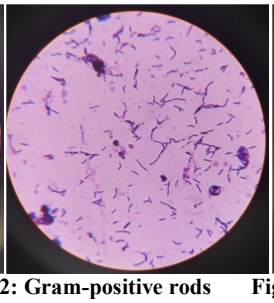

Figure 2: Gram-positive rods

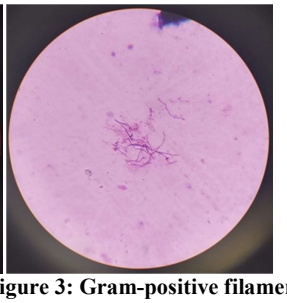

Figure 3: Gram-positive filamentous

Table 3: Cultural characteristics of isolates

Isolates code	Size	Shape	Margin	Elevation	Surface texture	Consistency	Opacity	Pigmentation
PB1	Small	Round	Entire	Convex	Smooth	Moist	Opaque	Lemon yellow
PB2	Small	Round	Entire	Convex	Smooth	Moist	Opaque	Saffron
PB3	Large	Irregular	Uneven	Flat	Rough	Dry	Opaque	Off white
PB4	Small	Round	Entire	Convex	Smooth	Moist	Opaque	Off white
PB5	Small	Round	Even	Convex	Smooth	Moist	Opaque	Light orange
PB6	Large	Round	Even	Convex	Rough	Powdery	Opaque	Chalky white
PB7	Small	Round	Even	Convex	Smooth	Moist	Opaque	White
PB8	Small	Round	Entire	Convex	Smooth	Moist	Opaque	White
PB9	Large	Irregular	Uneven	Flat	Smooth	Dewdrop	Transparent	Colorless
MP10	Pinpoint	Round	Entire	Flat	Smooth	Moist	Opaque	Yellow
MP11	Small	Round	Entire	Convex	Smooth	Moist	Opaque	Light saffron
MP12	Small	Wrinkled	Uneven	Raised	Smooth	Moist	Translucent	Colorless
PD13	Large	Wrinkled	Wavy	Raised	Rough	Dry	Opaque	White on front & saffron from back

Table 4: Results of biochemical tests of isolates

Isolates code	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
PB1	+	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	+
PB2	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	+	+
PB3	+	-	-	-	-	+	-	+	-	-	-	-	+	-	-	-	+	+
PB4	-	-	-	-	-	+	-	+	-	-	-	-	+	-	-	-	+	+
PB5	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	+	+
PB6	+	+	+	-	-	+	-	+	-	-	-	-	+	-	-	-	+	+
PB7	-	-	-	+	-	+	-	+	-	-	-	-	-	-	+	-	+	+
PB8	+	-	+	+	-	+	-	+	-	-	-	-	-	-	+	-	+	-
PB9	-	-	+	-	-	+	-	+	-	-	-	-	+	-	+	-	+	+
MP10	-	-	-	-	-	+	-	+	-	-	-	-	-	-	+	-	+	-
MP11	+	-	+	-	-	+	-	+	-	-	-	-	+	+	+	-	-	+
MP12	+	-	-	-	-	+	-	+	-	+	-	-	-	-	-	-	-	+
PD13	+	-	-	-	+	+	-	+	-	-	-	-	+	-	+	-	-	+

Where, A to R= Name of biochemical tests, A to F= Sugar utilization test, += positive test, -= negative test

A. Glucose, B. Xylose, C. Mannitol, D. Lactose, E. Maltose, F. Sucrose, G. Indole production test, H. Methyl red test, I. Voges-Proskauer test, J. Citrate utilization test, K. H_2S production test, L. Gelatin hydrolysis test, M. Starch hydrolysis test, N. Urea hydrolysis test, O. Nitrate reduction test, P. Triple sugar iron test, Q. Mannitol fermentation plate, R. Catalase test

Table 5: Identification of isolates

Isolates code	Tentatively identified spp.
PB1	***Staphylococcus spp.***
PB2	***Staphylococcus spp.***
PB3	***Bacillus spp.***
PB4	***Bacillus spp.***
PB5	***Staphylococcus spp.***
PB6	***Actinomycetes spp.***
PB7	***Staphylococcus spp.***
PB8	***Streptococcus spp.***
PB9	***Bacillus spp.***
MP10	***Streptococcus spp.***
MP11	***Bacillus spp.***
MP12	***Staphylococcus spp.***
PD13	***Bacillus spp.***

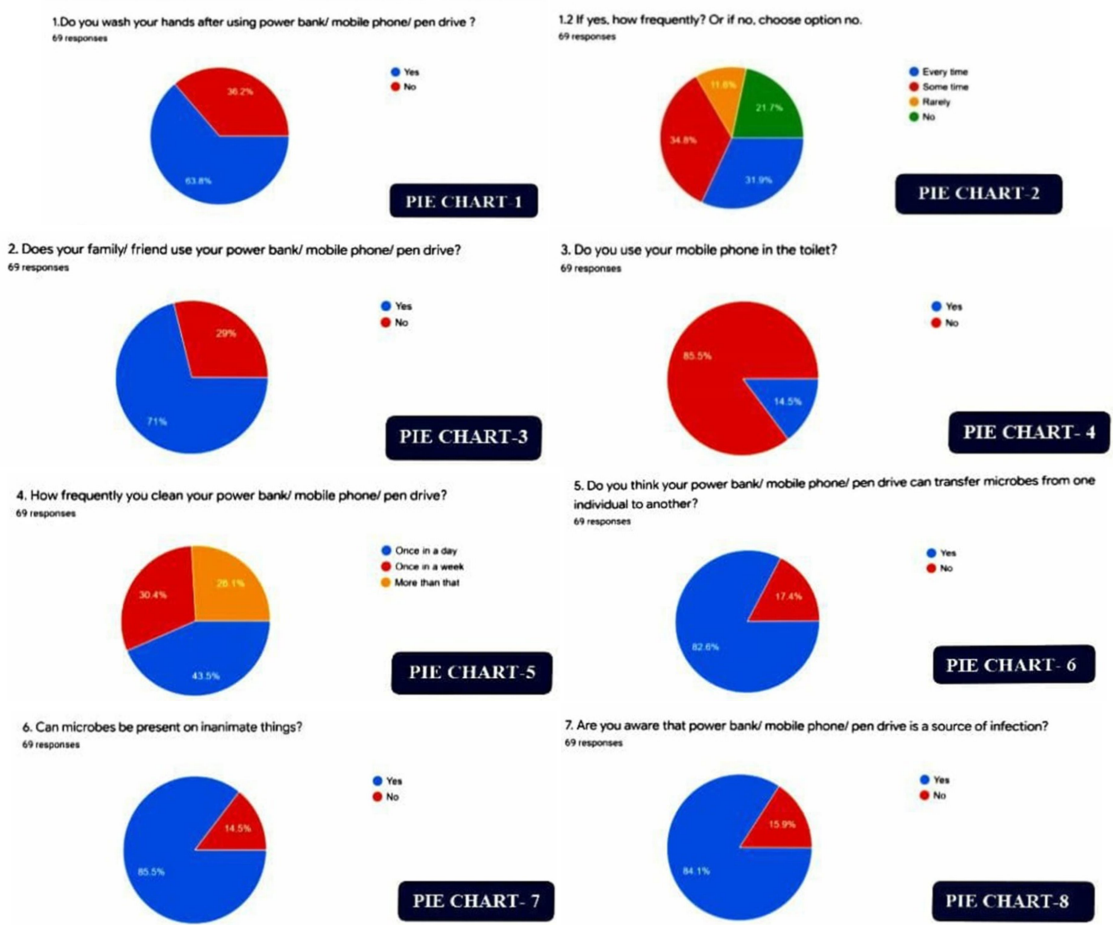

Figure 4: Pie charts showing the results of the survey

From the above pie charts **(Figure 4)**, it was observed that there is considerable lack of awareness about cleaning habits and sharing habits of their gadgets with others, among the users under survey.

The results of mobile phones of this study were quite similar to the study by **Abbas *et al.* [1]** & **Kumar and Aswathy [8]** showing *Staphylococcus spp.* and *Bacillus spp.* were frequently found on mobile phones and counter the study of **Usman *et al.* [9]** that most bacteria were found be gram-negative, with a few gram-positive bacteria.

100% bacterial contamination was found on the surfaces of electronic gadgets before disinfection, but after rubbing 70% isopropyl alcohol on the surfaces of electronic gadgets, the bacterial rate of contamination was considerably reduced as investigated in this study.

CONCLUSION

Most of the normal flora like *Staphylococcus spp.* & *Streptococcus spp.* of the human body surfaces were found predominantly on these gadgets, but some of the pathogenic and opportunistically pathogenic bacteria like *Bacillus spp.,*

Actinomycetes spp., Staphylococcus- spp., and *Streptococcus spp.* were also found to be present on the surfaces of these gadgets. After the application of 70% isopropyl alcohol, as a disinfectant a significant reduction in bacterial contamination was observed. Thus, it can be concluded that electronic gadgets definitely serve as vehicles to transmit bacteria from one individual to another if not disinfected properly and shared frequently. Surfaces of electronic gadgets should be made using antimicrobial accumulative materials to reduce bacterial transmission in future.

Hence, it is recommended that the users should share their gadgets after proper cleaning, wash their hands after handling, sneezing and coughing on these gadgets. Users must avoid eating food while using these gadgets, as well as disinfect their electronic gadgets with an appropriate disinfectant, market available cleaners, etc. regularly to prevent not only cross-transmission or fomites transmission but also lead healthy life style.

ACKNOWLEDGEMENTS

Authors are grateful to students and staff members of the Smt. S. M. Panchal Science College as well as respondents of the survey for their involvement in the study. Special thanks to Prof. M. F. Mansuri, & Mr. Maharsh Upadhyay who helped me for the successful completion of this work and Dr. C. D. Afuwale, for guiding me with constant insistence for perfection & in depth scientific approach.

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