



Identification of microbes and evaluation of efficacy of disinfectant on contaminated surfaces

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Abstract : *This study aimed to examine the presence of pathogenic and non-pathogenic bacteria on commonly used devices such as mobile phones, remote controls and refrigerator handles. Out of 30 samples screened, 27 were contaminated with bacteria, while fungal growth was found on three samples. Staphylococcus aureus was the most abundant isolate. The findings indicate that these devices can act as reservoirs of both pathogenic and non-pathogenic bacteria. Therefore, hand hygiene and frequent decontamination of these devices are recommended, to limit the risk of infections.*

Keywords: *Mobile phone, Remote control, Refrigerator handle, Bacteria, Contamination, Disinfection.*

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Introduction:

Environmental surface contamination provides a potent reservoir for pathogens to persist and cause infection (Beyene et al., 2013; Dannemiller et al., 2014). Indirect transmission via numerous objects such as Mobile phone, TV remote and Refrigerator handle, which have prolonged contact with the skin and those that are handled for extensive periods of time can transmit bacteria (Karabay et al., 2007; Dilek et al., 2009; Abdullahi et al., 2009; Acharya et al., 2010, Julian et al., 2012).

The most common concerns regarding heavy use of mobile phone is that they can act as a vehicle for the transmitting pathogenic bacteria and other microorganisms. People rarely disinfect mobile phones. As a result these devices have a potential for contamination with various bacterial agents (Selim and Abaza, 2015).

In the same way as the mobile phone is a germ factory, so is the remote control. Studies have found that thousands of bacteria can be hanging out on the remote (Reynolds, 2005). Remote control is most likely to come into contact with several different hands, leading to its contamination.

Refrigerator handle can also be the most bacteria-laden spot. It is a commonly touched surface in home and any shop, and bacteria can easily be transferred from person to person this way, thus serving a vehicle for bacterial infection.

The present study aimed to investigate the presence of pathogenic bacteria on mobile phones, remote controls and refrigerator handles. Studies on microbes present on mobile phone have been conducted by Amira and Abdalall (2010) and Selim and Abaza (2015), but they reported from hospital setup. Study on samples collected from door handles has been conducted by Shawk and Tarek (2018). This study reports about the common microbes that may be found on the commonly used gadgets, using the microbiological techniques.

Materials and Methods:

The present study was performed between August 2018 to September 2018, at the Central Research Laboratory, Patna Women's College, Patna. A total of 30 samples from mobile phones, remote controls and refrigerator handles were collected. Ten samples were collected from students' mobile phones. Another ten samples were gathered from different remote controls of various houses including those of televisions, air conditioners and sound boxes. The final ten samples were collected from handles of refrigerators in homes, college canteen and hostels.

Swabs were taken from these surfaces, immediately inoculated into the Nutrient Agar (NA) and incubated at 37°C for 48 hours. Bacterial colonies grown on NA were tested using colony count and Gram-staining method. Further, colonies were identified using several biochemical tests including Indole test, Methyl Red test, Voges Proskauer test, Citrate Utilization test and Catalase test. Simon Citrate agar, EMB agar and Mannitol

salt agar were also used during the isolation and identification of the microbes.

To maintain a check on the growth of the bacterial colonies and determine the efficacy of the disinfectant on the contaminated surfaces, the contaminated surfaces were wiped with 1:3 savlon-water solution. The swab sample was inoculated on nutrient agar and checked for bacterial growth. Statistical analysis was done by ANOVA.

Results and Discussion:

Different bacterial isolates obtained from electronic devices were identified and characterized on the basis of colony count, gram-staining and different biochemical tests such as (Indole Test, Methyl Red Test, Voges Proskauer Test, Citrate Utilization test, Catalase Test). The colony count result for 30 samples is shown in (Table 1).

Table 1. Colony count of microbes isolated from different samples

Sample	Mobile phone sample	Remote sample	Refrigerator handle sample
1	71	138	196
2	65	109	157
3	31	127	172
4	58	–	23
5	35	156	70
6	96	–	–
7	129	65	85
8	63	95	76
9	42	79	83
10	94	91	43

- indicates absence of bacteria and presence of fungi.

The average colony count of microbes isolated from mobile phone samples was found to be 68.4 colonies, from remote sample were 86.0 colonies, and from refrigerator handles were 90.5 colonies (Fig. 1). Fungal growth was also observed in the three samples from remotes and refrigerator handles. Comparatively more number of bacterial colonies was found on refrigerator handles. The difference in the means of colony counts on different devices was not statistically significant ($F = 2.3$, $P > 0.05$).

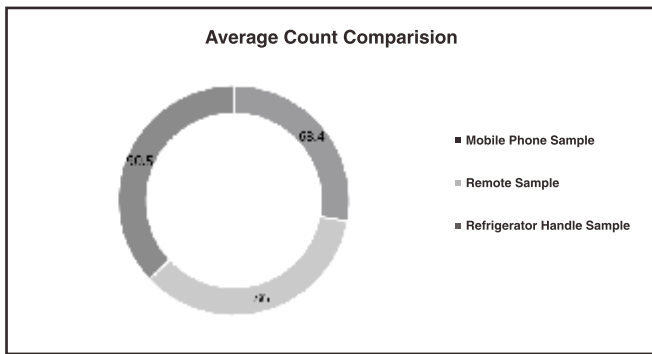


Fig. 1. Average colony count comparison of samples

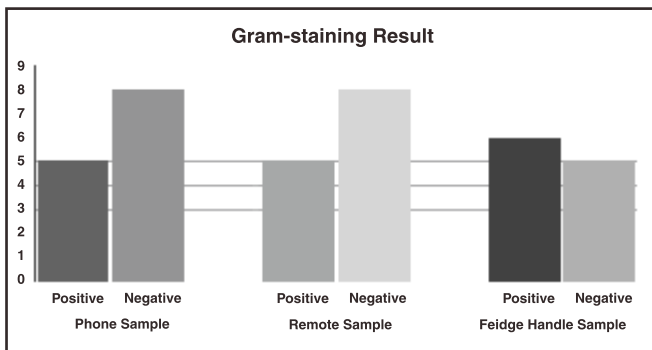


Fig. 2. Gram-staining result of different samples

The result of gram-staining (Fig. 2) inferred that, the samples from mobile phones and remotes had more gram negative bacterial colonies, while those from refrigerators had more gram positive bacterial colonies.

Table 2. Shape of microbes isolated from mobile

Sample	Shape
P1	Coccus
P2	Coccus
	Coccus
P3	Coccus
P4	Coccus
	Coccus
P5	Bacillus
P6	Coccus
P7	Coccus
P8	Diplococcus
P9	Bacillus
P10	Bacillus

Table 3. Shape of microbes isolated from remote

Sample	Shape
R1	Coccus
R2	Bacillus
	Coccus
R3	Bacillus
R4	-
R5	Bacillus
	Coccus
R6	-
R7	Diplobacilli, Coccus
	Streptobacillus
	Coccus
R8	Coccus
	Coccus
R9	Coccus
R10	Bacillus

Table 4. Shape of microbe isolated from refrigerator handle

Sample	Shape
F1	Bacillus
F2	Coccus
F3	Coccobacillus
	Staphylococcus
F4	Coccus
F5	Diplobacillus
F6	–
F7	Bacillus
F8	Coccobacillus
F9	Bacillus
F10	Coccus

In the sample taken from mobile phones, most of the colonies were Coccus, but Bacillus and Diplococcus were also found (Table 2). The sample from remotes had Coccus, Bacillus, Streptococcus and Diplococcus colonies (Table 3). In the sample from refrigerator handles, Coccus, Bacillus, Staphylococcus, Diplococcus and Coccobacillus colonies were found (Table 4). A few samples from mobile phones remotes and refrigerator handles even showed more than one type of colony.

Biochemical tests findings (Table 5), indicated the presence of *Bacillus subtilis*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli*, and *Klebsiella*. These organisms might have found their way into the devices through the skin of hands. This is because the isolated bacteria are a subset of the normal micro-biota present on skin as suggested by Jenner and Roth (1998).

Table 5. Biochemical Tests for identification of isolated microbes

Microbes	No. of Samples			Indole Test	Methyl Red	Voges Proskauer	Citrate Utilization	Catalase
	M	R	F					
<i>Bacillus subtilis</i>	4	6	5	–	–	+	+	+
<i>Staphylococcus aureus</i>	8	7	4	–	+	+	+	+
<i>Staphylococcus epidermidis</i>	6	4	4	–	–	+	–	+
<i>Escherichia coli</i>	3	2	1	+	+	–	–	+
<i>Klebsiella</i>	2	6	3	+	–	+	+	+

Bacillus subtilis, a gram-positive rod shaped bacteria has been identified as an important organism in spoilage of food (Andersson et al., 2009). The food poisoning has a rapid onset and with acute vomiting, commonly followed by diarrhoea. The presence of *Staphylococcus aureus* was reported may be due to their ability to adapt to different environments and colonize human skin, nails, nares and mucus membranes (Lowy, 1998). *S. epidermis*, (a Gram-positive coccus) is found at prosthetic joint, vascular graft and surgical site infections.

Escherichia coli, which is a gram negative, rod shaped bacteria, can cause serious food poisoning in their hosts (Coia, 1998). *Klebsiella*, confirmed by indole test also infects a variety of other animals, both as normal flora and opportunistic pathogens. It can lead to a wide range of disease states, notably pneumonia, urinary tract infections, septicemia, meningitis, diarrhoea, and soft tissue infections.

To maintain a check on the growth of the bacterial colonies and determine the efficacy of the disinfectant on the contaminated surfaces, five sample surfaces were wiped with 1:3 savlon-water solution. The findings showed that there was a decrease in the bacterial colony growth with an average fall in the CFU (colony forming unit) (Table 6).

Table 6. Reduction in colony count of microbes after disinfection with 1:3 savlon:water solution

Sample	Colony count before disinfection	Colony count after disinfection	Percentage Reduction
1	71	15	78.87
2	129	45	65.12
3	109	31	71.56
4	95	25	73.68
5	85	16	81.18

There was a reduction in the colony count of microbes after disinfection which ranged from 65%-81%. (Table 6). Therefore, washing of hands before handling food becomes imperative.

Conclusion:

The study concluded that commonly used devices such as mobile phones, remote controls and refrigerator handles carry microbes such as *Bacillus subtilis*, *Staphylococcus aureus*, *Staphylococcus epidermis*, *Escherichia coli* and *Klebsiella* sp.. these microbes could cause serious diseases. Therefore, periodic cleaning of such devices should be done and personal hygiene should be maintained.

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