

Are Commercial Disinfectants Equally Effective on Various Surfaces

Dasani Sonal*, Rai Shalini, Surve Nutan, Kuttisankaran Rajashree

Department of Life Sciences, K.C. College, Churchgate, Mumbai, India

* Corresponding author. Tel: +919820291092; Fax: +91(022)22029092; E-mail: sonaldasani@yahoo.com

Abstract

All of us are surrounded and in constant contact with a variety of microorganisms in day to day life. The warm and moist environment of surroundings including floors provides optimum conditions for the growth of common micro flora. There are many microbial species commonly present on various surfaces, most of which are pathogenic only in higher concentration. In order to control growth of such organisms disinfectants are commonly used. In our laboratory, common floor micro flora were isolated, identified and efficacy of various floor disinfectants were tested suggesting Dazzl to be most effective. Whereas, according to the Indian Medical Association, Lizol and Dettol are claimed to be the most effective disinfectants. However, these experiments were limited to floor of Laboratory. In practice, there are many areas with potential to support the growth of micro organisms, but generally neglected with reference to disinfection. Therefore, in the present study, several such areas were selected and efficacy and longevity of various disinfectants was determined using *in vivo* analysis.

Keywords: Disinfectant; Floor micro flora; *in vivo*; Pathogens; Turbidometry

1. Introduction

Television commercials, literature, and popular belief tell that there are bacteria floating around everywhere, sitting on every surface, just waiting to infect us [1]. Any environment that is warm and moist is an ideal place for bacteria to breed and establish themselves. In our surroundings, there are some such areas and it is sensible to take steps to avoid illness by following simple strategies for maintaining hygiene. Studies have shown that the most common bacteria found in indoor air are *Micrococcus*, *Staphylococcus*, *Bacillus*, and *Pseudomonas* [2].

No matter how clean one thinks their homes are, they are still teeming with bacteria that live on every surface, near and in toilets, sinks, showers, baths, in carpets, on pets and in and on the people who live there [3]. Objects that are handled a lot (TV remote control, telephone handsets) have more bacteria than tabletops and furniture. However, the

important thing to remember is the vast majority of these bacteria are harmless. There is little point in struggling to sanitize the entire home in a hope of reducing bacteria to zero as they are essential for human existence. However, beyond certain limit all these organisms can turn pathogenic, hence, it is advisable to take precautions to eliminate or avoid pathogenic bacteria.

Microorganisms present in various areas shows diversity with respect to their type and concentration [4].

1. Bacteria	<i>Pseudomonas</i> sp, <i>Staphylococcus</i> , <i>Salmonella</i> <i>vibrio</i> sp, <i>micrococcus luteus</i> etc.
2. Virus	<i>Agarobacterium</i> , <i>influenza</i> <i>Rhinoviruses</i> , <i>HIV</i> , <i>Hepatitis A B & C</i>
3. Fungi	<i>Trichophyton</i> , <i>Cladosporium</i> , <i>Aspergillus versicolor</i>
4. Parasites	<i>Giardia</i> .

Though majority of these microbes are nonpathogenic, under specific conditions they are potential to cause infections [5]. For example, *Serratia marcescens* is a human pathogen, involved in nosocomial infections, particularly catheter-associated bacteremia, urinary tract infections and wound infections. It is commonly found in the respiratory and urinary tracts of hospitalized adults and in the gastrointestinal system of children [6].

For prevention of such conditions growth of microorganisms should be controlled in our surroundings, though, practically it is impossible to eradicate microorganisms from the floor. Traditionally, it was accomplished using water, however, cleanliness of the floor can be ensured by removal of dirt and dust on a routine basis by adding surface cleans such as Phenyl [7]. However, Phenyl is not safe for the health as it is made up of chemicals which may damage the skin. Studies have shown that long term exposure to such chemicals can have serious health consequences [4]. With the increase in the knowledge and research in this field, "disinfectants" were introduced.

Disinfectants are the best weapons for fighting against germs. It is an agent, such as heat, radiation, or a chemical, that destroys, neutralizes or inhibits the growth of disease carrying microorganisms [8]. They can also be defined as antimicrobial agents

that are applied to non-living objects to destroy microorganisms [9]. Different disinfectants are presently available commercially to handle even the toughest cleaning jobs and have pleasant smell along with the ability to inhibit the growth of microorganisms. Merely cleaning with cleansing chemicals may remove the dirt, but not the germs. Breeding of germs and bacteria produces bad odor, as well as increases the possibility of spreading diseases [3].

In the last 20 years, the use of disinfectants has rampantly increased. There are number of disinfectant available in the market produced by reputed companies like Hindustan Unilever Limited (HUL), Dabur etc. There is cut through competition for the market share of hard surface cleaners (~ Rs. 165 crore industries). To have an edge over others, all the producers are coming up with attractive advertising campaigns. As a lay man, it is obvious to get biased and buy the disinfectants which have better packing and promotion campaign rather than the efficacy.

According to Indian Medical Association (IMA), a good disinfectant should be capable of killing the germs by 99.99% within 60 seconds [10]. Keeping the same in view, Lizol and Dettol are disinfectants recommended by Indian Medical Association. There are number of other floor disinfectants available in the market, but not approved by IMA. Earlier research from our laboratory using *in vitro* analysis [11] and *in vivo* experimentations by [12] showed that Dazzl has maximum antimicrobial activity as compared to other floor disinfectants.

Second important aspect of efficacy of any disinfectant from consumer's point of view would be the longevity of its effect. Once the floor is cleaned using a particular disinfectant, how long it can prevent the growth of microorganisms? Chavan et al. [12] have demonstrated that Dazzl give long lasting effect in controlling reoccurrence of micro organisms. However, all these studies were restricted to laboratory floor which represent relatively controlled movement of individuals and once a day cleaning using disinfectant.

Third important question is whether Lizol and Dazzl can be used to clean potential surfaces other than floor in our surroundings (which are likely to come in physical contact with human beings and can potentially exchange microbial load) or not. To address this question, with respect to above said information, following objectives has been set forth for the present study

- To select the potential areas in our surroundings for microbial growth
- Literature survey
- Standardization of methodology
- *In vivo* analysis to check effectiveness of floor cleansers
- To compare longevity of effect of the cleansers using *in vivo* analysis
- Analysis of the data.

2. Methods

The aim of present study is to determine comparative efficacy of various floor cleaners at various places susceptible for microbial growth. Keeping in mind the surfaces, with which one remains in physical contact and can contribute to the transfer of organisms are selected:

- Class room floor
- Laboratory floor
- House floor
- Kitchen floor
- Residential bathroom floor
- Refrigerator handle
- Mobile key pad

To check the efficacy and longevity of various disinfectants turbidometric method was used using nutrient broth as it promotes growth of various types of microorganisms.

From the area under study (i.e. Laboratory floor, class room floor, house floor, kitchen floor and bathroom floor) three different locations were marked 1 x 1 square feet and used for all the experimentation. Entire area of Refrigerator handle and Mobile key pad was considered for collecting the samples.

Sterile cotton swabs of 2 x 2 inches were dipped in sterile distilled water and the marked location was wiped with it. This swab containing sample (dirt) was suspended into a flask containing sterile saline (0.85% NaCl, pH 7.2). After mixing it for 2 minutes the swab was removed from the flask and discarded. The resultant solution was inoculated in nutrient broth and used as positive control. To nullify the effects of color imparted by nutrient broth, sterilized broth was used as negative control with each set.

All the commercially available disinfectants recommend minimum concentration to be used for its optimum effectiveness. However, our earlier studies suggest that their efficacy is not maximum at recommended concentration [12]. When these products are used without dilution, they were more effective. Keeping this in mind these products are used in concentrated form. The sterilized cotton swab was dipped in the particular disinfectant and the marked location was wiped and the swab was then discarded. After two to three minutes the same location was wiped with another swab dipped in sterilized distilled water. This swab, with the organisms not removed by disinfectant, was then suspended in a flask containing 20 ml sterile saline and mixed thoroughly. This formed the test sample for respective disinfectant. In the same manner the samples were collected for each of the disinfectant used in the present analysis.

All these samples of different locations were inoculated under aseptic conditions to the test tube containing 9 ml pre-sterilized broth. The tubes were then incubated at 37°C for 24 hours and optical density (OD) was recorded at 530 nm. All the

experiments were performed twice in duplicate with positive and negative controls.

To check the longevity of the efficacy of disinfectants, samples were collected after every 2 hours interval after cleaning the floor with respective disinfectant. One ml of the samples were inoculated in the nutrient broth and incubated for 24 hours at 37°C before taking OD.

The mean OD was determined and used for calculation of % inhibition in the growth. The OD of positive control was considered as 100% and compared with OD obtained using test samples to calculate % growth of floor microorganisms after the use of particular disinfectant. To calculate % inhibition, the values of % growth was subtracted from 100 and plotted on the graph against concentration or time of incubation.

To determine the significance of difference of various disinfectants used, the values of % inhibition obtained using different disinfectants were subjected to single factor analysis of variance. Microsoft Excel – 2007 was used for performing all the statistical analysis.

3. Results and Discussion

Microorganisms are omnipresent. For human beings, they may be useful (*Lactobacilli*), harmful (*Pseudomonas*, *Salmonella* etc.) or opportunistic (*E. coli*). Most of the microbes present around us are harmful only if they are present in higher concentration [2].

It is practically impossible and not necessary to keep our surroundings free from microorganisms; however, by following hygiene practices one can keep the growth of microorganisms under control. For that reason the surface with which we are in direct contact need to be cleaned regularly with suitable disinfectant and cleaners. To determine suitability of various disinfectant on various surfaces in the present study three different disinfectant and seven different surfaces are taken into consideration.

There are reports in the literature for the use of *in vitro* as well as *in vivo* analysis for determining efficacy of various floor cleaners [11]. However, the conditions of floor which is constantly exposed cannot be compared with conditions inside a test tube [12], therefore, in the present analysis, *in vivo* analysis was performed.

From our earlier *in vitro* and *in vivo* studies Dazzl was proved to be as effective as Lizol, which is recommended by IMA [10]. Germitol is a medicated disinfectant specially designed to clean heavily contaminated laboratory floors. Therefore, these three products viz. Lizol, Dazzl and Germitol were selected for the present study.

Floor is one of the most important surfaces for establishment and growth of microbes, with which one is in direct physical contact. Most of common floor microbes are infectious at higher concentration.

Children, aged individuals and patients are relatively more susceptible to such infection because of their low levels of immunity. The uneven surfaces of the floor including crevices present between the tiles of the floor are suitable to harbor more number of microbes as moisture often retains there.

Following surfaces, with which one can remain in physical contact and which can contribute to transfer of organisms are selected in the present study.

- **House floor** – Controlled movement and better cleaning frequency

To represent Warm and moist environment, which support the growth of microorganisms Kitchen and Bathroom floor were chosen.

- **Kitchen floor** – Amount of organic material being available is expected to be more, controlled movement but more humid
- **Residential bathroom floor** – Very humid environment

Bacteria can live quite well in shower trays, wastes, plug holes, under taps, in overflow channels and on damp toothbrushes and sponges. A sure sign that bacteria have begun to make a home in the bathroom is the appearance of unpleasant, fusty smells. As well as bacteria, moulds also grow well in these conditions, alongside bacterial colonies [13].

Several methods like Agar Ditch, Paper Disk, Turbidometry etc. have been employed to check efficacy of floor cleaners by Sinha *et al.* [11] and suggested no difference amongst them. However, paper disk and agar ditch methods are difficult to perform with respect to floor micro flora as some of the samples need to be concentrated to achieve lawn growth. Therefore, in the present study, to determine the effectiveness of products, *in vivo* analysis was performed using Turbidometric analysis.

To represent the crowded and controlled areas (public places and premises) / following floor samples were analyzed.

- **Class room floor** – Representing many footsteps in and out throughout the day before it actually cleaned using disinfectant.
- **Laboratory floor** – Relatively controlled movement and generally cleaned more frequently as compared to class rooms.

Figure 1 represents % inhibition in growth of micro organisms on the Floor surface of House, Kitchen and Bathroom against time after cleaning with Lizol, Dazzl and Germitol obtained using *in vivo* analysis by turbidometric method. Germitol is found to be slightly more effective as compared to Lizol and Dazzl in controlling micro organisms on kitchen and bathroom floors. Analysis of variance performed amongst various disinfectants used indicate statistically insignificant difference, where as Dazzl was more effective for longer duration on House floor ($P<0.1$). When efficacy of Lizol was compared with Dazzl, the later was found to be slightly more

effective on all the surfaces, but the difference was statistically insignificant ($P<0.27$).

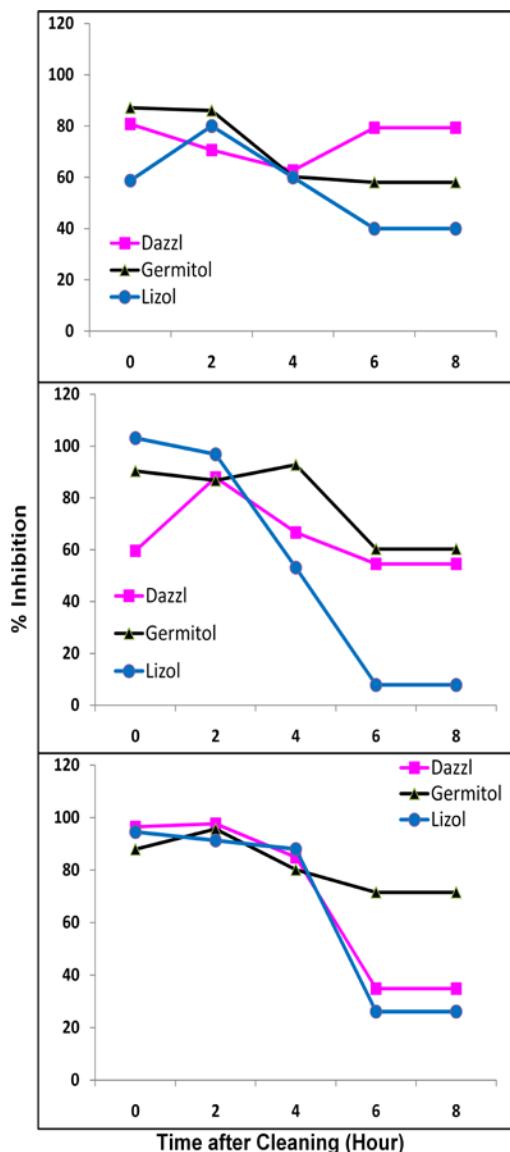


Fig. 1: % Inhibition in growth of micro organisms against time after cleaning with three disinfectants in House Floor, Kitchen Floor and Bathroom Floor.

The data on sensitivity of Laboratory and class room micro flora towards various disinfectants is presented in Figure 2. Class room floors were found to be heavily loaded with microorganisms may be because of lots of movement of individuals in the area. In one of our pilot experiments, samples collected from class room were inoculated on N-agar plate for comparison with other areas. After 24 hours, complete lawn growth was observed in samples collected from class room as compared to isolated colonies obtained from all other areas. Since, this method gave lots of variation with respect to number of colonies when experiments were repeated; turbidometry was used for all the samples. When three disinfectants were compared, Germitol was proved to be much better as compared to Lizol and followed by Dazzl. The

difference in their efficacy was found to be statistically significant ($P<0.05$).

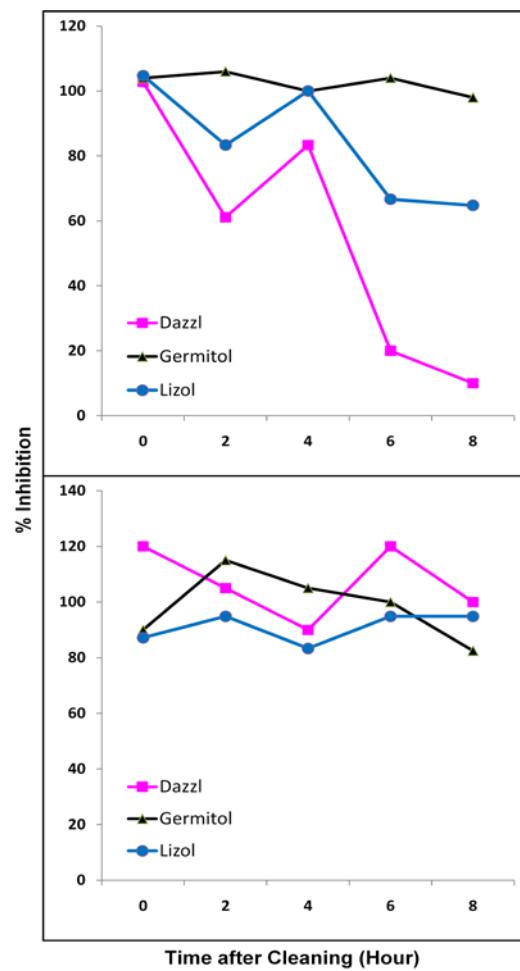


Fig. 2: % Inhibition in growth of micro organisms against time after cleaning with three disinfectants in Class room floor and Laboratory Floor

All the three disinfectants were able to inhibit 80% growth of microorganisms even after 8 hours of cleaning in laboratory. However, Dazzl is proved to be more effective as compared to other disinfectants used ($P<0.1$).

A survey called "Dettol & Lizol – Global Hygiene Survey" was conducted with more than 10,000 people in 10 countries. It showed that 52% Indian's thought that toilet basin was the site where most germs reside in the home and only 7% selected door handles, 17% selected kitchen surfaces and 10% selected germs on your hands. In reality most germs can be found on surfaces such as light switches, telephone receivers and television remote controls [4]. Keeping this in mind Refrigerator handle (Used many time a day by various people but not cleaned frequently using disinfectant) and Mobile key pad (Not used by many people, but used frequently and not cleaned using disinfectant) were also chosen as potential surfaces for present study.

Figure 3 represents % inhibition in the growth of microorganisms on mobile key pad and handle of refrigerator against time. None of the disinfectant

used were effective on these surfaces. Almost 100% of the micro flora was reestablished after 4-6 hours of cleaning, suggesting that the flora present on these areas might have more similarity with skin as compared to floor surfaces.

From these observations it can be concluded that Germitol works better if the microbial load of the surface is very high, where as Lizol and Dazzl are very effective and good enough to clean various areas of our surroundings that are disinfected at regular time interval ex. House floor, kitchen floor, bathrooms etc. However, Dazzl was found to be slightly more effective with respect to % inhibition and reoccurrence (longevity) of microbial growth as compared to Lizol. This also supports the earlier finding from our laboratory.

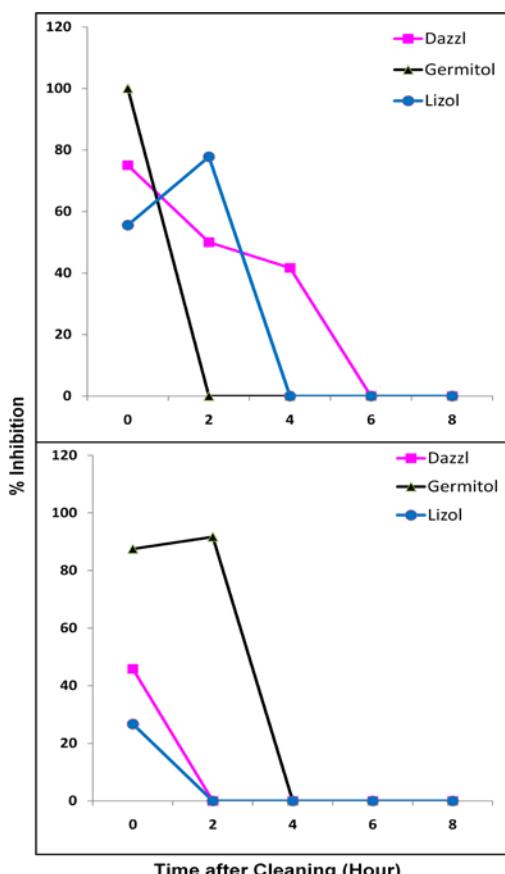


Fig. 3: % Inhibition in growth of micro organisms against time after cleaning with three disinfectants on Mobile Key Pad and Refrigerator Handle.

4. Conclusion

- Germitol is very concentrated and should be used to clean the public places with high microbial load
- Lizol and Dazzl are very effective to clean residential surfaces. Dazzl is found to be

little more effective as compared to Lizol recommended by Indian Medical Association

- Amongst residential areas studied, kitchen floor found to be most potential surface for the growth of microorganisms
- Class room floor was found to be loaded with microorganisms
- The places which are crowded need to be cleaned regularly with disinfectants

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