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Comparative Study & Efficacy of Commonly Used Disinfectant against Human Pathogens

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***Abstract*—** Disinfection is the process of elimination of virtually all pathogenic organism on inanimate objects & surfaces thereby reducing the level of microbial contamination to safe level.The study aimed to evaluate sensitivity of some clinical organisms used for the tests are *S. aureus, Klebshiella , Pseudomonas, E. coli, Bacillus* with the activity of some selected commercial disinfectants used are Dettol, Lysol, Ultraclean, Phenyl & Phenol. All the disinfectants used in this study have bactericidal effect against the test organisms whereas Phenol Coefficient test was carried out to compare sensitivity of disinfectants to that of phenol under experimental method so as to determine the disinfectant efficacy. Phenol & Dettol showed highest antimicrobial activity against all test organisms. Ultraclean also showed high antimicrobial activity except Pseudomonas aeuroginosa. Phenol coefficient test was used for Staphylococcus appear as Lysol is the most potent disinfectant than all other disinfectant and for Bacillus appear as Dettol is more effective than other disinfectant used in this study.

Keywords— Disinfectants, Kirby-Bauer method, S. aureus, Klebshiella , Pseudomonas, E. coli, Bacillus, Phenol coefficient test.

I. INTRODUCTION

Disinfection procedures are typically used the most kind of intervention in hospital settings against potentially pathogenic microorganisms [1, 2] and aim to reduce complications due to infectious organisms. Disinfectants are usually utilized in hospitals and different health care settings for variety of topical and hard surface applications [3].The main objective of disinfection is to manage and control the spread of infectious diseases. According to [4] disinfectants are chemicals used to inhibit or prevent the growth of microorganisms on inanimate objects.They are usually are "cidal" in action ,killing susceptible potential pathogenic microbes. The majority of disinfectants can either be bacteriostatic or bactericidal [5]. Many parameters include concentration, time of action, pH, temperature as well as phenol concentration influence disinfectant effectiveness [6]. Depending on their effectiveness against vegetative bacteria, tubercle bacilli, fungal spores, enveloped and non-enveloped viruses, and bacterial spores, several disinfectants are available [7].Out of many disinfectants, Savlon, Dettol, Lysol, Phenol, Alcohol, and Betadine are just a few of the disinfectants that are both cost-efficient and effective in removing practically all pollutants. However, as a result of environmental changes and mutations in the genomic structure of microorganisms, they are becoming increasingly resistant to current disinfectants, necessitating the search for fresh disinfectants.Their resistance to various antimicrobial substances can compromise patients' therapeutic protocol [8], necessitating improved cleaning methods in healthcare environments [9,10]. Disinfectants are typically employed in dilutions, but it has been demonstrated that when some of these agents are diluted for usage, Gram negative bacteria such as Pseudomonas aeruginosa can survive, making them ineffective against nosocomial infection [11,12]. Infection control and patient treatment are both being hampered by the rise of resistant microbes in hospitals and the community. Methicillin-resistant Staphylococcus aureus, glycopeptide-resistant enterococci, and Klebsiella pneumoniae producing extended range beta-lactamase are among the organisms of particular concern. All of these pathogens are passed from patient to patient on the hands of the caregivers [13]. A recent large review of antibiotic resistance stressed the necessity of hospital infection control and the control of these organisms, and many authorities have emphasised the key role of hand washing with disinfectants [14]. The range of organisms controlled and the manner by which these agents perform vary greatly. Some puncture the microorganisms' cell walls, enabling the contents to flow out, while others permeate and enter the cell, killing the microorganism from within [15]. The goal of this study was to determine the phenol coefficient test and examine the antibacterial activity of various common disinfectant brands that were employed in this study, such as Dettol, Lysol, Ultraclean, and Phenyl, against all test organisms.

II. METHODOLOGY

Organisms & Inoculum preparation :
Specified strains of S. aureus, Klebshiella , Pseudomonas, E. coli and Bacillus are usually recommended. This strains was procured from NCL, PUNE (National Chemical Laboratory), organisms maintained in the nutrient agar in petridish. The inoculates were then incubated at 37°C for 48 hours and a loopful culture was used as inoculum for further used.

Disinfectant used :
The commercial disinfectant used for this research work were purchased from Pharmaceutical store in Nagpur. They are Dettol, Lysol, Ultraclean & Phenyl.

Antimicrobial activity of disinfectant:
Agar well disffusion or Kirby- Bauer's method was employed for checking the antimicrobial activity of the disinfectant samples. 24 hour cultures of S. aureus, Klebshiella , Pseudomonas, E. coli, Bacillus were used for the sensitivity test. The Mueller Hinton Agar was prepared & autoclaved at 121oC for 15 minutes. The plates then were swabbed with respective organisms and labelled according to the organism. A total of three wells were made on each plates. On first well phenol was poured with a micropipette and loaded into the wells. On second well, given disinfectant was loaded into the wells and third well was for control. This test was carried out for all the organisms and disinfectants used in this study. Then the plates were incubated at 37oC for 24 hours. A zone of inhibition is indicative of microbial activity against the test organism. Presence of zone of inhibition indicates that the disinfectant is effective and was measured.

Phenol Coefficient Test : 1% phenol concentration was prepared by dissolving 1g of phenol crystals in 100ml of sterilized distilled water in a conical flask, a series of dilution of the phenol and the test disinfectants were prepared in sterile test tubes and were all equalized to 5ml each in the order 1:70, 1:90. 1:100. Prepared a glucose broth as per the composition then added bromothymol blue indicator until its pH gets neutral. 5ml of samples containing different dilutions of phenol (1:70, 1:90, 1:100) and the test disinfectants (1:70, 1:90, 1:100) of each set was inoculated with only two test organisms i.e. Staphylococcus aureus and Bacillus substilis. At 5, 10 and 15 min of intervals, 0.1ml sample of dilutions were withdrawn and transferred into glucose broth and incubated at 37o C for 48 hrs. Observed the growth on the basis of colour change. The phenol coefficient was determined as the ratio of the reciprocal of the highest dilution of disinfectant that prevented growth at 10 min and not 5 min to that of phenol. The higher the phenol coefficient values the more the efficacy of the disinfectant was compared to phenol. Phenol coefficient was determined by following formula.

$$\text{Phenol coefficient ratio} = \frac{\text{Highest dilution of chemical being tested that destroyed the microorganisms in 10min not in 5 min}}{\text{Highest dilution of phenol that destroyed the microorganisms in 10min not in 5 min}}$$

III. RESULTS AND DISCUSSION

1) Antimicrobial activity of disinfectant:

Table 1: Antimicrobial activity of all test disinfectant as compared to Phenol

Organisms	Phenol (in mm)	Dettol	Lysol	Ultraclean	Phenyl
E. coli	40	22	13	13	13
Bacillus	40	24	15	18	13
Pseudomonas	49	16	14	15	13
Klebshiella	42	27	15	24	13
S. aureus	43	21	12	15	12

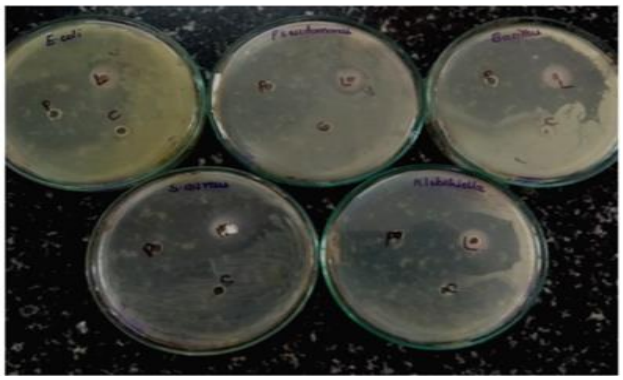


Figure 1: Antimicrobial activity of Phenol

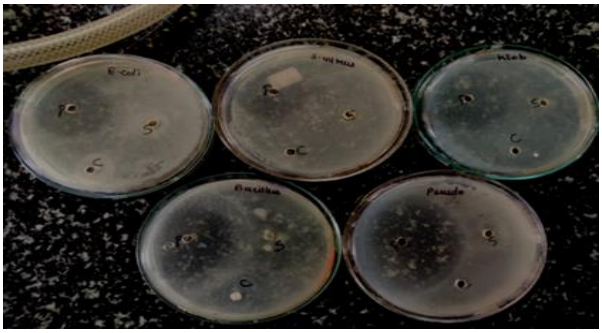


Figure 2: Antimicrobial activity of Dettol

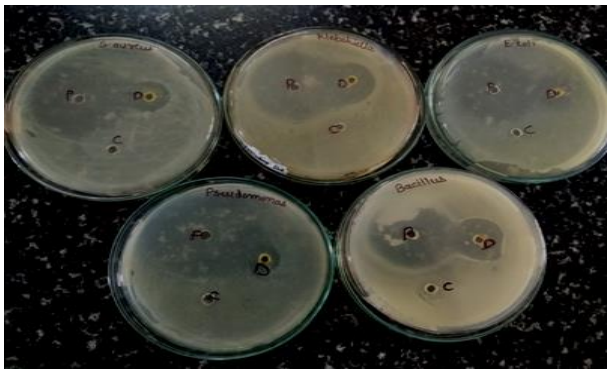


Figure 3: Antimicrobial activity of Ultraclean

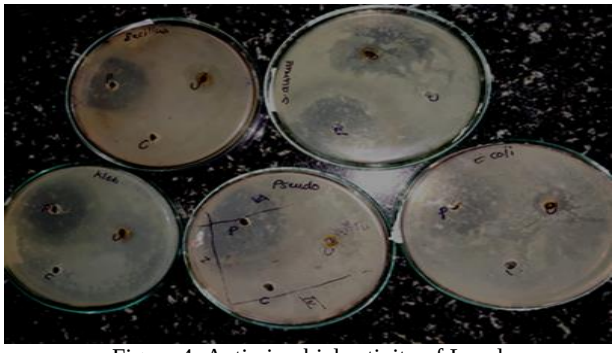


Figure 4: Antimicrobial activity of Lysol

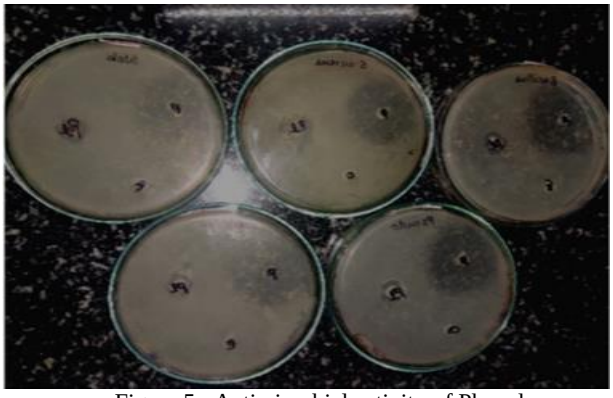
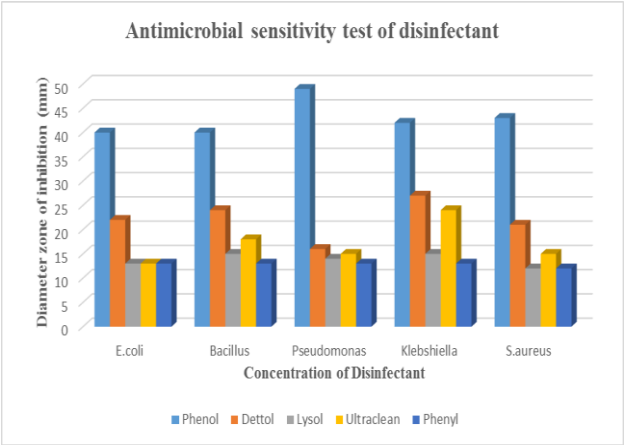


Figure 5 : Antimicrobial activity of Phenyl



Graph 1: Antimicrobial sensitivity test of disinfectant against E.coli, Baillus, Pseudomonas, Klebshiella, S.aureus

The result obtained in this study of the zone diameter of inhibition of all test disinfectant on various test organism is represented in Table 1 & in Graph 1. Phenol & Dettol showed highest zone of inhibition as compared to lysol,Ultraclean,Phenyl. Antimicrobial activity was performed by well diffusion method. In sensitivity testing, the zone of inhibition were as follows;

A) E.coli- Phenol>Dettol whereas lysol, ultraclean & phenyl (13mm) was same effective.
B) Bacillus- Phenol>Dettol>ultraclean>Lysol>phenyl.
C)Pseudomonas- Phenol>Dettol>Ultraclean>lysol>phenyl.
D) Klebshiella- Phenol>Dettol>Ultraclean>lysol>phenyl.
E) S.aureus - Phenol>Dettol>ultraclean>lysol=phenyl

Mcclure et al. (1992) & Bloomsfield et al. (1996) have demonstrated that invitro evaluation is done and chlorohexidine against Pseudomonas spps..Padma Singh et al. (2014) have demonstrated that lysol was more effective disinfectant of choice against all isolate Pseudomonas, Micrococcus & Bacillus spps. followed by Savlon and Dettol.

B) Phenol Coefficient Test :
a) Efficacy test for S.aureus :
1)

Table 2 : Observation table for Dettol

	Time Intervals		
Dilution	**5mins**	**10mins**	**15mins**
1:70	Positive	Negative	Positive
1:90	Positive	Negative	Positive
1:100	Positive	Positive	Positive

By using Phenol coefficient formula,

$$\textbf{1) Phenol coefficient} = \frac{\textbf{1:90}}{\textbf{1:100}}$$

$$= \textbf{0.9}$$

The value of phenol coefficient of Dettol is **0.9**

Figure 6: Phenol coefficient test of Dettol

Table 3: Observation table for Lysol

2)	**Time Intervals**		
Dilution	**5mins**	**10mins**	**15mins**
1:70	Negative	Positive	Negative
1:90	Negative	Negative	Positive
1:100	Positive	Negative	Negative

By using Phenol coefficient formula,

$$\textbf{2) Phenol coefficient} = \frac{\textbf{1:100}}{\textbf{1:100}}$$

$$= \textbf{1}$$

The value of phenol coefficient of Lysol is **1.**

Figure 7 : Phenol coefficient test of Lysol

3)

Table 4 : Observation table for Ultraclean

	Time Intervals		
Dilution	**5mins**	**10mins**	**15mins**
1:70	Negative	Negative	Positive
1:90	Positive	Negative	Negative
1:100	Negative	Positive	Positive

By using Phenol coefficient formula,

3) Phenol coefficient = 1:70 / 1:100

= 0.7

The value of phenol coefficient of ultraclean is **0.7.**

Figure 8 : Phenol coefficient test of Ultraclean

4)

Table 5 : Observation table for Phenyl

	Time Intervals		
Dilution	**5mins**	**10mins**	**15mins**
1:70	Negative	Negative	Positive
1:90	Positive	Negative	Positive
1:100	Negative	Positive	Positive

By using Phenol coefficient formula,

4) Phenol coefficient = 1:70 / 1:100

= 0.7

The value of phenol coefficient of Phenyl is **0.7**

Figure 9 : Phenol coefficient test of Phenyl

a) Efficacy test for Bacillus :

1)

Table 6: Observation table for Dettol

	Time Intervals		
Dilution	**5mins**	**10mins**	**15mins**
1:70	Negative	Positive	Negative
1:90	Positive	Negative	Negative
1:100	Positive	Positive	Positive

By using Phenol coefficient formula,

1) Phenol coefficient = 1:90 / 1:100

= 0.9

The value of phenol coefficient of Dettol is **0.9.**

Figure 10 : Phenol coefficient test of Dettol

2)

Table 7 : Observation table for Lysol

	Time Intervals		
Dilution	**5mins**	**10mins**	**15mins**
1:70	Positive	Negative	Negative
1:90	Negative	Negative	Negative
1:100	Negative	Negative	Positive

By using Phenol coefficient formula,

$$\textbf{2) Phenol coefficient} = \frac{\textbf{1:70}}{\textbf{1:100}} = \textbf{0.7}$$

The value of phenol coefficient of Lysol is **0.7.**

Figure 11: Phenol coefficient test of Lysol

3)

Table 8 : Observation table for Ultraclean

	Time Intervals		
Dilution	**5mins**	**10mins**	**15mins**
1:70	Negative	Negative	Positive
1:90	Positive	Positive	Negative
1:100	Positive	Positive	Negative

By using Phenol coefficient formula,

$$\textbf{3) Phenol coefficient} = \frac{\textbf{1:70}}{\textbf{1:100}} = \textbf{0.7}$$

The value of phenol coefficient of ultraclean is **0.7.**

Figure 12 : Phenol coefficient test of Ultraclean

4)

Table 9 : Observation table for Phenyl

	Time Intervals		
Dilution	**5mins**	**10mins**	**15mins**
1:70	Negative	Negative	Positive
1:90	Positive	Positive	Negative
1:100	Positive	Positive	Negative

By using Phenol coefficient formula,

$$\textbf{4) Phenol coefficient} = \frac{\textbf{1:70}}{\textbf{1:100}} = \textbf{0.7}$$

The value of phenol coefficient of Phenyl is **0.7**

Table 10: Overall Comparative study of phenol coefficient ratios (PCR) of different disinfectants

Disinfectant Name	**Phenol coefficient value**	
	S.aureus	**Bacillus**
Dettol	0.9	0.9
Lysol	1	0.7
Ultraclean	0.7	0.7
Phenyl (Glamic)	0.7	0.7

In this study, the phenol coefficient obtained with each of the disinfectant for S. aureus & Bacillus ranged from 0.7 to 1.From table 10,the disinfectant that is most effective in which ratio of phenol to disinfectant is more than 1.Lysol (1) is most potent disinfectant for S.aureus followed by Dettol (0.9)then Ultraclean and phenyl (0.7) has same efficacy and less effective. On Bacillus, Dettol is more effective (0.9) followed by Lysol ,Ultraclean & Phenyl has same efficacy (0.7) & less effective than phenol being less than 1.Soliman et al.(2009) evaluated the antimicrobial activities of disinfectant & reported 100% effectiveness of quarternary ammonium compound & gluteraldehyde against S.aureus ,E.coli, Klebshiella oxytoca & Pseudomonas aeruginosa offer 10,5,20,20 min respectively. According to the work done by Olowe (2004) and Olasehinde et. al., (2008) showed that Dettol is a strong antimicrobial agent. It also showed that the dilutions of the other disinfectants exhibited remarkable growths of the test microorganisms, (that is the form in which these disinfectants are used).

IV. Conclusion and Future Scope

The potency of disinfectants is critical for increasing their efficacy in reducing microbial populations, which includes disease transmission and infection prevention. Finally, the findings of this investigation revealed that all of the disinfectants tested had a significant bactericidal impact. Out of that, Phenol & Dettol showed highest antimicrobial activity against all test organisms. Ultraclean also showed high antimicrobial activity except Pseudomonas aeuroginosa. Phenol coefficient test was used for Staphylococcus appear as Lysol is the most potent

disinfectant than all other disinfectant and for Bacillus appear as Dettol is more effective than other disinfectant used in this study. To reduce cases of infection by most of the bacteria, the use of good disinfectants should be advocated.

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