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# EVALUATION OF ANTIBACTERIAL ACTIVITY OF SOME COMMERCIALLY SOLD DISINFECTANTS IN PORT HARCOURT ON SOME BACTERIAL ISOLATES

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**Abstract**

Disinfectants are chemical substances designed to eliminate or reduce the presence of microorganisms on surfaces or objects, including bacteria, viruses, and fungi. This study aimed to evaluate the Antibacterial Activities of some commercially sold Chemical Disinfectants on Bacterial Isolates. Eight popular brands of disinfectant locally available and used in Port Harcourt were chosen for the study. They were Dettol, Savlon, Hypochlorite, Purit, Septol, Premier, Tetmosol, and Izal. Staphylococcus aureus, Escherichia coli, Klebsiella pneumonia, and Proteus spp were the test organisms used in the study. In assessing the antimicrobial susceptibility of the test organisms to the chemical disinfectants, the agar disc diffusion method and direct inoculation method were employed. The Minimum Inhibitory Concentration of the chemical disinfectants was determined by increasing concentrations (ranging from 5% to 100%, in 5% increments) of each disinfectant in sterile nutrient broth tubes, each containing 9 ml. Data generated from the study showed that Dettol, Salvon, Purit, Hypochlorite, Septol, Tetmosol and Premier disinfectants in their adequate concentration are very effective antibacterial disinfectants against Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus, and Proteus spp. The minimum inhibitory concentration (MIC) of the selected disinfectants against the isolates showed that Dettol, Salvon, Purit, Hypochlorite, Septol, Tetmosol, and Premier disinfectant had the highest percentages of 90% using 1:10 dilution. This indicates their high efficacy against Escherichia coli, Klebsiella pneumoniae Staphylococcus aureus, and Proteus spp while Izal disinfectant was the least with 0% MIC using 1:10 dilution. However, determining the true efficacy of these chemical warriors involves a systematic and rigorous process. The use of reliable and effective chemical disinfectants and their accurate and specific concentration with minimal dilution should be encouraged as a preventive measure against infectious diseases.

***Keywords****: Bacteria, Disinfectants, Antimicrobials, Susceptibility*

## 1.0 INTRODUCTION

Within the intricate interplay of the microbial world and human health, the quest to mitigate bacterial infections remains a constant and evolving challenge. Bacterial pathogens, despite their diminutive size, can exert substantial impacts on individuals, communities, and entire healthcare systems [1] As these microorganisms adapt, evolve, and occasionally outpace our interventions, the search for effective strategies to counter their proliferation becomes increasingly vital. The story of chemical disinfectants is one of scientific ingenuity and practical necessity. These agents are meticulously designed to curb the proliferation of harmful microorganisms, acting as vanguards in our ceaseless battle against infectious diseases. From bustling healthcare settings to tranquil homes, bustling research laboratories to bustling research laboratories, their significance spans far and wide [2]

In essence, chemical disinfectants are warriors on the molecular scale, harnessing mechanisms of action that target the very essence of microbial life. They disrupt cellular structures, dismantle vital proteins, and inflict oxidative damage, culminating in the neutralization or death of microorganisms. Yet, their prowess is not universal; different types of disinfectants wield varying degrees of power, relying on their unique mechanisms to subdue different types of pathogens [3]. However, the deployment of chemical disinfectants is not without its complexities. The selection of the right disinfectant, the consideration of concentration and contact time, and the careful balance between efficacy and environmental impact form a delicate tapestry of decisions that impact infection control strategies [4]. The battle against microbial resistance, the evolving dynamics of sensitivity and resistance patterns, and the imperative to harmonize effective microbial control with sustainable practices further enrich this narrative. Bacterial infections remain a persistent challenge in healthcare, research, and various industries, necessitating the implementation of effective infection control measures. Among these measures, the use of chemical disinfectants holds a prominent place as a primary strategy to mitigate bacterial contamination. The antibacterial activity of chemical disinfectants on bacterial isolates presents a multifaceted problem encompassing variability in efficacy, the emergence of resistance, inadequate selection strategies, lack of standardized testing methods, and potential over-reliance. Addressing these issues is crucial to enhancing the efficacy of infection control measures, optimizing disinfection protocols, and safeguarding public health across various settings [5]. A comprehensive investigation into these challenges will contribute to the development of evidence-based practices and strategies for effective bacterial contamination control. The aim and Objective of this study is to evaluate the Antibacterial Activities of some commercially sold Chemical Disinfectants on Bacterial Isolates. To assess and quantify the effectiveness of different chemical disinfectants against a diverse range of bacterial isolates.

## 2.0. MATERIALS AND METHODS

### 2.1 Study Area

The study was carried out in Port Harcourt, Rivers State. Port Harcourt is the capital of Rivers state, Nigeria. It lies along the Bonny River and is located in the Niger Delta with a population of 1,148,665. Rivers State University (RSU), formerly Rivers State University of Science and Technology (RSUST) is a university located in the Diobu area of Port Harcourt, Rivers State, Nigeria. The university has

staff strength of 3,000 and a student population of 22,400 as of 2017. It is the first technological university in Nigeria and also the first university to be situated within the Niger Delta. In 2014, it was rated as Nigeria's best e-learning institution and was ranked as the 15th best university in the country.

### 2.2 Collection of Samples

Eight popular brands of chemical disinfectants; Dettol, Salvon, Hypo, Purit, Septol, Premier, Tetmosol, Izal available and used in Port Harcourt were chosen for the study. The products were selected based on interactions with consumers and observations at different retail outlets. Each of the products were stored as recommended by the respective manufacturer and analysis was carried out well before their expiration dates.

### 2.3 Disinfectants Dilution Preparation

The manufacturers of these different brands of disinfectants on the bottles stated how the disinfectants were to be diluted to be effective in their antibacterial activity. Dettol was to be diluted 1ml in 160ml of water, Salvon was to be diluted 5ml in 100ml of water, Purit 1 capful (2.7ml) in 250ml of water, Hypo was to be diluted 3.7ml in 250ml of water, Izal was to be diluted in a 1 in 200 solution, Tetmosol was to be diluted 5.75ml in 250ml of water, Septol was to be diluted 2.7ml in 250ml of water, Premier was to be diluted 3.75ml in 250ml of water.

### 2.5 Disc Diffusion Method

In agar disc diffusion method, nine milliliters (9mls) of distilled water was pipetted into four test tubes arranged in a row in a test tube rack. Serial dilutions were made by transferring One milliliter (1ml) from the various disinfectant to tubes labelled “1”,which is the stock tube, it was thoroughly mixed and 1ml was transferred to tubes labelled II, it was thoroughly mixed again and 1ml was transferred to tubes labelled III, thoroughly mixed again and 1ml was transferred to tubes labelled IV, giving a concentration of 1:10 (0.1ml), 1:100 (0.01ml), 1:1000 (0.001ml), 1:10000 (0.0001ml). The sterilized filter paper discs were impregnated with 10µL of the undiluted disinfectants. Also, 10µL of the diluted disinfectants (1:10, 1:100, 1:1000 and 1:10000) were impregnated into the sterilized filter paper discs each.

Thereafter, four well dried and properly labelled nutrient agar plates were seeded (inoculated) by streaking the test organisms (Escherichia coli, Proteus sp., Klebsiella pneumonia, and staphylococcus aureus) separately throughout the surface of individual plates. This was followed by aseptically transferring the disc impregnated with disinfectants and the discs impregnated with the serial dilutions on the surface of the inoculated agar plates with the aid of forceps sterilized by flaming. Four nutrient agar plates were used for the four bacteria and each plate contained five discs representing the five concentrations i.e., the absolute concentrated disinfectant and four serial dilutions.

### 2.6 Direct Inoculation Method

In direct inoculation method, a sterile pipette tip was used to create five depressions (representing the five different concentrations) on four well labelled nutrient agar plates then the test organisms are streaked separately throughout the surface of individual plates. After streaking, a sterile Pasteur pipette was used to place a single drop each of the disinfectants and serial dilutions in individual depressions on each plate. After use, the disinfectants and serial dilutions were stored in the refrigerator. The inoculated nutrient agar plates with test discs and direct inoculation were incubated at 37oC. After incubating for 24hours,

plates showing clear zones of inhibition were noted and the zones diameter measured in millimeter (mm).

## 3.0 Results

A total of eight (8) popular brands of disinfectant brands locally available and used in Port Harcourt were chosen for the study. They were Dettol, Savlon, Hypochlorite, Purit, Septol, Premier, Tetmosol and Izal.

Table 1 presents the result obtained for antibacterial activity of some disinfectants against isolates using the disc diffusion method. The result shows that the organisms were resistant to Dettol at ratio 1:640 and 1:1280. Furthermore to the result obtained in Table 1, the result shows resistant detection was observed at ratio 1:180 and 1:360 for K.pneumonia, S.aureus and Proteus spp against Dettol. The results also shows that E. coli was resistance against Septol disinfectant at ratio 1:134 and 1:268. At ratio 1:536, the result (Table 1) shows total resistance of the organism to Septol. For the result obtained for Hypo disinfectant on table 1, the result shows that K.pneumoina and Proteus spp shows resistivity against Hypo at ratio 1:120. The result also shows that all organisms were resistance to Hypo at ratio 1: 67 and 1:268. The last result obtained on table 1 shows the result for Salvon disinfectant against the isolates. The results shows that the organisms were resistance at ratio1:16 except for E.coli while resistivity was also observed for all the organisms at ratio 1:32.

| Organism | Dettol (mm) | | | | Septol (mm) | | | | Hypo (mm) | | | | Salvon (mm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1:160(Manufacturers dilution) | 1:320 | 1:640 | 1:1280 | 1:67(Manufacturers dilution) | 1:134 | 1:268 | 1:536 | 1:67(Manufacturers dilution) | 1:134 | 1:268 | 1:536 | 1:4(Manufacturers dilution) | 1:8 | 1:16 | 1:32 |
| *E. coli* | 19 | 5 | R | R | 21 | 10 | 7 | R | 19 | 6 | R | R | 21 | 16 | 5 | R |
| *K. pneumonia* | 19 | 12 | R | R | 20 | R | R | R | 18 | R | R | R | 19 | 11 | R | R |
| *S. aureus* | 18 | 5 | R | R | 15 | R | R | R | 23 | 9 | R | R | 20 | 12 | R | R |
| *Proteus spp* | 18 | 0 | R | R | 8 | R | R | R | 25 | R | R | R | 22 | 10 | R | R |

**Table 1: Antibacterial activity of some disinfectants against isolates using the Disc Diffusion method**

Table 2 presents the result obtained for antibacterial activity of some disinfectants against isolates using the disc diffusion method. The result shows that organism used shows resistance to Purit disinfectant at ratio 1:368 and 1:736. Furthermore to the result on table 2, Premier disinfectant at ratio 1:134 has no effect on S. aureus while other organisms were affected. While at ratio 1:268, the organisms shows resistivity against Premier except for Proteus spp. Last result for Premier disinfectant shows that all the organisms were resistant to Premier disinfectant at ratio 1:536. Tetmosol disinfectant against the organism shows that only Proteus sp was resistant at ratio 1:86, while at ratio 1:172, other organisms were resistant but S. aureus was not. However at ratio 1:324 all the organisms were resistant against Tetmosol disinfectant. The last result obtained for the antibacterial activity of disinfectants used making use of disc diffusion methods shows that at all the ratio used (1:324,1:200,1:400,1:800 and 1:1600) all the organisms were resistant.

**Table 2: Antibacterial activity of some disinfectants against isolates using the Disc Diffusion method**

| Organism | Purit (mm) | | | | Premier (mm) | | | | Tetmosol (mm) | | | | Izal (mm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1:92(Manufacturers dilution) | 1:184 | 1:368 | 1:736 | 1:67(Manufacturers dilution) | 1:134 | 1:268 | 1:536 | 1:43(Manufacturers dilution) | 1:86 | 1:172 | 1:324 | 1:200(Manufacturers dilution) | 1:400 | 1:800 | 1:1600 |
| *E. coli* | 20 | 15 | R | R | 20 | 12 | R | R | 12 | 5 | R | R | R | R | R | R |
| *K. pneumonia* | 22 | 17 | R | R | 21 | 15 | R | R | 14 | 8 | R | R | R | R | R | R |
| *S. aureus* | 20 | 12 | R | R | 11 | R | R | R | 15 | 10 | 5 | R | R | R | R | R |
| *Proteus spp* | 18 | 0.5 | R | R | 21 | 11 | 1 | R | 8 | R | R | R | R | R | R | R |

Antibacterial activity of some disinfectants against isolates using the direct inoculation method is presented on Table 3. The result shows that Dettol at ratio 1:160 has Proteus sp resistance towards it. At ratio 1:320, 1:640 and 1:1280, all the organism were resistance against Dettol disinfectant. Septol disinfectant results against the isolates in Table 3 shows that at all the ratio used (1:67, 1:134, 1:268 and 1:536), all the organisms were resistance against Septol. For Hypo disinfectant antibacterial activity against the isolates used, the results shows that K. pneumonia and Proteus sp were the only two organism resistance against these disinfectants at ratio 1:134 while at ratio 1:268 and 1:536, all the organisms recorded resistivity against hypo disinfectant. The last results obtained on Table 3 for Salvon disinfectants against the isolates shows that all the organism were resistance against Salvon at ratio 1:16 and 1:32. However, no resistance was observed for these organism against Salvon disinfectant at ratio 1:4 and 1:8.

**Table 3: Antibacterial activity of some disinfectants against isolates using the direct inoculation method**

| Organism | Dettol (mm) | | | | Septol (mm) | | | | Hypo (mm) | | | | Salvon (mm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1:160(Manufacturers dilution) | 1:320 | 1:640 | 1:1280 | 1:67(Manufacturers dilution) | 1:134 | 1:268 | 1:536 | 1:67(Manufacturers dilution) | 1:134 | 1:268 | 1:536 | 1:4(Manufacturers dilution) | 1:8 | 1:16 | 1:32 |
| *E. coli* | 18 | R | R | R | 11 | R | R | R | 16 | 6 | R | R | 17 | 8 | R | R |
| *K. pneumonia* | 12 | R | R | R | 10 | R | R | R | 14 | R | R | R | 15 | 6 | R | R |
| *S. aureus* | 27 | R | R | R | 21 | R | R | R | 20 | 9 | R | R | 13 | 7 | R | R |
| *Proteus spp* | R | R | R | R | 8 | R | R | R | 17 | R | R | R | 21 | 0 | R | R |

Antibacterial activity of some disinfectants against isolates using the direct inoculation method results is presented in Table 4. The result shows that most of the isolates were resistance against Purit disinfectants at ratio 1:184 except for S. aureus which was not resistance. At ratio 1:368 and 1:736, all the organism shows resistivity against Purit disinfectant. Premier disinfectant against the antibacterial activity of these isolates shows that all the organisms at ratios (1:134, 1:268 and 1:536) were all resistance against Premier disinfectant. The result however shows no resistance from all the organism against Premier disinfectant at ratio 1:67. Furthermore to the result obtained on Table 4, the result shows no resistance of all the organism at ratio 1:43. However, all the organisms

were shown to be resistance against Tetmosol at ratio 1:86, 1:172 and 1:324. The last result for Antibacterial activity of some disinfectants against isolates using the direct inoculation method shows that all the organisms were all resistance to Izal disinfectant at all the ratio used.

**Table 4: Antibacterial activity of some disinfectants against isolates using the direct inoculation method**

| Organism | Purit (mm) | | | | Premier (mm) | | | | Tetmosol (mm) | | | | Izal (mm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1:92(Manufacturers dilution) | 1:184 | 1:368 | 1:736 | 1:67(Manufacturers dilution) | 1:134 | 1:268 | 1:536 | 1:43(Manufacturers dilution) | 1:86 | 1:172 | 1:324 | 1:200(Manufacturers dilution) | 1:400 | 1:800 | 1:1600 |
| *E. coli* | 20 | R | R | R | 12 | R | R | R | 11 | R | R | R | R | R | R | R |
| *K. pneumonia* | 14 | R | R | R | 13 | R | R | R | 9 | R | R | R | R | R | R | R |
| *S. aureus* | 29 | 1 | R | R | 16 | R | R | R | 0 | R | R | R | R | R | R | R |
| | | 2 | | | | | | | | | | | | | | |
| *Proteus spp* | 20 | R | R | R | 14 | R | R | R | 3 | R | R | R | R | R | R | R |

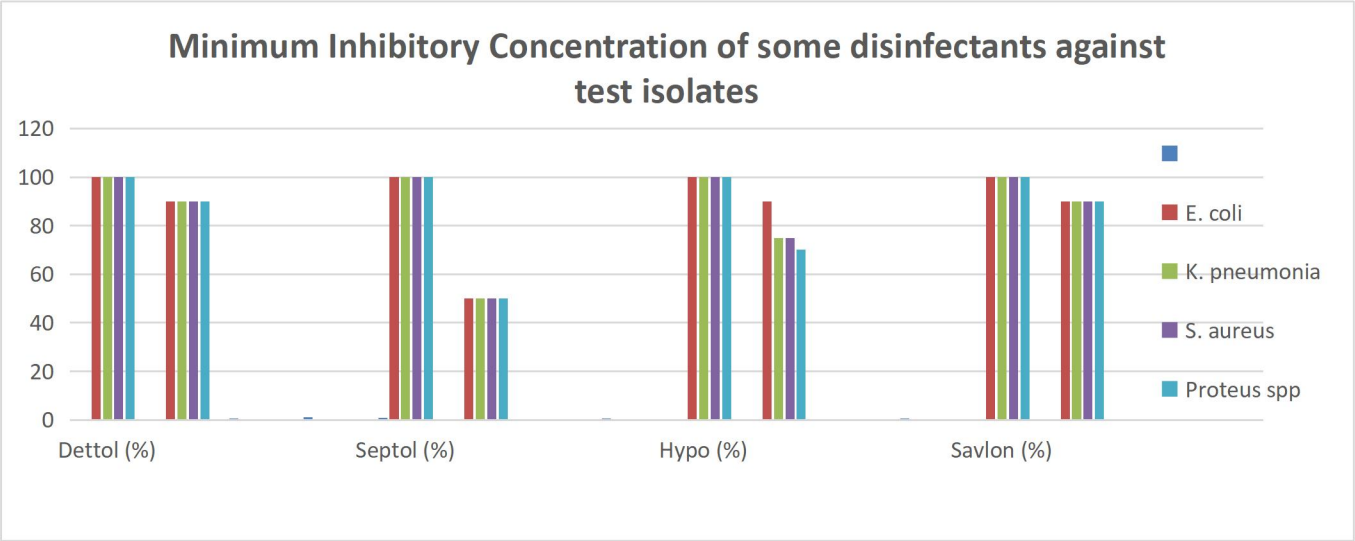


**Figure 1: Minimum Inhibitory Concentration of some disinfectants against test isolates**

Figure 1 shows the result obtained for minimum inhibitory concentration of some disinfectants against test isolates. The result shows that at 1:640 and 1:1280, the organisms were not inhibited but showed resistance against Dettol. In the case of Septol inhibitory, the organisms in Figure 1 shows resistance at 1:268 and 1:536 while for hypo, resistance of the organism against this disinfectant was observed at 1:268 and 1:536. For Savlon disinfectant the result shows that resistance was recorded against this disinfectant at 1:16. However, Savlon was effective against S.aureus at this ratio of application. Minimum inhibitory concentration of some disinfectants against these isolates in the results (Fig 1) also shows that all the organism were resistance at 1:32.

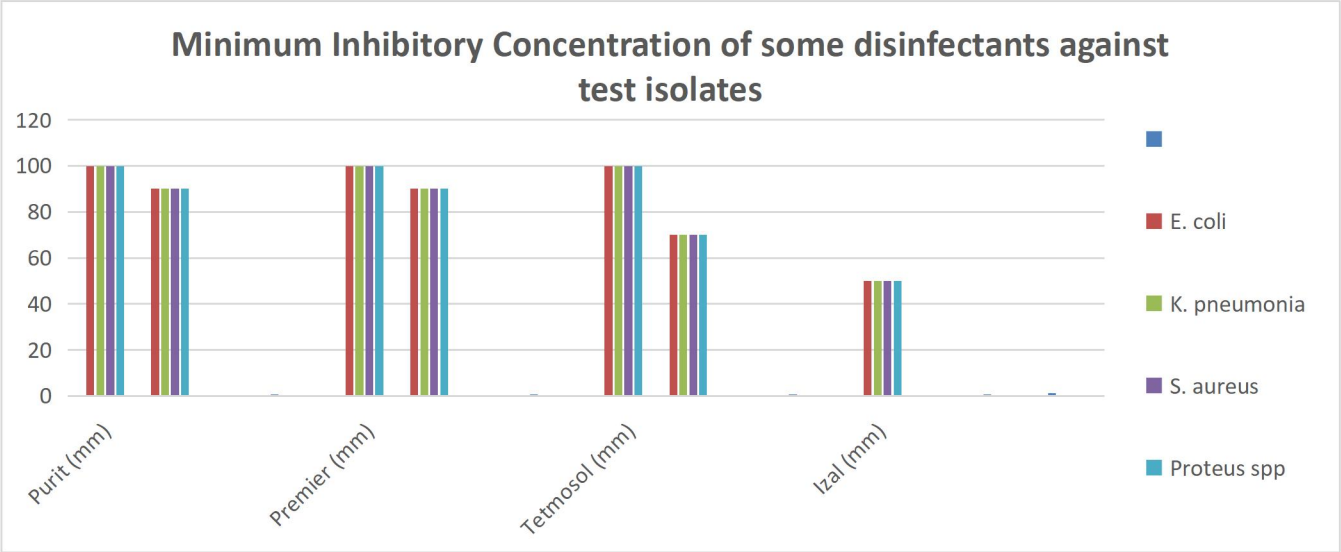


**Figure 2: Minimum Inhibitory Concentration of some disinfectants against test isolates**

Minimum Inhibitory Concentration of some disinfectants against test isolates is shown in Fig 2. The result shows that Purit disinfectant at 1:368 and 1:736 were not effective against the tested isolates as they were all resistance towards it. For Premier disinfectant, the result (Fig. 2) shows that the tested isolates were resistance against this disinfectant at 1:268 and 1:536. Tetmosol disinfectant result on figure 4.2 shows resistance of the organisms at 1:172 and 1:324. The last result on Figure 2 for Izal disinfectants shows that at 1:400, 1:1800 and 1:160, all the organism were resistance towards this disinfectant except at 1:120 was this disinfectant effective against the these organisms**.**

## 4.0 DISCUSSION

Microorganisms can be transmitted from one place to another through person-to-person transmission or through contact with contaminated objects [6]. Disinfectants have been used in the control of infectious diseases, microbial food spoilage, and unwanted microbes [7]. Microorganisms can also develop resistance to biocidal agents when there is constant selective pressure, and simultaneously it may increase the development rate of antibiotic resistance, hence improving their tolerance to antibiotics.

The results obtained from this present study show that most of the organisms (*S.aureus, K. pneumona, E.coli, and Proteus* spp) were resistant to the disinfectants of Dettol, Septol Hypo, and Salvon making use of disc diffusion methods. These present findings result in tandems to the result of [8] who also observed some differences in some organisms used in their study against selected disinfectants. The result obtained from these present findings also aligned with the study of [9] which in their findings reported that microorganisms isolated from their study show different sensitivity levels to disinfectants just like this present study. What however separates this present study from that of [9] is that disinfectants used in their study were not mentioned to be able to compare with this present study. [6] mentioned that disinfectants of different brands and with the same active ingredient have different antimicrobial activity. In this study, disinfectants such as premier and tetmosol were effective against some of these organisms at the right ratio. This is in

agreement with the study of [10] where it was detected that disinfectants such as Dettol and Savlon were against some pathogenic organisms [11]. This present study how differs from that of [12] based on the fact that only *Pseudomonas* was the most resistant in their organism, whereas, for this present study, all the organism shows a very high level of resistivity to the disinfectants. This present study does not also conform to the study of [12] where it was shown that only Dettol and Salvon were the only major disinfectants that were efficient against the organism used in their study whereas for this study, Purit shows more sensitivity on the organisms compared to others.

This present study also detects antibacterial activity of some disinfectants against isolates using the direct inoculation method making use of disinfectants of Purit, Premier, Tetmosol, and Izal. Making use of the direct inoculation method for the antibacterial activity of some disinfectants was also done by [13] in their study on the direct inoculation method for identification and antimicrobial susceptibility testing. This present finding and that of [13] does not however tally with each other because [13] never specified any form of disinfectant used in their study. The organisms (*E. coli, Pseudomonas, and Klebsiella pneumoniae*) used in [13] study however aligned with this present study. The disc diffusion method identifying antibacterial results also shows that 1:160 Dettol dilution had a 19mm zone of inhibition on *Escherichia coli* and *Klebsiella pneumoniae*, 18mm zone of inhibition on *Staphylococcus aureus and Proteus* spp. 1:320. Dettol dilution had a 5mm zone of inhibition on *Escherichia coli*, 12mm zone of inhibition for *Klebsiella pneumoniae*, a 5mm zone of inhibition for *Staphylococcus aureus,* and 0mm zone of inhibition for *Proteus* spp. 1:640 and 1:1280 Dettol dilution both showed resistance for the isolates. This result indicates Dettol effectiveness against *Escherichia coli Klebsiella pneumoniae* and *Staphylococcus aureus* which agrees with the study of [11] and [14]. In this study, the determination of the efficacy of the selected commercial disinfectants against some isolates showed that different types of microorganisms vary in their response to different types of disinfectants. This agreed with the work of [15] which stated that pathogens depend on the inherent characteristics and cell composition such as cell envelope, non-susceptible proteins, or the ability to develop resistance either by adaption or by exchange of resistant gene response differently to different disinfectants. [16] study outcome conforms with these present findings where five commercial disinfectants were used against some clinical isolates. These present finding and that of [16] however differs in some of the disinfectants used as this present study never made use of ivy and Robert's disinfectants. Izal and Dettol used in these present findings are not efficient against the tested isolates used in this study thus, does not provide scientific evidence to support the use of disinfectants as part of a program to control infectious disease through surface decontamination, their use in healthcare facilities as recommended by the Centres for Disease Control and Prevention [17].

A varying minimal zone of inhibition compared to the disc diffusion method was observed on direct inoculation of isolates on disinfectants. This could be a result of this procedure not being a standard procedure. The disc diffusion test is a standard that has been used for years. This is because it offers many advantages over other methods: simplicity, low cost, and the ability to test varieties of microorganisms (CLSI, 2016). Also, in the result, absolute Izal and serial dilutions yielded resistance respectively for *Escherichia coli, Klebsiella pneumoniae Staphylococcus aureus,* and *Proteus spp*. as was observed in the disc diffusion method. This confirms the inefficacy of Izal disinfectant against *Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus,* and Proteus spp. Results

obtained from the determination of the minimum inhibitory concentration (MIC) of the selected disinfectants against the isolates showed that Dettol, Salvon, Purit, and Premier disinfectant all had high percentages of minimum Inhibitory concentration against the isolates. This indicates their high efficacy against *Escherichia coli, Klebsiella pneumoniae Staphylococcus aureus,* and *Proteus spp* which agrees with the study of [12] while Izal disinfectant had a low percentage of minimum Inhibitory concentration against the isolates. This indicates Izal disinfectant is not effective against the bacterial isolates as also observed in the disc diffusion method. This result is in agreement with the study of [16]. In the realm of infection prevention and control, the effectiveness of disinfectants is paramount. However, determining the true efficacy of these chemical warriors involves a systematic and rigorous process.

## CONCLUSION

This study has indicated the effectiveness of some selected chemical disinfectants through evaluating there antibacterial activities on bacterial isolates. Based on the findings obtained from this study, It is recommended that the use of reliable and effective chemical disinfectants should be encouraged as a preventive measure against infectious diseases. Manufacturers should make efforts to improve the quality and effectiveness of their chemical disinfectants and adherence to use of adequate concentration of these chemical disinfectants should be emphasized as dilution of these disinfectants before use is becoming a norm. Further studies should be carried out on other chemical disinfectants sold around the study area not covered in this study.

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