



## Original Research Article

## Determining the frequency of microbial growth “in-use” detergent products in various dental clinics: A microbiological research

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## ARTICLE INFO

## Article history:

Received 09-04-2020

Accepted 29-06-2020

Available online 21-07-2021

## Keywords:

Bar soap

Dentist

Handwashing

Liquid soap

Microbial load

Soap contamination

## ABSTRACT

Clean hands are hands and as a part of dental clinic infection control measure hand washing by a dental health professional before having contact with a patient's oral cavity becomes a fundamental duty. Most detergents claim a 99.99% efficacy in killing bacteria however, there is paucity in literature if there will be a microbial growth “in use” detergents. Thus, the aim of this study was to evaluate bar soap and liquid soap from liquid soap from dental clinics for microbial contamination while it was in use.

The study period was 2- month, dentists and dental assistants were the participants of the study. A total of 25 handwashing place samples from 12 different dental clinics were collected. All the test tube samples of bar soap and liquid soap were all transferred to the microbiology laboratory for microbiological analysis.

**Statistical analysis used:** data was analyzed using a one- sample paired t-test and independent students t-test.

**Results:** 6 different microbial species were identified. The abundance of staphylococcus aureus was highest compared to other microorganisms in both soaps. Further, the mean number of microorganisms was found similar ( $P > 0.05$ ) in liquid soap.

**Conclusions:** the microbial load of a mixed flora of Gram-positive bacteria, Gram-negative bacteria, aerobes, and fungi were found in both the in-use bar soap and liquid soap. Thus, the results indicate that the bar soap ‘in-use’ condition harbors a greater number of microorganisms as compared to that of liquid soap.

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### 1. Introduction

Aerosols are a source if major infections in general and more importantly in this pandemic covid 19 situation dentists comes in direct contact with a variety of microorganisms despite taking all precautionary measures as they deal with oral cavity which is a reservoir for pathogens that may cause clinical infections while treating other patients.<sup>1</sup>

Hand hygiene in dental practice is one the most important parts of infection control process to reduce the risk of transmitting microorganisms from dentist to patient.<sup>2</sup>

In 1988 and 1995, guidelines for handwashing were published by the Association of Professionals in

Infection Control and indications were recommended for handwashing which was similar to those presented in the Centers for Disease Control and prevention guidelines. The transient microorganism includes Escherichia coli, Salmonella spp., and hepatitis A virus. The most common transient microorganisms include Gram-negative coliforms and Staphylococcus aureus.

It becomes a fundamental duty of the dentists to wash hands thoroughly with a clean medicated or antimicrobial soap to avoid spread of infection or cross contamination which is like doing more harm to the patient than helping. Either a bar soap or liquid soaps are routinely used in medical filed but which one among them causes less microfilament growth when “in use” still remains in the dark hence the purpose of this study was to investigate

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whether the bar soap or liquid soap is highly susceptible to contamination and thereby further transmission or cross contamination of infection.

## 2. Materials and Methods

A cross-sectional exploratory study was carried out on dentists and dental assistants working in various clinics to identify the frequency of microorganisms in bar and liquid soap washed hand samples. During the 2-month period from march to may 2021, post institutional ethical committee clearance, 25 specimens of the bar and liquid soap hands was collected from 1 dental clinic and was sent for microbiological investigation.

### 2.1. Sample collection

For the 1<sup>st</sup> month study, fresh bar soaps (medicated) that is commonly used was given to all 12 dental clinics and was placed at the clinic's handwashing site. A sample collection was done at pre-use (Baseline 0 week) and post use consecutively for 4 weeks (end of 1<sup>st</sup> week, 2<sup>nd</sup> week, 3<sup>rd</sup> week and 4<sup>th</sup> week). The soap samples were obtained by using sterile cotton swab dipped with phosphate-buffered solution (PBS). Under sterile conditions, the moistened the swab was slid with a single stroke over the top portion of the bar soap the hand was samples was immediately collected into a sterile test tube containing 2 ml of PBS carefully.

In the 2<sup>nd</sup> month the bar soap was replaced with a medicated liquid soap from the same company to avoid any bias. The liquid soap had a soap dispenser button hence at any given point the hands of the dentist would not come in contact with the soap. Each time of use 10ml of sample of liquid soap was collected at baseline 0 week and after every week for the next 4 weeks and the samples of handwashing's was also collected in the previous manner.

### 2.2. Microscopic evaluation

Post vigorously shaking the test tubes for 20 s, a single streak of collected samples was done on growth medium in a Petri dish. The medium used were Gram-positive aerobes and facultative, MacConkey agar for Gram-negative aerobes and facultative and blood agar for anaerobes. The plated were incubated for 2 days at 37°C aerobically and anaerobically. For the culture of fungi Sabourad's dextrose agar was used incubated for 5 days at same temperature. The isolated organisms were identified through biochemical tests in a semi-automated culture identifying system. The plates were counted for microbial colonies and expressed as colony-forming units (CFU)/per bar soap and CFU/ml of liquid soap.

### 2.3. Statistical analysis

Statistical package for the Social Sciences (SPSS Inc., released 2008, SPSS Statistics for Windows, version 19.0 Chicago, IL, USA) was used for statistical analysis. The frequency of microorganism (number) was summarized as mean  $\pm$  standard deviation (SD). The microorganisms' frequency in pre-and post-handwashed samples.

## 3. Results Bar soap

All the samples were found to be completely free of microorganism, that is 0 but post use, all showed an abundance of microorganisms with the highest mean of E.Coli and least of Diphtheroid. Statistically comparing the pre and post mean abundance of microorganisms, a one-sample paired t-test showed statistically significant ( $P < 0.05$  or  $P < 0.01$  or  $P < 0.001$ ) abundance of all the microorganisms at post-use as compared to pre-use.

### 3.1. Liquid soap

All the samples were found to be completely free of microorganism, that is 0 but post use, all showed an abundance of microorganisms with the highest mean of E.Coli and least of Diphtheroid. Statistically comparing the pre and post mean abundance of microorganisms, a one-sample paired t-test showed statistically significant ( $P < 0.05$  or  $P < 0.01$  or  $P < 0.001$ ) abundance of all the microorganisms at post-use as compared to preuse.

### 3.2. Bar soap versus liquid soap

The frequency of microorganisms after bar soap and liquid soap use are summarized in Table 3 and shown in Figure 3. The mean number of microorganisms of E.Coli, Klebsiella sp., and S. aureus was higher in bar soap as compared to that of liquid soap. Comparing the mean frequency of microorganisms of the two groups, Student's t-test showed similar ( $P > 0.05$ ) results between the two groups (soaps), that is, did not differ significantly.

In the present study, the microbial load of the "in-use" bar soap and liquid soap constituted a mixed variety of Gram-positive bacteria, Gram-negative bacteria, aerobes, anaerobes, and fungi, in total microbial population obtained from hand washed sample with bar and liquid soap represented six different varieties.

## 4. Discussion

One of the prime practice used to reduce the possibility of contamination and propagate it is Hand washing and a vast majority of general dental practitioners also use soap and water for handwashing.<sup>1</sup> Acceptable products for hand hygiene in various clinical and non-clinical dental departments include plain bar soap, liquid soap, antimicrobial soap, alcohol hand rubs, and appropriate

**Table 1:**

Micro.organisms	0 week	1 week	2 week	3 week	4 week	Mean SD	T test
Diphtheroid	0	3	6	8	12	7.25	7.3
E.Coli	0	15	17	28	32	23	22.65
Klebseilla	0	16	18	20	17	17.25	15.6
s.Aureus	0	34	38	44	49	128.25	40.36
S.Citreus	0	12	18	20	28	19.5	15.5
S.Epidermidis	0	16	20	17	18	17.75	15.63
Diphtheroid	0	2	3	3	5	3.25	3.42
E.Coli	0	16	18	20	20	18.5	18.2
Klebseilla	0	12	12	14	13	41.25	13.44
s.Aureus	0	24	25	28	30	84.5	26.2
S.Citreus	0	8	10	11	14	32.5	10.7
S.Epidermidis	0	2	2	3	4	2.75	3.45

lotions.

In the present study, after microbiological examination shows the presence of frequency of the diverse microorganisms [Table 1] during pre and post-use of bar soap were *S. aureus*, *Klebsiella* species, *E. coli*, and *S. citreus* with few others listed in Table 1.

This analysis shows that all (100%) bar soaps and liquid soap dispensers in usage conditions yielded positive culture. As shown in Table 1, after the pre and post-use of liquid show the frequency of diverse microorganisms listed are *S. aureus*, *E. Coli*, *Klebsiella* species and *S. citreus*. In a study done by Kabara and Brady in 1984, on bar and liquid soaps collected from 26 public lavatories were investigated for microbial colonies and found 100% positive culture report after analyzing 84 samples obtained from bar and liquid soap and the microbial population obtained from the bar and liquid soap represented over 16 different genera.<sup>3</sup> Similar results were observed in the current study where all the samples showed positive results for the presence of microorganisms.

In a study conducted by McBride in 1984, 92%–96% of the samples from the “in-use” bar soaps (with and without antibacterial) yielded positive culture.<sup>4</sup> Similar results were found in a study done by Hegde et al. in 2006, which is in accordance with the current study. In a study conducted in a household setting, Brook and Brook studied the microbial content of 14 bar soap. The significant bacteria isolated were *Staphylococcus* and *Enterobacteriaceae*. It was also observed that the number of bacteria isolated from heavily used soaps that were wet was higher than that from infrequently used soaps that were dry.<sup>5</sup>

The significance of handwashing is more vital when it is allied to dentists because of possible contagious influence of bacteria that can be pathogenic, and studies have revealed that liquid soaps contain active antimicrobial ingredients which take away more bacteria as compared to plain soap.<sup>6</sup> These results illustrate that liquid soaps significantly decrease the bacterial population than bar soaps. Similar results have been deduced by Caetano et al. in 2011 and by

Toshima in 2001, which is in accordance to the liquid soap sample results of the present study.<sup>7</sup>

In the present study, the significant bacteria isolated were *Staphylococcus* and *Enterobacteriaceae*. It was also observed that the number of bacteria isolated from heavily used bar soaps that were wet was higher than that isolated from infrequently used bar soaps that were dry.

In this study, the presence of diverse microorganisms found in in-use bar soap and liquid soap samples suggests that bar soap and dispenser handles may be an important infection reservoir. *S. aureus*, *E. Coli*, and *Klebsiella* which are isolates from the samples are shown to be the prime organisms that cause nosocomial infections.<sup>7</sup> The use of such a contaminated product may thus serve as a continuous source of infection and re-infection for the users. The present study results may have implications for health professionals and medical educators aiming to design effective programs to promote hand hygiene practices. Future research needs to research the impact of different hand hygiene procedures to remove bacteria present in dentists’ hands.

## 5. Conclusions

Dentist being in the profession that deals with handling oral cavity which is a reservoir for a variety of microorganisms are at a potential risk of getting infection or worse cross contamination of various infection. A simple hand washing becomes the fundamental, crucial and effective intervention to reduce the incidence of related diseases in the health-care sector. Unfortunately, compliance with standard hand hygiene protocols has generally been poor in the health-care environment. While antibacterial liquid soaps have experimentally proven to destroy the bacteria at a certain concentration. Dentists should use soaps in their clinical and nonclinical workplaces according to the health and hygiene criteria. In this way, many patients with immunocompromised status or poor tolerance will be covered against the transmission of pathogenic or opportunistic pathogens. Dental care staff should be

encouraged to use liquid soap instead of bar soap in hand washing to protect from contamination and they should also increase awareness of the use of liquid soap to protect patients from the occurrence of bacterial contamination.

## 6. Conflict of Interest

The authors declare that there are no conflicts of interest in this paper.

## 7. Source of Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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**Cite this article:** Divyashree R, Raj K. Determining the frequency of microbial growth “in-use” detergent products in various dental clinics: A microbiological research. *J Dent Spec* 2020;8(2):52-55.