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Comparative study of the disinfection capacity of different floor cleaning solutions on ventilated room floor

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Abstract

Floor cleaning solutions is used to promote floor hygiene. It removes dirt and bacteria and provides a clean walking surface. Most of the cleaning is achieved by the mechanical action of the mop along with the floor cleaning solutions. The present study aimed to analyze the effect of various floor cleaners (Exo, Lysol, Dettol, Lemon grass oil) in the recommended concentration on floor bacteria. The floor cleaners tested in the present study were selected based on the popularity and availability in market. The study was performed using swabbing method for collection of bacteria and pour plate method for bacterial culture. Among the four floor cleaners, Dettol shows maximum antibacterial action, the chloroxylenol containing in Dettol that show higher anti microbial activity. It is obvious that ayurvedic floor cleaner Lemon grass oil exhibit antibacterial action like other selected floor cleaners. Before cleaning, bacterial population of the specific area was 31 CFU and in after cleaning sample with lemon grass oil 9 bacterial colonies were observed. All the variations between the CFU of bacteria before and after treatment was found as significant in student t test performed. An attempt has been done in the present study to screen antimicrobial effect of four selected floor cleaning solutions on floor with an objective to evaluate performance of daily usable floor cleaning solutions, avoiding bacterial contaminations in floor.

Keywords: Antimicrobial effect, Dettol, Exo, Lysol, Lemon grass oil.

1. Introduction

Floor Cleaner is a concentrated biodegradable floor cleaning solution which kills germs, effectively removes tough stains and leaves a pleasant fragrance; but even clean and dry floors can harbour bacteria. There are many floor cleaner manufactures, exporters, suppliers based in India. Good hygiene routines based on cleaning of surfaces are recommended to help control the spread of pathogens. We live in the age of bacteria (Prescott and Klein, 1996). The microbial colonization of all environmentally accessible surfaces of the body begins at birth. Such surfaces are exposed to a wide range of microorganisms derived from the environment and from other persons. This results in the acquisition, selection and natural development of a diverse but characteristic micro flora at distinct sites (Marsh and Martin, 2009).

Promotion of hygiene is important, and is arguably the single most cost effective way of reducing the global burden of infectious disease and without the clever use of new or expensive technologies (Jamieson *et al*., 2006). Good hygiene can prevent gastrointestinal, respiratory, skin and parasitic infections and neonatal mortality (Rhee *et al.,* 2008 and Curtis *et al.,* 2011). In the bathroom, whilst the toilet is probably the origin of enteric bacteria, wet items including baths, basins, toilets, and cleaning cloths or sponges are potent reservoirs of pathogens (Scott and Bloomfield 1990).

2. Materials and methods

Materials used:

Nutrient agar

Ingredients	Gms / Litre
Peptic digest of animal tissue	5.000
Sodium chloride	5.000
Beef extract	1.500
Yeast extract	1.500
Agar	15.000
Final pH (at 25°C) 7.4±0.2	

Floor cleaners for susceptibility test:

Easily available and popularly used floor cleaning solutions were considered in the present study, including lemon grass oil, a natural floor cleaning product available in the market. Similar studies were scanty, so the active products present in each test solution were considered to compare and contrast the results obtained in the study. *In vivo* disinfection treatment was performed on exposed room floors of the college including laboratory and class rooms. A total of four test solutions (Exo, Lysol, Dettol, Lemon grass oil) were used in their recommended concentration.

Culture media preparation:

The culture media used was Nutrient agar. 2.8gm of agar was dissolved in 100ml distilled water, boiled on a hot plate to mix evenly, cotton plugged and sterilized in an autoclave At 121ºC and 15 lb/in^2 pressure for 15 minutes and preserved at 4ºC for further use. Dry sterilization of petriplates, cotton swabs, test tubes and conical flasks were done in hot air oven.

Preparation of culture plates:

The semi fluid nutrient agar medium was transferred to a pre sterilized petriplate and then the plate was kept undisturbed inside an inoculation chamber for preventing possible cross contamination. As the medium solidifies, inoculum was introduced.

Sampling:

Test was performed as an *in vivo* study. Two adjacent unit square centimetre area of room floor were considered for the study. One was considered as the control for estimating the normal microbial population on the floor and the other was subjected to cleansing using standardized floor cleaning solution, using a sterilized cotton swab. Floor microbial sampling was done using a sterilized cotton swab and transferred to 10ml distilled water. The inoculum was subjected to single serial dilution and 1ml of this was transferred to culture plate.

Antibacterial susceptibility test using pour plate method:

The antibacterial assay was carried out by using pour plate method performed in laminar flow. Using a sterilized cotton swab, heterogeneous carpet culture of floor bacteria was sampled from the control and test areas of floor and the inoculums was prepared. 1ml of the inoculums was transferred to culture plates and spread evenly on the agar surface mechanically. The plate was kept undisturbed. Three replicas were also made with to minimize sampling error. Culture plates were then kept in incubator at 37^{o}C for 24 hours. After 24 hrs of incubation, the culture plates were observed to count the number of colonies produced for each treatment. Average number of colonies was considered for further analysis and interpretations.

Calculations:

Number of colonies produced in culture plate before and after cleaning was obtained from the experiment. The values were converted into percentage of kill for each test solution as

$$Percentage\ of\ kill = \frac{Number\ of\ colonies\ after\ treatment}{Number\ of\ colonies\ before\ treatment} X\ 100$$

Statistical analysis:

Descriptive statistics was done using MS Excel software. One way ANOVA was performed to analyze the variation between CFUs produced before and after floor cleaning process. Student T test was performed with the primary data to identify the significance of variations in test and control results. Level of significance was estimated at 5%.

3. Results and Discussion

Three chemical floor cleaners and one herbal product were used for *in-vivo* antibacterial assay on floor bacteria. Five floor sites were subjected to cleaning process with floor cleaners and with sterilized distilled water for comparative analysis of microbial count on floor in two phases. During first phase bacteria present on the sites of floor before cleaning were enumerated. Second phase bacterial count was taken from the similar adjacent floor sites after cleaning floor with selected floor cleaner. List of floor cleaners and the major active ingredient were depicted in table 1. Floor cleaners diluted in same concentration were used in the study. For each floor cleaners 1ml solution is diluted to 500ml with distilled water, as recommended by the manufactures. The loaded petriplate were incubated at 37^{o}C for 24 hours. After incubation, surface of the petriplates were evenly spread with

spotted colonies of floral bacteria. Numerical counting of plate surface was done using digital colony counter and tabulated. The observable difference was seen in all floor cleaners.

Table 1: Representation of each floor cleaner in antibacterial study and active ingredients present in each floor cleaner

No	Name of floor cleaners	Active ingredient	Concentrations
1	Exo	Ionic and non ionic surfactants	1ml to 500ml using distilled water
2	Lysol	Benzalkoniun chloride	1ml to 500ml using distilled water
3	Dettol	chloroxylenol	1ml to 500ml using distilled water
4	Lemon grass oil	citral	1ml to 500ml using distilled water

For control, sterilized distilled water was used for cleaning the floor surface. Samples before and after cleaning process were collected. 19 bacterial colonies were obtained in before cleaning sample and 13 bacterial colonies were obtained in after cleaning sample (Table 2). Among the four floor cleaners, Dettol shows maximum antibacterial action. At standard concentration, 92 bacterial colonies present before cleaning and 23 bacterial colonies present after cleaning.

While analysing the antimicrobial activity of Exo in prescribed concentration, 61 bacterial colonies were present before cleaning and 19 bacterial colonies were present after cleaning adjacent sampling squares. Lyzol also showed antibacterial activity, 25 bacterial colonies obtained in petriplate for sample before cleaning and 7 bacterial colonies obtained in petriplate of sample after cleaning. It is obvious that ayurvedic floor cleaner pulthailam exhibit antibacterial action like other selected floor cleaners. Before cleaning, bacterial population of the specific area was 31 CFU and in after cleaning sample with lemon grass oil 9 bacterial colonies were observed (Table 2). All the variations between the CFU of bacteria before and after treatment was found as significant in student t test performed, since the test value was lower than critical value at 5% significance (Table 3).

Table 2: Effect of cleaning with distilled water, dettol, exo, Lysol, lemon grass oil on floor microbial population (Mean ± SD)

Name	Microbial count		
	Before cleaning	After cleaning	Percentage
I) **Distilled Water**			
1	16	18	31.57%
2	21	12	
3	20	9	
Mean ± SD	**19±2.62**	**13±4.58**	

II) **Dettol**			
1	99	18	75%
2	87	26	
3	90	25	
Mean ± SD	**92±6.244**	**23±4.358**	
III) **Exo**			
1	63	22	68.85%
2	56	15	
3	64	20	
Mean ± SD	**61±2.62**	**19±4.58**	
III) **Lysol**			
1	20	7	72%
2	28	5	
3	27	9	
Mean ± SD	**25±4.36**	**7±2.0**	
V) **Lemon grass oil**			
	32	11	70.96%
	34	9	
	27	7	
	31±3.60	**9±2.0**	

Table 3: Statistical analysis of antibacterial activity using student t test

Indices	Values
T test value calculated	0.055080394
T test value (critical)	0.71
Degree of freedom	4
Level of significance	0.05

4. Conclusion

The use of a floor cleaning solutions as an adjunct to floor cleaning may assist floor hygiene in a number of ways. It may prevent bacterial adherence to the floor surface and reducing disease. In the present study four types of floor cleaning solutions were selected and utilized in the study. So that to obtain results with extreme accuracy. The antimicrobial agents in tested floor cleaning solutions include chloroxylenol, ionic and non ionic surfactants, and benzalkonium. Benzalkonium chloride

(BAC) is a major non-alcohol-based active ingredient used for clinical, food line, and domestic household biocides (Kampf and Kramer, 2004 and Mangalappalli-Illathu and Korber, 2006)

Among four floor cleaning solutions tested, Dettol showed highest antibacterial effect. The active component is benzalkonium, which was observed as an effective compound in removing peripheral bacterial colonies. About 75% of bacterial colonies were removed by Dettol on primary treatment. Dettol is widely used in homes and healthcare settings for various purposes including disinfection of skin, objects and equipments, as well as environmental surfaces. With prior cleaning before application, the number of microorganisms colonizing the skin and surfaces are greatly reduced (Rutala, 1995). Pulthailam (lemon grass oil) floor cleaning solution is advertised as natural ayurvedic cleaning solution, and its active component is citral. Exo is also used this study, its active component is ionic and non-ionic surfactants. These selected commercial floor cleaning solutions in the present investigation may be considered as excellent products for preventing accumulation of bacteria on floor.

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