Comparative Analysis of Antimicrobial Efficacy of Different Commercial Cleaning Agents Against Common Environmental Microorganisms: An Action Research Study

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Abstract-
Background: Commercial cleaning agents play a crucial role in maintaining hygiene and preventing microbial contamination in educational institutions. Understanding their effectiveness against various microorganisms is essential for informed selection and usage.
Objective: To evaluate and compare the antimicrobial efficacy of five renowned commercial cleaning agent brands (Dettol, Lizol, Harpic, Domex, and Savlon) against common environmental bacteria and fungi isolated from school premises.
Methods: This experimental study employed disk diffusion method and colony counting techniques to assess antimicrobial activity. Environmental samples were collected from various locations within the school premises, and microbial isolates were tested against different concentrations of cleaning agents. Zone of inhibition measurements and percentage reduction in microbial load were analyzed.
Results: Dettol demonstrated the highest antimicrobial efficacy with average zone of inhibition of 18.5mm, followed by Savlon (16.2mm) and Lizol (14.8mm). All tested agents showed significant reduction in microbial load, with Dettol achieving 99.2% reduction at recommended concentrations.
Conclusion: The study provides evidence-based recommendations for cleaning agent selection in educational settings, emphasizing the importance of proper concentration and application methods for optimal antimicrobial effectiveness.

Indexed Terms- Antimicrobial efficacy, commercial disinfectants, environmental microbiology, disk diffusion method, bacterial inhibition, fungal control

I. INTRODUCTION

Microbial contamination in educational environments poses significant health risks to students and staff, particularly in the post-pandemic era where hygiene practices have gained paramount importance. Schools serve as breeding grounds for various pathogenic microorganisms due to high occupancy rates, frequent surface contact, and diverse activities conducted within the premises.

Commercial cleaning agents have evolved from simple soap-based formulations to complex antimicrobial solutions containing active ingredients such as quaternary ammonium compounds, alcohols, phenolic compounds, and chlorine-based disinfectants. The selection of appropriate cleaning agents requires understanding their antimicrobial spectrum, efficacy, and practical application parameters.

Previous research has demonstrated varying degrees of antimicrobial activity among different commercial brands, influenced by factors including active ingredient concentration, pH levels, contact time, and target microorganism susceptibility. However, limited studies have been conducted in Indian educational settings using locally available products.
This action research aims to bridge the knowledge gap by systematically evaluating the antimicrobial efficacy of commonly used cleaning agent brands in

an Indian school environment. The findings will contribute to evidence-based decision-making for hygiene maintenance protocols and provide practical insights for educational institutions seeking optimal antimicrobial solutions.

The research questions addressed include: Which commercial cleaning agents demonstrate superior antimicrobial efficacy? How do different concentrations affect antimicrobial activity? What are the practical implications for school hygiene protocols?

II. METHODOLOGY

2.1 Study Design and Setting

This experimental study was conducted over a period of 8 weeks at Shambhu Dayal Global School laboratory facilities. The research employed both qualitative and quantitative approaches to assess antimicrobial efficacy through standardized microbiological techniques.

2.2 Materials and Reagents

Cleaning Agents Tested:

- Dettol Antiseptic Liquid (Chloroxylenol 4.8%)
- Lizol Floor Cleaner (Benzalkonium Chloride 1.25%)
- Harpic Bathroom Cleaner (Hydrochloric Acid 9.5%)
- Domex Multi-Purpose Cleaner (Sodium Hypochlorite 3.5%)
- Savlon Antiseptic Liquid (Cetrimide 0.5% + Chlorhexidine Gluconate 0.1%)

Laboratory Materials:

- Nutrient Agar medium
- Potato Dextrose Agar medium
- Sterile petri dishes
- Filter paper disks (6mm diameter)
- Sterile swabs and sampling containers
- Autoclave and incubator facilities
- Measuring cylinders and pipettes

2.3 Sample Collection

Environmental samples were collected from five different locations within the school premises using sterile techniques:

- Classroom door handles and desks
- Restroom surfaces and fixtures
- Cafeteria tables and serving areas
- Library reading tables and book shelves
- Laboratory benches and equipment

Samples were collected using sterile cotton swabs moistened with sterile saline solution and immediately transported to the laboratory for processing.

2.4 Microbial Isolation and Identification

Environmental samples were streaked onto Nutrient Agar plates for bacterial isolation and Potato Dextrose Agar plates for fungal isolation. Plates were incubated at 37°C for bacteria and 25°C for fungi for 24-48 hours. Isolated colonies were purified and identified using standard morphological and biochemical tests.

2.5 Antimicrobial Efficacy Testing

Disk Diffusion Method:

- Pure cultures of isolated microorganisms were prepared
- Bacterial and fungal suspensions were adjusted to 0.5 McFarland standard
- Sterile filter paper disks were impregnated with different concentrations of cleaning agents (1:10, 1:20, 1:50 dilutions)
- Disks were placed on inoculated agar plates with appropriate controls
- Plates were incubated under optimal conditions
- Zone of inhibition diameters were measured after 24 hours

Colony Counting Method:

- Standardized microbial suspensions were exposed to cleaning agents for specific contact times (30 seconds, 1 minute, 5 minutes)
- Treated suspensions were plated on appropriate media
- Colony counts were performed after incubation
- Percentage reduction in viable counts was calculated

2.6 Data Analysis

Statistical analysis was performed using descriptive statistics for zone measurements and percentage

calculations for microbial reduction. Results were compared using appropriate statistical tests, and significance was determined at $p<0.05$ level.

2.7 Quality Control and Safety Measures
All experiments were conducted under sterile conditions with appropriate biosafety measures. Positive and negative controls were included in all tests. Equipment calibration and media sterility testing were performed regularly.

III. RESULTS AND DISCUSSION

3.1 Microbial Isolation Results
A total of 25 bacterial isolates and 15 fungal isolates were obtained from environmental samples. The most commonly isolated bacteria included Staphylococcus species, Bacillus species, and Escherichia coli. Fungal isolates primarily consisted of Aspergillus species, Penicillium species, and Rhizopus species.

3.2 Antimicrobial Efficacy Results
Zone of Inhibition Analysis:

Cleaning Agent	Average Zone of Inhibition (mm)	Standard Deviation
Dettol	18.5	±2.3
Savlon	16.2	±1.8
Lizol	14.8	±2.1
Domex	13.2	±1.9
Harpic	11.7	±2.4

Microbial Reduction Percentages:
At recommended dilutions and 1-minute contact time:

- Dettol: 99.2% reduction
- Savlon: 97.8% reduction
- Lizol: 95.4% reduction
- Domex: 92.1% reduction
- Harpic: 88.7% reduction

3.3 Discussion of Findings
Superior Performance of Dettol: Dettol demonstrated the highest antimicrobial efficacy, likely attributed to chloroxylenol's broad-spectrum activity and optimal concentration. The phenolic compound effectively disrupts microbial cell membranes and denatures proteins, resulting in comprehensive antimicrobial action.

Effectiveness of Savlon: Savlon's dual-active ingredient formulation (cetrimide and chlorhexidine) provided synergistic antimicrobial effects. The combination targets different cellular components, enhancing overall efficacy against both gram-positive and gram-negative bacteria.

Concentration-Dependent Activity: All tested agents showed concentration-dependent antimicrobial activity. Higher concentrations generally produced larger zones of inhibition and greater microbial reduction, emphasizing the importance of proper dilution protocols.

Contact Time Significance: Extended contact times (5 minutes vs. 30 seconds) resulted in improved antimicrobial efficacy across all products, highlighting the critical role of adequate exposure duration in cleaning protocols.

Spectrum of Activity: Gram-positive bacteria showed higher susceptibility to tested agents compared to gram-negative bacteria, consistent with cell wall structure differences. Fungal isolates demonstrated variable susceptibility, with some species showing remarkable resistance.

3.4 Practical Implications
The research findings suggest that Dettol and Savlon represent optimal choices for general-purpose antimicrobial cleaning in school environments. However, cost-effectiveness analysis indicates that Lizol provides acceptable efficacy at lower cost, making it suitable for routine floor cleaning applications.

Specialized applications require targeted agent selection: Domex proves effective for restroom cleaning due to its bleaching properties, while Harpic's acidic formulation makes it suitable for mineral deposit removal in addition to antimicrobial action.

3.5 Limitations
This study was conducted under controlled laboratory conditions, which may not fully replicate real-world

cleaning scenarios. Environmental factors such as organic load, pH variations, and surface materials can influence antimicrobial efficacy. Additionally, the study focused on culturable microorganisms and did not assess activity against viral pathogens or spore-forming bacteria.

CONCLUSION

This action research successfully evaluated the antimicrobial efficacy of five commercial cleaning agents against environmental microorganisms commonly found in school settings. The study provides evidence-based recommendations for cleaning agent selection and application protocols.
Key findings include the superior performance of Dettol and Savlon in antimicrobial activity, the critical importance of proper concentration and contact time, and the need for targeted agent selection based on specific cleaning requirements.

The research contributes valuable data for developing evidence-based hygiene protocols in educational institutions and demonstrates the practical application of microbiological principles in real-world settings. Future research should investigate long-term antimicrobial effectiveness, environmental impact, and cost-benefit analysis of different cleaning strategies.

These findings support the implementation of scientifically-informed cleaning protocols that balance antimicrobial efficacy, safety considerations, and economic feasibility in educational environments.

RECOMMENDATIONS

1. Primary Recommendation: Implement Dettol or Savlon for high-touch surface disinfection in classrooms and common areas.
2. Secondary Applications: Utilize Lizol for routine floor cleaning with appropriate contact time protocols.
3. Specialized Use: Reserve Domex and Harpic for specific applications in restroom facilities.
4. Protocol Development: Establish standardized dilution ratios and minimum contact times based on research findings.
5. Training Implementation: Conduct staff training on proper cleaning agent application and safety measures.
6. Monitoring System: Develop regular efficacy monitoring protocols to ensure continued antimicrobial effectiveness.

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