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ANTIBACTERIAL EFFICACY OF COMMERCIALLY AVAILABLE HERBAL AND ALCOHOL BASED HAND SANITIZERS- AN IN VITRO STUDY

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ABSTRACT

Introduction

Hand sanitizers significantly increase the chance of keeping the hands clean and aseptic.Traditionally, microbes habitation on hands is divided into resident and transient floras. Involved resident floras are commonly Staphylococcus aureus and Enterococcus faecalis that colonize the deeper skin layers and are resistant to mechanical removal. Therefore, the aim of the present study is to evaluate and compare the antimicrobial efficacy of four different hand sanitizers against Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli

Materials and methods:

The present study is an in vitro study to evaluate antimicrobial efficacy of Palmolive, Lifebuoy, Spar and Margo hand sanitizers against clinical isolates of the aforementioned test organisms. The well variant of agar disk diffusion test using Mueller-Hinton agar was used for evaluating the antimicrobial efficacy of hand sanitizers. After incubation, antimicrobial effectiveness was determined using a digital caliper (mm) by measuring the zone of inhibition.

Results

Assessment of antimicrobial effectiveness among herbal and alcohol based hand sanitizers revealed that in all cases herbal based hand sanitizers(group III Spar-20mm and IV Margo-16mm) showed maximum efficacy against bacteria as much as the alcohol based sanitizers.

Conclusion
Herbal hand sanitizers possessed maximum antimicrobial effect against all the Bacteria's used in the study. Despite the claims of efficacy and 99.9% bacterial reduction by hand sanitizer manufacturers, there still exists a need for verification of these claims by regulatory bodies and higher authorities for the enforcement of good-quality measures

Key words: Hand sanitizers, Hygiene, Organisms, efficacy, Innovative analysis

INTRODUCTION

Hospital and community-acquired infections are escalating and pose a serious public health problem worldwide [1]. Hands are considered to be the primary route for transmitting microbes and infections to the individuals[2]. The importance of hygiene is universally recognized and evidence-based. It is well known that hand hygiene is crucial to prevent and minimize healthcare-associated infections [3]. Several studies have shown the importance of proper hand hygiene in reducing the incidence of nosocomial infections[4].

Hand sanitizers significantly increase the chance of keeping the hands clean and aseptic.Traditionally, microbes habitation on hands is divided into resident and transient floras. Involved resident floras are commonly Staphylococcus aureus and Enterococcus faecalis that colonize the deeper skin layers and are resistant to mechanical removal[5]. The transient floras consists of S. aureus and Escherichia coli that colonize the superficial layers of skin in a short period of time[6].To overcome the limitations of plain hand washing, hand sanitizers were introduced claiming to be effective against those pathogenic micro-organisms as well as to improve skin condition due to the addition of emollients in it[7]. Several studies suggested that sanitizers with at least 70% alcohol were suggested to kill 99.9% of the bacteria on hands [8].

Alcohol-based hand sanitizers exist in liquid, foam, and easy- flowing gel formulations. Sometimes combined with quats (quaternary ammonium cations) such as benzalkonium chloride quarts are added at level up to 200parts per million to increase antimicrobial effectiveness[9]. Before the discovery of modern medicine, plants were the main remedy for treating various diseases. With the advent of different antibiotics microbes also gradually develop resistance to these substances. These bring researchers interest towards the plants having antimicrobial properties. They try to exploit the unique ability of different secondary metabolites to show persistent and prolonged activity against a broad spectrum of microbes [10].To protect the skin from harmful microorganisms and to prevent spreading of many contagious diseases, hand washing is absolutely an important precaution.

Food production workers and food service personnel must be taught to use correct hand and fingertip washing by management in preparation for work[11]. Contaminated hands can serve as vectors for the transmission of microorganisms. Pathogenic microorganisms accountable for outbreaks are spread from the hands of the food handler to others when the food handler contaminates his/her hands and then passes these microorganisms to consumers via hand contact with food or drinks [12].
Our team has extensive knowledge and research experience that has translate into high quality publications[13–21],[22],[23],[24,25],[26],[27],[28–32] The aim of the study is to evaluate the antimicrobial efficacy of four different hand sanitizers against Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli as well as to compare the antimicrobial effectiveness among four different hand sanitizers.

MATERIALS AND METHODS

The present study is an in vitro study conducted at the Department of Nanotechnology, Saveetha Dental College, Chennai, India.Ethical clearance for the study was obtained from the Saveetha Institutional Review board. Four different brands of hand sanitizers were selected out of many available in the market based on their popularity and maximum usage in Chennai City.

Selected hand sanitizers to test their antimicrobial efficacy were Spar(Trisis Ventures Pvt Ltd.,India).Palmolive(Colgate-Palmolive Co Pvt.Ltd.,,India), Margo(Accra pac Pvt. Ltd., India), and Lifebuoy (Hindustan Unilever Pvt. Ltd., India) [Figure 1]. Recently manufactured and packed sanitizers have been purchased based on their popularity from the local retail outlet.

The culture media used in the present study were Mueller-Hinton agar for agar diffusion method while nutrient broth and nutrient agar medium for bacterial isolate preservation. The clinical isolates of S. aureus, E. coli, and P.

aeruginosa were obtained from the culture plates of the respective micro-organisms preserved on the nutrient agar slants and were stored at 4°C in the Department of Microbiology, Saveetha Dental College,Chennai, India.

McFarland standards were taken as a reference to adjust the turbidity of bacterial suspensions. The McFarland 0.5 turbidity standard was prepared by adding 0.5 ml of 1.175% w/v barium chloride dihydrate ($BaCl2 \cdot 2H2 O$) solution to 99.5 ml of 15 w/v sulfuric acid ($H2SO4$).A sterile loop was used to pick a loopful of inoculum from a pure culture of the test organism. This was then transferred and suspended into a tube containing sterile normal saline (NaCl 8.5 g, distilled water 1 L). The tube was compared with the turbidity standard, and the density of the organism was adjusted by adding more bacteria or sterile saline until standardization was attained.

RESULTS AND DISCUSSION

Herbal hand sanitizers were effective against all the test organisms. The antimicrobial effectiveness was assessed by measuring the zone of inhibition against the particular test organism. Maximum inhibition(in mm) seen in Spar which shows the antibacterial effectiveness against S. Aureus is 20mm, P. Aeruginosa is 10mm and E. Coli is 9mm. Margo shows the antibacterial effectiveness against S. Aureus is 16mm, P. Aeruginosa is 11mm and E. Coli is 12mm. Minimum inhibition seen in Lifebuoy which shows the antibacterial effectiveness against S. Aureus is 11mm, P. Aeruginosa is 9mm and E. Coli is 8mm. Palmolive shows the antibacterial effectiveness against S. Aureus is 9mm, P. Aeruginosa is 7mm and E. Coli is 6mm.[Figure 4]

To overcome the negative impact of microbial contamination in health-care settings, hand sanitizers are recommended as an adjunct to plain hand washing. Most commonly and easily available hand sanitizers in Chennai city were selected for the study. Among the four hand sanitizers used in this study, Palmolive and Lifebuoy were alcohol-based and Spar and Margo was herbal, i.e., non-alcohol-based hand sanitizer[33]. Many studies have been conducted to assess the antimicrobial effectiveness of hand sanitizers alone, but very few literature is available to assess the difference between various disinfectants and hand sanitizers. Disinfectants are chemical agents with an immediate and sustained activity which destroys micro-organisms to such a level mandated for hygienic and surgical indications[34].

Sanitizers, on the other hand, are agents with an immediate activity that reduce the number of micro-organisms to a safe level to meet the public health requirements.A study conducted by Oke et al. revealed that Dettol hand sanitizer was effective only against P. aeruginosa whereas herbal hand sanitizers are effective against S. aureus and E. coli[35]. A study conducted by Mondal and Kolhapure showed that Herbal hand sanitizers were effective against E. coli, Proteus mirabilis, Shigella sonnei, S. aureus, and S. epidermidis.[36]

Lifebuoy hand sanitizer also showed antimicrobial activity against the tested organisms; however, the exact and valid comparison could not be done with other studies due to lack of scientific literature.The present study also showed antimicrobial efficacy of Alcohol based hand sanitizers against tested organisms; however, it was the least effective among all the hand sanitizers which may be probably due to low antimicrobial potency of alcohol. Further studies are required to find the exact cause of least effectiveness of alcohol based hand sanitizer against the tested organisms.[37]

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Figure 1: Different hand sanitizers used in the study.

Figure 2: Analysis of zone of inhibition to evaluate antimicrobial efficacy of Herbal hand sanitizers.

Figure 3:Analysis of zone of inhibition to evaluate antimicrobial efficacy of Alcohol hand sanitizers.

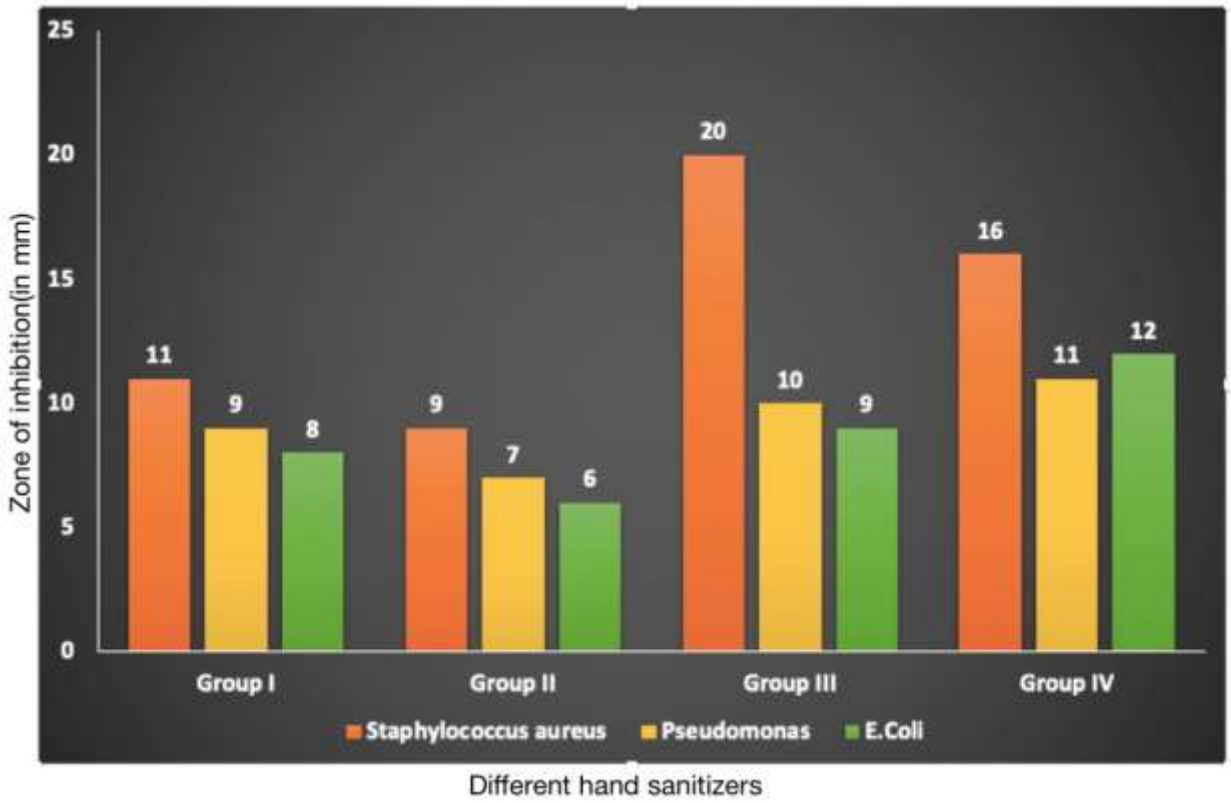

Figure 4: Bar graph depicting herbal based hand sanitizers Group III & IV (Spar & Margo) and the alcohol based hand sanitizers Group I & II (Lifebuoy & Palmolive) . X axis represents the different hand sanitizers used in this study and Y axis represents the zone of inhibition(in mm). Orange colour denotes S. Aureus and yellow colour denotes Pseudomonas Aeruginosa and green colour denotes E.Coli.

CONCLUSION

Herbal hand sanitizers possessed maximum antimicrobial effect against all the Bacteria's used in the study. Despite the claims of efficacy and 99.9% bacterial reduction by hand sanitizer manufacturers, there still exists a need for verification of these claims by regulatory bodies and higher authorities for the enforcement of good-quality measures.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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