ORIGINAL ARTICLE

AFRICAN JOURNAL OF CLINICAL AND EXPERIMENTAL MICROBIOLOGY MAY 2015 ISBN 1595-689X VOL16 No.2
AJCEM/1513 http://www.ajol.info/journals/ajcem
 http://dx.doi.org/10.4314/ajcem.v16i2.5
AFR. J. CLN. EXPER. MICROBIOL. 16(1): 73-78

EFFICACY OF HOUSEHOLD CLEANING AGENTS AGAINST SOME SELECTED PATHOGENIC BACTERIA

***Igbinosa, E. O., Ibhazukor, M. A., Eribo, O. A. & Ogofure, A. G.**

Department of Microbiology, Faculty of Life Sciences, University of Benin, Private Mail Bag 1154 Benin City, Nigeria

***Correspondence: email: eigbinosa@gmail.com**

ABSTRACT
The emergence and spread of microorganisms with reduced susceptibility to antimicrobial agents is a major public health problem. This study evaluated the antibacterial effect of household cleaning agents on selected bacterial isolates. Standard culture-based procedure was used to determine the efficacy of disinfectants on selected bacteria isolates. The activity assessed was against *Staphylococcus aureus, Klebsiella pneumonia, Streptococcus pyogenes, Escherichia coli* and *Pseudomonas aeruginosa.* Ariel was found to have more bactericidal effect on *Streptococcus pyogenes* being sensitive and *Staphylococcus aureus*. Dettol exhibited antibacterial effect against all tested isolates with zones of inhibition for *Streptococcus pyogenes* (24±0.12mm) and *Staphylococcus aureus* (9±0.01mm). Harpic revealed antibacterial activity against *Pseudomonas aeruginosa* and other tested isolates with average zones of inhibition of 20±0.20mm. Jik was active against *Klebsiella pneumonia* and *Escherichia coli* while Omo showed good inhibitory effect against all tested isolates except *Pseudomonas aeruginosa.* Based on the present study, the levels of decreased susceptibility to household cleaning agents seem to be increasing, regardless of whether these products used in the home or not. The eventual clinical implications of this decreased susceptibility need continue surveillance.

Key words: Antibacteria, Commensal flora, Disease, Disinfectant, Hygiene, Public health

L'EFFICACITE DES PRODUITS D'ENTRETIEN MENAGER CONTRE CERTAINES BACTERIES PATHOGENES SELECTIONEES

.

***Igbinosa, E.O., Ibhazukor, M.A., Eribo, O.A., et Ogofure,A.G.**

Département de microbiologie, faculté de sciences de la vie, Université du Bénin, Private Mail Bag 1154 Bénin, Nigeria.
***Correspondence : Email: eigbinosa@gmail.com**

RESUME
L'émergence et la propagation des micro-organismes d'une sensibilité réduite aux agents antimicrobiens est un problème majeur a la santé publique. Cette recherche a évalué l'effet antibactérien des agents d'entretien ménager sur isolats bactériens sélectionnés. Procédure fondée de culture Standard a été employé pour déterminer l'efficacité des désinfectants sur des isolats bactériens sélectionnés. L'activité évaluée était contre *Staphylococcus aureus, Klebsiella pneumonia, Streptococcus pyogenes, Escherichia coli et Pseudomonas aeruginosa*. L'Ariel a été trouvé d'avoir plus effet bactéricide sur *Streptococcus pyogenes* étant sensible et *Staphylococcus aureus.* Le dettol a exposé l'effet antibactérien contre tous les isolats testés avec des zones d'inhibition pour *Streptococcus pyogenes* (24±0,12mm) et *Staphylococcus aureus*(9±0,01mm). Harpic a révélé l'activité antibactérienne contre *Pseudomonas aeruginosa* et les autres isolats testés avec des zones moyennes d'inhibition de 20±0,20mm. Jik a été actif contre *Klebsiella pneumonia* et *Escherichia coli* tandis que l'Omo a montré un bon effet inhibiteur contre tous les isolats testés sauf *Pseudomonas aeruginosa*. Fondée sur la recherche de ce moment, les niveaux de la diminution de la sensibilité aux agents d'entretien ménager paraissent être de plus en plus indépendamment du fait que ces produits sont utilisés à la maison. Finalement, les implications cliniques finales de cette diminution de la sensibilité ont besoin d'une surveillance continuelle.

Mots - clés: Antibactérien, Flore commensal, Maladie, Désinfectants Hygiène, Santé publique.

INTRODUCTION

Antibacterial products have been effectively used to prevent transmission of disease causing micro- organisms among patients, particularly in hospitals environment. They are now being added to products used in homes, schools (especially in day care centres), and veterinary settlings (1). The number of chemicals in antibacterial products are enormous, probably at least 10,000 with 1,000 commonly used in the hospitals and homes. Of the chemicals used to reduce or wipe out microbes important groups include halogens, phenols, ammonia compounds, alcohols,

heavy metals, acids and certain special compounds (2).

Hygiene has a measurable impact on reducing the burden of infections in the developing world, as well as in specialized populations. Homes, hospitals and other health care settings extensively use antiseptics and disinfectants on a variety of tropical and hard-surface applications to control the growth of microbes on both living tissues and inanimate objects (3). Over the years, antiseptics and disinfectants have generally played important roles in the control of infectious diseases, microbial food spoilage and unwanted microbes rather than the use of antimicrobial drugs (4). However, the antimicrobial activity of these agents may be influenced by their formation effects, level of organic load, synergy, temperature and dilution test method (5). Different pathogens vary in their response to different antiseptics or disinfectants (6) and they are continuously acquiring resistance to new antiseptics and disinfectants, as a result, no single antiseptic or disinfectant will be appropriate for all pathogen (7).

Jik, contains 3.5% sodium hypochlorite, it is used on a large scale for surface cleaning, bleaching, odour removal and water disinfection. Salvon is another disinfectant that is composed of 2.8% n-propyl alcohol, 0.3g chlorohexidine gluconate and 3.0g centrimole. Dettol is an antiseptic 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 (8, 9). Omo and Ariel are detergents which are surfactants or a mixture of surfactants with cleaning properties in dilute solutions. They are used for laundry, fuel additives and dish washing. Detergents have been added into different disinfecting solutions to lower their surface tension and to enhance their antibacterial effects (10, 11).

Many household cleaners have been found to be effective against bacteria when used properly, but many times they are not properly used. These can cause mutation in the genetic make-up of the organisms making them to be resistant to that environment because of their high reproduction rate and transfer of resistant genes. Concern is growing over the use of household cleaning and hygiene products labelled as antibacterial as a result of laboratory data showing a link between exposure to ingredients in these products, particularly household agents, and emergence of antimicrobial drug resistance (1, 12, 13). This study aimed to determine the efficacy of some household cleaning agents against clinically relevant bacterial species.

MATERIALS AND METHODS

Collection of samples

Household cleaning agents were purchased from the market and local stores. The products were stored in the dark at room temperature and prepared at their recommended use dilution in sterile distilled water on the day of the evaluation. All products were tested within the specified shelf-life. The household cleaning agents used in this study include the following dettol, salvon, jik, harpic, omo and ariel.

Bacterial strains and culture conditions

Bacterial species were selected because they are specifically found in the home and hospital environments (*Staphylococcus aureus*, *Klebsiella pneumonia, Streptococcus pyogenes, Escherichia coli,* and *Pseudomonas aeruginosa*). Prior to experimental use, cultures were initiated from single colonies and grown in trypticase soy broth for 48 h at 37^{o}C. Log-phase cultures, used as seed in disinfection studies, were obtained by inoculating 49mL of trypticase soy broth with 1.0mL of a 48 h culture, then incubating for 5 h at 37^{o}C.

Antibiotic susceptibility testing

All bacterial isolates were tested against a panel of antibiotics. Antibiotic susceptibility testing was done in accordance with the description of Bauer *et al*. (14) as recommended by the Clinical and Laboratory Standards Institute (15) using antibiotics discs Amoxicillin (30µg), Augmentin (30µg), Gentamycin (10µg), Pefloxacin (30µg), Tarivid (10µg), Streptomycin (30µg), Septrin (30µg), Chloram- phenicol (30µg), Sparfloxacin (30µg), Ciprofloxacin (10µg), Rifampin (30µg), Erythromycin (30µg), Ampiclox (30µg), Zinnacef (10µg). Determination of the resistance or susceptibility profile of the isolates was performed by measuring zones of inhibition and comparing with the interpretative chart to determine the sensitivity of the isolates to the antibiotics.

Determination of antibacterial activity on household cleaning agents

The antibacterial activity was determined by using a modified National Committee for Clinical Laboratory Standards (NCCLS) agar well dilution method (16). The bacterial isolates were first grown in a nutrient broth for 18 h before use and standardized to 0.5 McFarland standards (1.5×10^{8}cfu/mL). Two hundred microliter of the standardized cell suspensions were spread on a Mueller-Hinton

agar (Oxoid). Wells were then bored into the agar using a sterile 6 mm diameter cork borer. Approximately 50µL of the respective household cleaning agents at 5.0mg/mL were inoculated into the wells, allowed to stand at room temperature for about 2 h and then incubated at 37°C. The plates were observed for zones of inhibition after 24 h.

Determination of Minimum Inhibitory Concentrations (MICs)

MICs were assessed by using a modified NCCLS agar dilution method (16). Plates containing Mueller Hinton agar (Oxoid) were prepared by using twofold increasing concentrations of respective household cleaning agents (0.156-5.0mg/mL). Approximately 10^8 CFU of each logarithmically grown isolate was applied, and the inoculated plates were incubated aerobically for 24 h at 35°C. The lowest dilution that showed no visible growth indicated the MIC.

RESULTS

Omo and harpic exhibited zones of inhibition for *Staphylococcus aureus* of 23.7 ± 0.01 mm and 33.7±0.05 mm respectively (Figure 1). Zone of inhibition for both omo and harpic was 32±0.01 mm (*Escherichia coli*) and 21.3±0.04 mm (*Klebsiella pneumonia*) respectively (Figure 1). Ariel had zone of inhibition for *Staphylococcus aureus* (27±0.02 mm) and for *Streptococcus pyogenes* (42 ±0.01 mm) (Figure 1).

Minimum inhibitory concentrations (MIC) of the selected household cleaning agents were prepared at various concentrations 5.0, 2.5, 1.25, 0.625, 0.312 and 0.156 mg/mL. Results for salvon antiseptics revealed MIC of 0.312 mg/mL for *Streptococcus pyogenes, Klebsiella pneumonia* and *Pseudomonas aeruginosa.* Jik antiseptics, revealed an MIC result of 0.312 mg/mL in *Klebsiella pneumonia.* Detol antiseptic gave an MIC of 0.625 mg/mL and 0.312 mg/mL in the case of *Staphylococcus aureus* and *Klebsiella pneumonia* respectively. Ariel and omo revealed MICs of 0.312 mg/mL for *Staphylococcus aureus.*

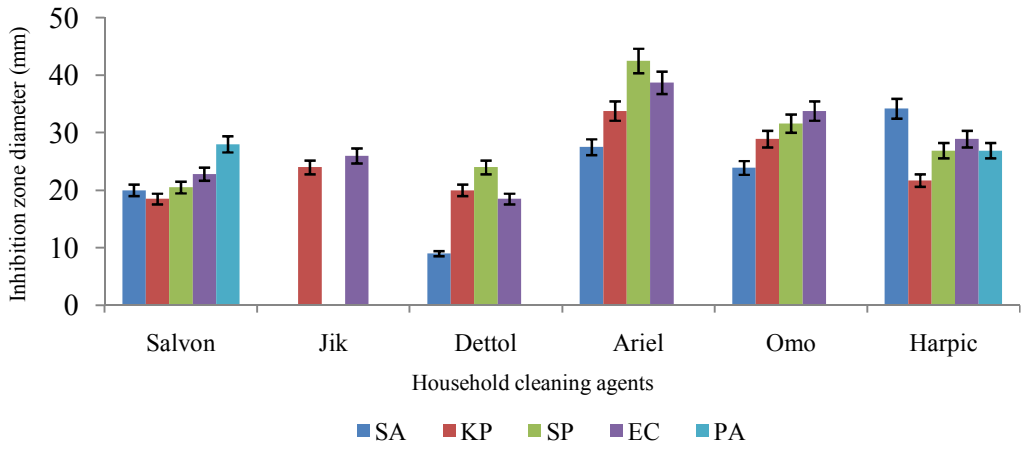

FIGURE 1: THE ANTIBACTERIAL ACTIVITY OF HOUSEHOLD CLEAING AGENTS ON SELECTED BACTERIA

Legend: SA-*Staphylococcus aureus*; KP- *Klebsiella pneumonia*; SP-*Streptococcus pyogenes*; EC-*Escherichia coli*; PA-*Pseudomonas aeruginosa*

TABLE 2: ANTIBIOTIC SUSCEPTIBILITY PROFILE OF BACTERIAL ISOLATES

Gram negative	AM	AU	CN	PEF	OFX	STR	SXT	CH	SP	CPX
K. pneumoniae	R	R	I	R	I	I	R	I	R	S
E. coli	R	R	S	S	I	R	R	R	R	I
P. aeruginosa	I	I	S	S	S	R	R	I	R	S
Gram positive	**AM**	**R**	**CPX**	**S**	**SXT**	**E**	**PEF**	**CN**	**APX**	**Z**
S. aureus	R	I	S	R	R	R	I	I	R	1
S. pyogenes	R	R	S	S	R	R	S	S	I	1

Legend: AM-Amoxacillin (30µg); AU-Augmentin (30µg); CN-Gentamycin (10µg); PEF-Pefloxacin (30µg); OFX-Tarivid (10µg); STR-Streptomycin (30µg); SXT-Septrin (30µg); CH-Chloramphenicol (30µg); SP-Sparfloxacin (30µg); CPX-Ciprofloxacin (10µg); R-Rifampin (30µg); E-Erythromycin (30µg); APX-Ampiclox (30µg); Z-Zinnacef (10µg)

DISCUSSION

Widespread contamination of environmental surfaces with commensal flora has been found in homes, hospital and child-care centres, especially in rooms housing diaper age children. These have been associated in person-to-person transmission of enteric pathogens (17). Results obtained for the antibacterial activities of the various household cleaning agents reveal several zones of inhibition obtained for each of the bacterial isolates employed in this study. The findings from the antibacterial activities is in accordance with the findings Ikegbunam *et al.* (10) where of all tested detergent, ariel was most effective against tested bacterial isolates. When bacteria are exposed to sub-lethal levels of biocides, only minor cell damage is caused.

The consequences of that may include changes in their phenotype and induction of gene expression, giving rise to a more resistant population. Resistance mechanisms are the means that living organisms have to respond to continuously changing environment in order to survive (18). Gram-negative bacteria are generally less susceptible to biocides than Gram-positive species. Such resistance is likely to be intrinsic, due to outer membrane that acts as a protective barrier. Due to

the capacity of surviving in unfavourable environmental conditions and to the high resistance to antibiotic agents, antiseptics and disinfectants, bacteria species continues to be an important pathogen in hospital acquired infections, mainly respiratory and urinary infections (19).

Scientific evidence supports the use of disinfectants as part of a program to control infectious disease by interrupting transmission through surface contamination. Their use in healthcare facilities is recommended by the Centres for Disease Control and Prevention (20), Occupational Safety and Health Administration and Professional Organizations such as the Association for Professionals in Infection Control and Epidemiology (8). Disinfectants are also used in child-care centres, extended-care facilities, restaurants, and the domestic home as part of an effort to control transmission of infectious diseases. The use of disinfectants on contaminated surfaces has been cited as a means to reduce or prevent the spread of gastrointestinal or respiratory pathogens.

The emergence of resistant microorganisms in hospitals and the community is causing problems for both the treatment of patients and infection control. Organisms of particular concern include methicillin-resistant *Staphylococcus aureus*, glycopeptide resistant enterococci and extended spectrum beta-lactamase producing *Klebsiella* (21). Environmental contamination has been demonstrated to play an important role in the transmission of certain nosocomial pathogens, including vancomycin resistant *Enterococcus* species, methicillin-resistant, *Staphylococcus aureus,* and especially the hospital associated *Clostridium difficile* (22). Careful studies using molecular analysis have suggested for these pathogens, environmental contamination has contributed to transmission between individuals.

Many human pathogenic viruses and bacteria may survive in a sufficient dose and for an appropriate duration to serve as a source of human exposure. In experimental trials, disinfection of environmental surfaces has been shown to decrease or eliminate potential pathogens and thereby decrease or eliminate acquisition of disease (23). Antibiotic sensitivity test demonstrated by using panel

standard antibiotics against bacterial isolates (Table 1). The alarming worldwide increase of bacterial resistance to antibiotics threatens their chemotherapeutic application leading to high mortality and morbidity in communities affected by epidemics or endemic infections. Since some of the resistant factors are also transferable to sensitive bacteria, frequent assessment of antimicrobial activity of commonly used antibiotic is desirable (24). Our results strongly suggest that the members of the bacterial isolates were significantly resistant and show multi-drug resistance with respect to antibiogram characteristics.

Our data demonstrate that currently available home disinfectants were moderately activity against potentially pathogenic bacteria likely to contaminate home environmental surfaces. Since the efficacy of commercial disinfectants for use in the home has been demonstrated, a controlled trial should be undertaken to determine if routine disinfection of home environmental surfaces will lead to decreased infection rates among household members.

REFERENCES

1) Levy SB. Antibacterial household products: cause for concern. *Emerging Infectious Diseases,* 2001; 7(Supplementary): 512-515.
2) Bhat, PR., Prajna, PS., Menezez, VP., Shetty P. Antimicrobial activities of soap and detergents. *Advances in Bioresearch,* 2011; 2: 52- 62.
3) Saha, AK., Haque, MF., Karmaker, S., Mohanta SK. Antibacterial effects of some antiseptics and disinfectants. *Journal of Life and Earth Science,* 2009; 3-4; 19-21.
4) Larson, EL., Morton HE. Alcohols in disinfection, sterilization and preservation, 4th edition. Block, S.S. (Ed.). Philadelphia. 1996: 191-203.
5) Russel, AD., Russel NJ. Biocides: activity, action and Resistance. *General Microbiology Journal,* 1995; 53: 327-365.
6) Russell AD. Activity of biocides against mycobacteria. *Journal of Applied Bacteriology Symposium Supplement,* 1996; 81: 87-101.
7) Tortora, GJ., Berdell, RF., Case CL. *Chemical methods of microbial control. In: Microbiology*. Benjamin Cumming Publishing Company, California, USA. 1998: 191.
8) Rutala WA. APIC guideline for selection and use of disinfectants. *American Journal of Infection Control,* 1996; 24: 313-342.
9) Gardener JS. Guideline for isolation precautions in hospitals. *Infections Control in Hospital and Epidemiology,* 2002; 17: 53-80.
10) Ikegbunam, MN., Metuh, RC., Anagu, LO., Awah NS. Antimicrobial activity of some cleaning products against selected bacteria. *International Research Journal of Pharmaceutical and Applied Sciences,* 2013; 3: 133-135.
11) Wang, Z., Shen, Y., Ma, J., Haapasalo M. The effect of detergents on the antibacterial activity of disinfecting solutions in dentin. *Journal of Endodontics,* 2012; 38: 948-953.
12) Levy SB. Antibiotic and antiseptic resistance: impact on public health. *Pediatric Infectious Disease Journal*, 2000; 19(Supplementary): S120-122.
13) Aiello, AE., Larson E. Antibacterial cleaning and hygiene products as an emerging risk factor for antimicrobial drug resistance in the community. Lancet Infectious Disease, 2000; 3: 501-506.
14) Bauer, AW., Kirby, WMM., Sheris, JC., Turck M. Antibiotics susceptibility testing by standardized single disk method. *American Journal of Clinical Pathology,* 1966; 45: 493-496.
15) CLSI (Clinical Laboratory Standards Institute). Performance standards for antimicrobial susceptibility testing; 15th informational supplement, M100-S15, vol. 25, no. 1. Clinical and Laboratory Standards Institute Wayne, PA: CLSI 2005:
16) NCCLS (National Committee for Clinical Laboratory Standards). Methods for dilution antimicrobial susceptibility tests for bacteria that grow aerobically, 6th ed. Approved standard M7-A6. National Committee for Clinical Laboratory Standards, Wayne, Pa. 2003:
17) Laborde, DJ., Weigle, KA., Weber, DJ., Kotch JB. Effect of faecal contamination on diarrheal illness rates in day-care centers. *American Journal of Epidemiology,* 1993; 138: 243-255.
18) Araujo, P., Lemos, M., Mergulhao, F., Melo, L., Simoes M. Antimicrobial resisitance to disinfectants in biofilms. *Science against microbial pathogens.* Mendez-Vilas (Ed.). Porto, Portugal. 2011: 826-834.
19) Lotfipour, F., Nahaei, MR., Milani, M., Javaherzadeh, V., Omranic, A., Attar N. Antibacterial activity of Germicide-P: A Persulfate based detergent/disinfectant on dome hospital isolates. *Iranian Journal of Pharmaceutical Sciences*, 2006; 2: 225-230.
20) Anderson, RL., Carr, JH., Bond, WW., Favero MS. Susceptibility of vancomycin-resistant enterococci to environmental disinfectants. *Infections, Control, Hospital and Epidemiology,* 1997; 18: 195-199.
21) French, GL., Phillips I. Antimicrobial resistance in hospital flora and nosocomical infection. *Hospital Epidemiology and Infection Control*. Williams, B. and Wilkins, B. (Eds.). May-Hall. 1996: 980-990.
22) Rutala, WA., Barbee, SL., Aguiar, NC., Sobsey, MD., Weber DJ. Antimicrobial activity of home disinfectants and natural products against

23) potential human pathogens. *Infection Control and Hospital Epidemiology*, 2000; 21: 33-38.
24) Weber, DJ., Rutala WA. Role of environmental contamination in the transmission of vancomycin-resistant enterococci. *Infections Control in Hospital and Epidemiology*, 1997; 18: 306-309.
25) Igbinosa, EO., Obi, LC., Tom, M., Okoh AI. Detection of potential risk of wastewater effluents for transmission of antibiotic resistance from *Vibrio* species as a reservoir in a peri-urban community in South Africa. *International Journal of Environmental Health Research*, 2011; 21: 402-414.