

# **ANTIBACTERIAL ACTIVITY OF VARIOUS HAND SANITIZERS AGAINST DIFFERENT BACTERIAL STRAINS**



Project work by  
**ANGELA GINSON**  
**AB20ZOO001**

Under the guidance of  
**Dr. REEMA KURIAKOSE**, Associate Professor  
Department of Zoology, St. Teresa's College (Autonomous), Ernakulam  
Kochi- 682011

Submitted to  
Mahatma Gandhi University, Kottayam  
In partial fulfilment of requirement for the Degree of Bachelor of  
Science in Zoology

2022-23

**ANTIBACTERIAL ACTIVITY OF VARIOUS HAND SANITIZERS  
AGAINST DIFFERENT BACTERIA**

## **CERTIFICATE**

This is to certify that the project report entitled “**ANTIBACTERIAL ACTIVITY OF VARIOUS HAND SANITIZERS AGAINST DIFFERENT BACTERIAL STRAINS**” submitted by Ms. Angela Ginson, Reg No: AB20ZOO001 in partial fulfilment of the requirement of Bachelor of Science degree of Mahatma Gandhi University, Kottayam, is a bonafide work under my guidance and supervision and to my best knowledge, this is her original effort.

Dr. Reema Kuriakose  
Associate Professor  
Department of Zoology  
St. Teresa’s College (Autonomous)  
Ernakulam

Dr. Soja Louis  
Head of Department  
Department of Zoology  
St. Teresa’s College (Autonomous)  
Ernakulam

## **EXAMINERS**

1)

2)

## **DECLARATION**

I, hereby declare that this project work entitled "ANTIBACTERIAL ACTIVITY OF VARIOUS HAND SNITIZERS AGAINST DIFFERENT BACTERIA" is submitted to St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam in partial fulfilment of the requirements of Bachelor of Science degree in Zoology. This work has not been undertaken or submitted elsewhere in connection with any other academic course and the opinions furnished in this report are entirely my own.

NAME: ANGELA GINSON

SIGNATURE

REGISTRATION NUMBER: AB20ZOO001

## **ACKNOWLEDGEMENT**

I would like to express my gratitude and appreciation to all those who have contributed to this project. First and foremost, I would like to thank my project guide Dr.Reema Kuriakose for the invaluable guidance, support, and encouragement. Thank you for guiding us along to build a good project work, by providing all the necessary information, the best available resources.

I thank all the teaching staff of the Department of Zoology, St. Teresa's college, Ernakulam who were always willing to encourage and help us in all our efforts.

Finally, I would like to thank my family for their unwavering support, patience, and encouragement during this challenging research project. Their love and support have kept me motivated and focused on completing this project successfully.

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## ABSTRACT

Hospital and community-acquired infections are a serious problem worldwide often leading to increased deaths, costs and other problems. Hand hygiene has been promoted as the most important way to prevent these infections. The use of hand sanitizers is one of the ways to address the barriers to effective hand hygiene.

The project entitled : Antibacterial activity of various Hand sanitizers, tested the effect of Lifebuoy, Savlon , Dettol, Meredith and Yardley against *Escherichia coli*, *Klebsiella pneumoniae*, *Enterococcus*, *Staphylococcus aureus*, *Streptococcus iniae*, *Vibrio cholera*

The antibacterial effect was measured using Kirby- Bauer disc diffusion method.

The result of the study showed that five different sanitizer showed antibacterial activity against different bacteria with the zone of inhibition ranging from 0.4 to 2 cm. It was seen that Lifebuoy showed effect against most of the bacteria taken whereas the least activity was shown by Dettol

The most sensitive bacteria was *E.coli* seen highly sensitive towards Meredith and showed sensitivity towards all other sanitizers, while *St iniae* were the least sensitive bacteria showing sensitivity towards only lifebuoy .

## INTRODUCTION

It is well recognized that hand hygiene is essential to reducing microbial burden, transmission, and infection. The density and species of bacteria that colonize the hands of individuals are highly variable and can be influenced by a number of factors including age, sex, ethnicity, and profession. Health care workers have been of particular interest, as they may provide a reservoir for the circulation and transmission of drug-resistant bacteria within the hospital setting. Conventional hand washing using water, soap, and friction is an effective means of reducing microbial burden, which when combined with other infection control practices (i.e., glove usage, compliance, and education) has significantly reduced microbial transmission, hospital-acquired infections, reduced gastrointestinal and respiratory illness, and improved overall health. The hands are part of body that are used for many day to-day activities. It is extremely easy to meet different microbes and transfer them to other objects like doorknobs, pen, pencils, seats and even people. Surprisingly fingernails harbor the most bacteria found on the human hands. Children can contaminate their own food by playing in dust, eating with dirty hands and many unhygienic activities. The hands of a person may get contaminated with *Staphylococcus aureus* either by contact with genital areas, nose, toilet doors, playing with sand etc. Also, long nails of pupils tend to harbor more microorganisms than short nails. [ Hedderwick 2000 ,Watutantrige ,2012]

Hand sanitizers are preparations (liquid, gel, or foam) containing alcohol or non-alcohol based active ingredients which are applied to the hands in order to reduce the number of viable microorganisms on them. However, the CDC only recommends the use of alcohol based hand sanitizers. [Boyce,2002] . Hand sanitizers are preferred over conventional hand washing with soap and water in terms of compliance because they are more effective in antimicrobial action, they are more convenient, and they are gentler on the skin and require less time for hand washing. [Jumaa, 2015].



The purpose of this study was to evaluate the antibacterial activity of four different Hand sanitizer [ Lifebuoy, Savlon , Dettol, Meredith and Yardley] against seven different bacterial strains [Escherichia coli, Klebsiella, Vibrio parahaemolyticus, Enterococcus, Mycobacterium tuberculosis, Staphylococcus aureus and Streptococcus iniae. All the selected Hand sanitizers were conventionally used for the elimination of various types of pathogenic organisms and several disease causing bacteria.

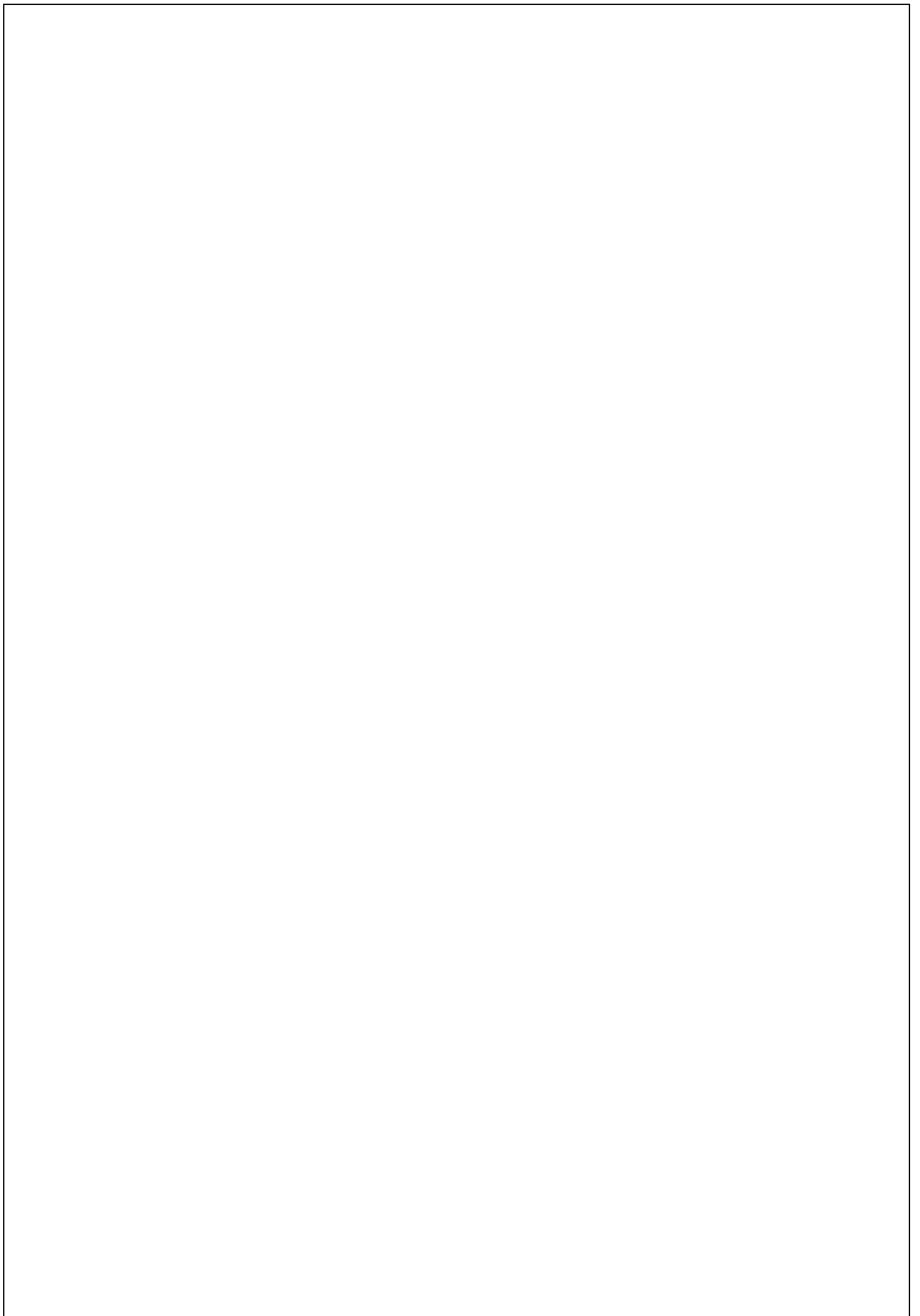
The main ingredients in Lifebuoy hand sanitizer are Ethyl alcohol [70%], Water, Glycerine, Carbomer copolymer, Camellia sinesis leaf extract , aloe barbadensis leaf extract, d- menthol, triethanolamine .

Dettol consists of Denatured alcohol[ 69.4%], water, copolymer propylene glycol ,acrylate ,alkyl acrylate, cross polymer, tetrahydroxypropyl, ethylenediamine, perfume and limonene.

Yardley hand sanitizer consists of Ethyl alcohol [95%], Glycerin , and Hydrogen peroxide.

Savlon is an alcohol based hand sanitizer that contains Ethanol[95%], Absolute alcohol denatured with isopropyl alcohol [3.1%]

Meredith is an herbal hand sanitizer that contains neem, coriander and lime.



## REVIEW OF LITERATURE

Hospital and community-acquired infections are escalating and pose a serious public health problem worldwide.[Hassan et.al.,2012] Hands are considered to be the primary route for transmitting microbes and infections to the individuals.[Monda ,2004] Personal as well as hand hygiene is important to prevent many communicable diseases. The Centers for Disease Control and Prevention, the World Health Organization, and many other health experts promote hand hygiene as the single most important measure in the prevention of hospital-acquired infections. Several studies have shown the importance of proper hand hygiene in reducing the incidence of nosocomial infections.[ Erasmus et.al.,2010, Pittet et.al., 2009, Son ,2011]

Scientific studies have even shown that after hand washing, as many as 80% of individuals retain some pathogenic bacteria on their hands. [Tambekar et.al., 2007] Hand washing removes body's own fatty acids from the skin, which may result in cracked skin that provides an entry portal for pathogens.[ Larson et.al., 1998, Winnefeld et.al., 2000] To overcome the limitations of plain hand washing, hand sanitizers were introduced claiming to be effective against those pathogenic microorganisms as well as to improve skin condition due to the addition of emollients in it.[ Lauharanta et.al., 1991]. Hand sanitizers were also effective in reducing gastrointestinal illnesses in households,[ Sandora et.al.,2004] respiratory tract infections, and skin infections,[ Bloomfield et.al., 2007] in curbing absentee rates in elementary schools,[ Hammond et.al., 2000] and in reducing illnesses in university dormitories.[ White , 2003] Furthermore, to reduce infections in healthcare settings, alcohol-based hand sanitizers are recommended as a component of hand hygiene.[ Boyce et.al., 2002]

Some products marketed to the public as antimicrobial hand sanitizers are not effective in reducing bacterial counts on hands. In fact, despite a label claim of reducing “germs and harmful bacteria” by 99.9%, some studies have observed an apparent increase in the concentration of bacteria in handprints impressed on agar plates after

cleansing.[ Reynolds et.al.,2006] Hence, there still exists a need for verification of these claims by the regulatory authorities for the enforcement of good-quality measures. [Dent , 2016]

## DISCUSSION

In the present study, five hand sanitizers [Savlon , Lifebuoy , Dettol , Yardley, Meredith] were tested against different bacterial strains [ E.coli, Vibrio parahaemolyticus, Enterococcus , Klebsiella , St.aureus , St.iniae, Mycobacterium]

Infection with environmental microbes is increasing alarmingly. Normal human skin always harbors bacteria . The transfer of bacteria from the hands to food, objects, or people plays an important role in the spread of many communicable diseases. To overcome the negative impact of microbial contamination in health-care settings, hand sanitizers are recommended. Most commonly and easily available hand sanitizers in the Indian market were selected for the study. Among the five hand sanitizers used in this study, Savlon, Yardley, Dettol, and Lifebuoy were alcohol-based and Meredith was a non-alcohol-based hand sanitizer.

Alcohol was the main active ingredient in alcohol-based hand sanitizer which exerts antimicrobial activity by causing protein denaturation, disruption of tissue membranes, and dissolution of several lipids.[Kar,2008] Alcohol has increasing effectiveness from 60% to 90% with 1-propanol being most effective followed by 2-propanol and finally by ethanol, whereas Coriander, Lime, and Neem were the active ingredients responsible for antimicrobial activity in Meredith herbal hand sanitizer.

Lifebuoy is an alcohol based hand sanitizer that contains, active Ingredients, Ethyl alcohol[ 70%] Inactive Ingredients present in it includes Water, glycerine, carbomer copolymer, camellia sinensis leaf extract, aloe barbadensis leaf extract, d-menthol, triethanolamine . It exhibited action against all gram positive and gram negative bacteria except Klebsiella . Among the three gram negative bacteria tested, Lifebuoy was most effective against E.coli with a zone of inhibition of 1.4cm. The effectiveness of Lifebuoy hand sanitizer was due to the presence of 70% ethyl alcohol which was in accordance with a previous study [Dent Res,2016]

Dettol is another alcohol based hand sanitizer . It mainly consists of Denatured Alcohol[69.4%] and Propylene glycol. Its Simple, fast and effective, Dettol Instant Hand Sanitizer helps to protect against 99.99% of germs, with no need for soap or water. It exhibited zone of inhibition towards *E.coli* [0.8cm], *Enterococcus* [1.1cm],and *Vibrio* [1cm] and was completely resistant towards *Klebsiella*, *S. aureus*, *St iniae* , and *Mycobacterium*. A study conducted by Oke *et al.* revealed that Dettol hand sanitizer was effective only against *P. aeruginosa* whereas it was not effective against *S. aureus* and *E. coli*, which was in accordance with our study. The effectiveness of Dettol hand sanitizer was due to the presence of denatured alcohol and propylene glycol that posses significant antibacterial activities.

Yardley hand sanitizer spray with a WHO recommended formulation, kills 99.9% of disease causing germs and provides effective protection. It's a alcohol based hand sanitizer that contains Ethyl Alcohol[ 95% ], Glycerin , and Hydrogen Peroxide. Yardley was more effective towards Gram negative bacteria than Gram positive bacteria. It exhibited zone of inhibition towards *E.coli*[1cm], *Klebsiella*[0.9cm], and *vibrio*[0.9cm] and was completely resistant towards *S.aureus*, *St.iniae*, and *Mycobacterium* except *enterococcus*[1.1cm]. . The effectiveness of Yardley hand sanitizer is due to the presence of 95% Ethyl alcohol and Hydrogen Peroxide. Hydrogen peroxide is responsible for certain bactericidal effects observed in biological systems, such as growth inhibition of one bacterial species by another and killing of invading microorganisms by activated phagocytic cells.

Savlon is an alcohol based hand sanitizer that offers protection against a wide variety of bacteria while being gentle on skin. With neutral pH ratings and low alcohol content, Savlon antiseptics act without burning or hurting your skin. Its active ingredients include Ethanol [95%] , Absolute Alcohol Denatured With Isopropyl Alcohol[ 3.1%]. Savlon reacted towards all gram negative bacteria taken in the study, exhibiting zone of inhibition towards *E.coli*[1.2cm], *Klebsiella*[0.8cm], and *Vibrio*[0.8cm]. Among the gram positive bacteria taken it exhibited zone of inhibition towards *S. aureus*[1.2cm] and *mycobacterium*[1.2cm] and was completely resistant towards *Enterococcus* and *St iniae*. In a study conducted by Ashwini Ramchandra ingole [2021] on the Comparative assessment of different hand sanitizers Savlon was found to be effective towards *S. aureus* due to the presence of 95% Ethanol and

isopropyl alcohol. Isopropyl alcohol kills organisms by denaturing their proteins and dissolving their lipids and is effective against most bacteria, fungi and many viruses, but is ineffective against bacterial spores (CDC, 2020).which was in similar to our study

Meredith is a herbal hand sanitizer that contains neem, coriander, and lime. It showed highest significant zone of inhibition among the whole study towards E.coli[2cm], followed by Enterococcus[1.5cm], S.aureus[1cm] and Klebsiella[0.7cm]. It was completely resistant towards Vibrio, St iniae and Mycobacterium. However, the least effectiveness towards these different bacteria may be probably due to low antimicrobial potency of Coriander, Lime, and Neem present in it. Further studies are required to find the exact cause of least effectiveness of Meredith hand sanitizer against the tested organisms.

# OBSERVATIONS AND RESULTS

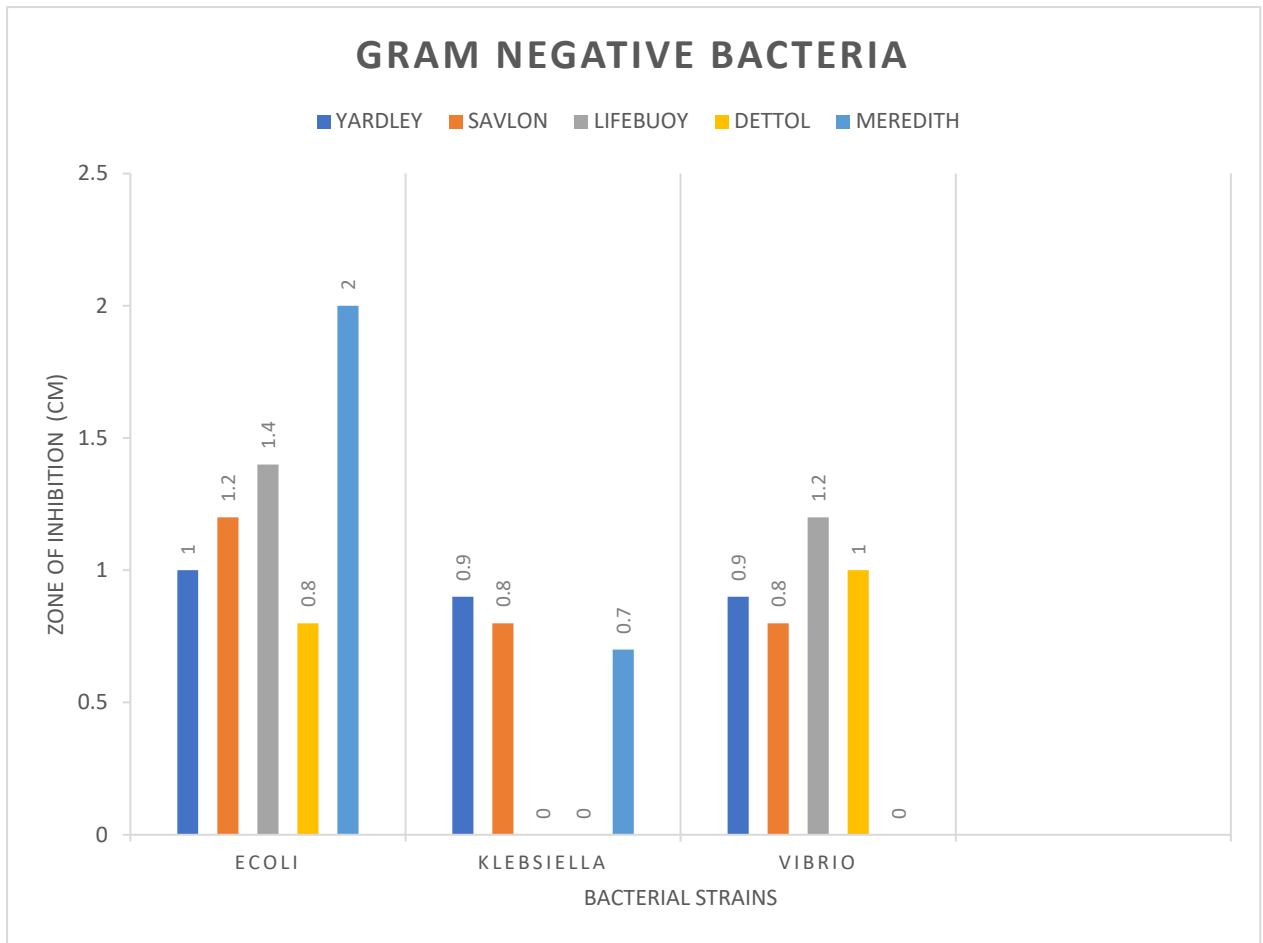
SANITIZERS	ZONE OF INHIBITION						
	GRAM POSITIVE BACTERIA			GRAM NEGATIVE BACTERIA			
	E. coli	Klebsiella	Vibrio	Enterococcus	S. aureus	St. iniae	Mycobacterium
YARDLEY	1	0.9	0.9	1.1	0	0	0
SAVLON	1.2	0.8	0.8	0	1.2	0	1.2
LIFEBUOY	1.4	0	1.2	1	1	0.4	0.4
DETTOL	0.8	0	1	1.1	0	0	0
MEREDITH	2	0.7	0	1.5	1	0	0

Table showing the zone of inhibition produced by various sanitizers against 3 Gram negative and 3 Gram positive bacteria

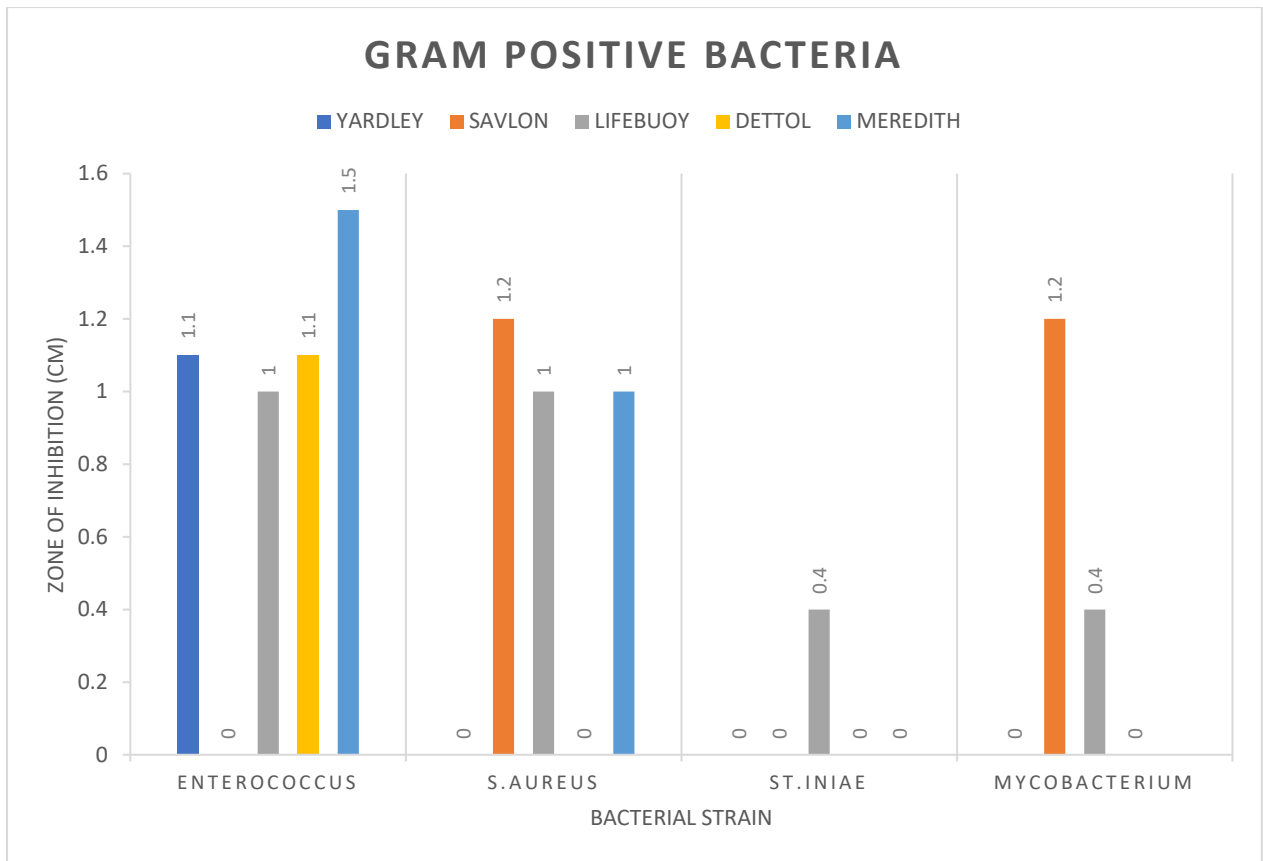


Photos showing the zone of inhibition by various sanitizers

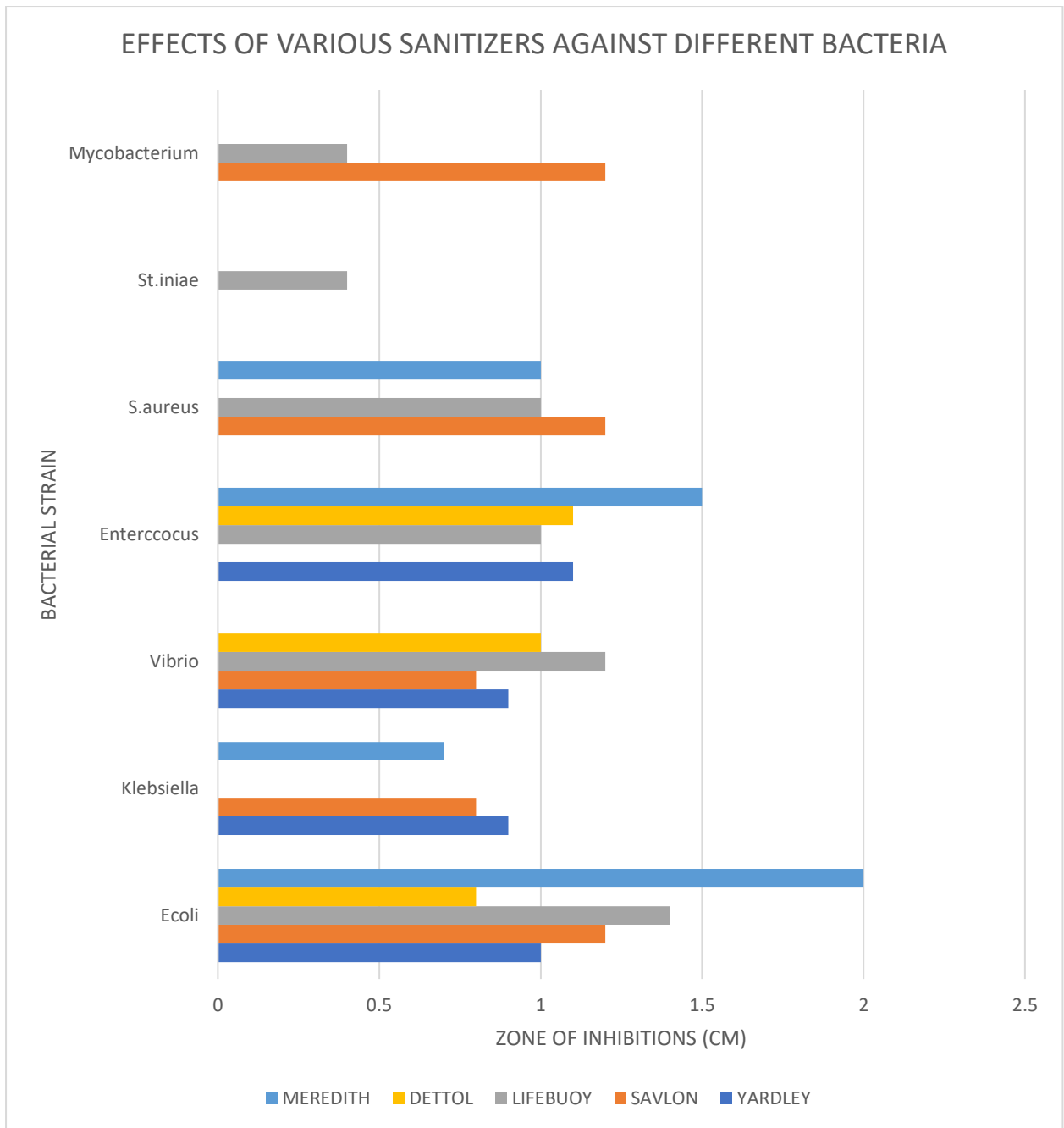




**GRAPH 1: Showing the zone of inhibition produced by different gram negative against sanitizers**



**GRAPH 2: Showing the zone of inhibition produced by different gram-positive bacteria against ayurvedic medicines.**



**GRAPH 3: Showing the zone of inhibition produced by different bacteria against various sanitizers.**

## RESULT

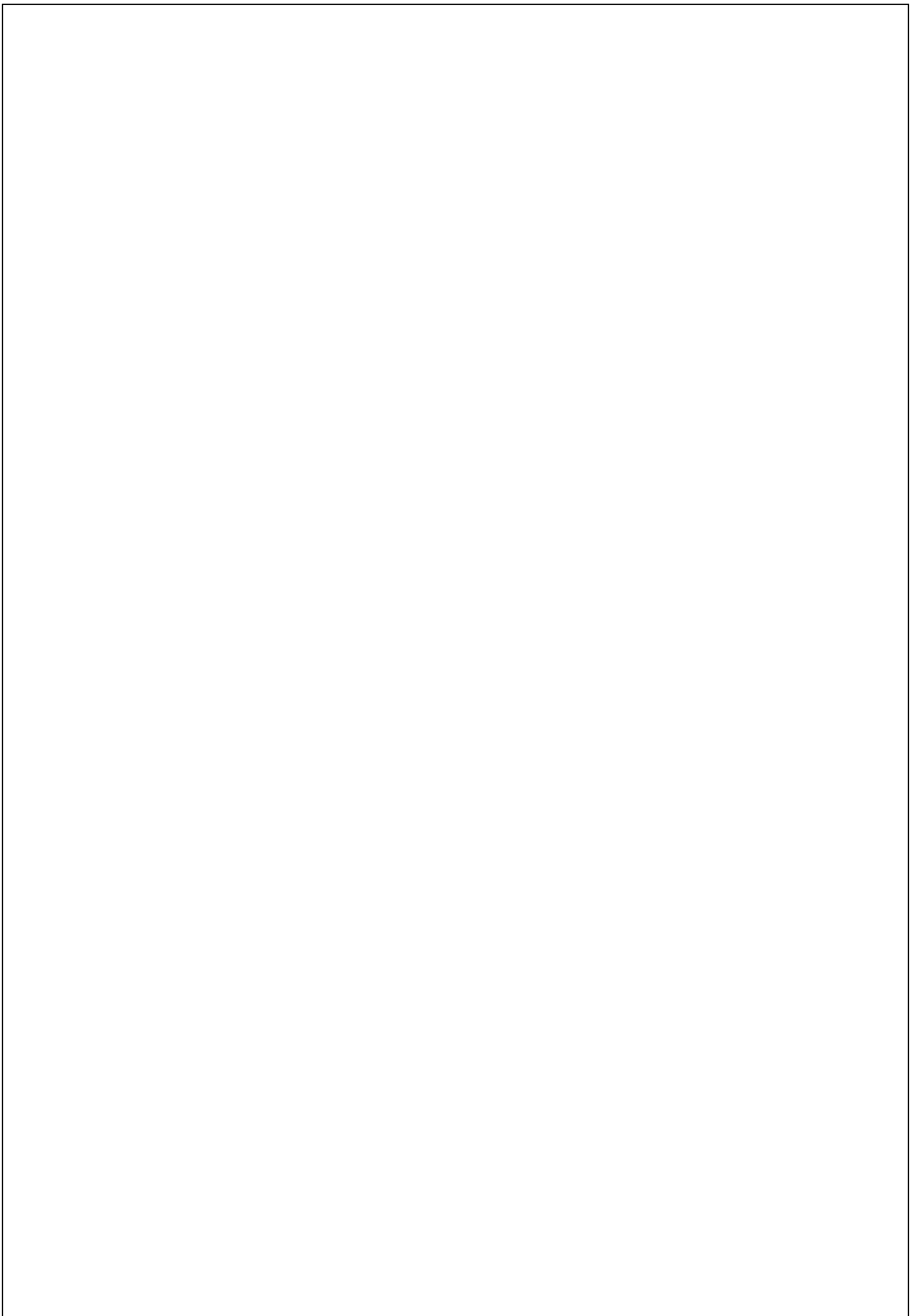
The objective of this study was to evaluate the antibacterial activity of different sanitizers' {Yardley, Savlon, Lifebuoy, Dettol, Meredith} against six different bacterial strains{ Escherichia coli, Klebsiella, Vibrio parahaemolyticus, Enterococcus, Staphylococcus aureus, Streptococcus iniae, Mycobacterium. }. Sanitizers exhibited inhibition zones ranging from 0.4 to 2cm .

Among the bacteria tested St. iniae was resistant to almost every sanitizer except lifebuoy and E.coli was found to be the most sensitive bacteria, it showed inhibition against all sanitizer showing maximum inhibition towards lifebuoy [1.4cm]. The bacteria klebsiella which causes pneumonia was found to be resistant towards lifebuoy and Dettol , but it was sensitive towards Yardley ,savlon and Meredith showing maximum inhibition towards Yardley[0.9cm]

Vibrio parahaemolyticus which causes gastrointestinal illness like Klebsiella was found resistant towards the sanitizer Meredith , it showed maximum inhibition towards Lifebuoy[1.2cm] .Enterococcus bacteria was completely resistant towards savlon and showed maximum inhibition towards Meredith [1.5cm]. S. aureus bacteria showed resistance towards Yardley and Dettol, .But it was sensitive towards savlon [1.2cm],lifebuoy[1cm] and Meredith [1cm].

Streptococcus iniae was completely resistant towards almost all the sanitizer's except lifebuoy [0.4cm]. Mycobacterium showed complete resistant towards Yardley, Dettol , and Meredith but it showed inhibition towards savlon and lifebuoy with zone of inhibition of 1.2cm and 0.4 cm respectively.

From the above observations, of all the sanitizer's used for the study , the highest significant zone of inhibition was exhibited by Meredith [2cm 1.5c. The bacterial strain E coli was sensitive to all sanitizer's taken in the study exhibiting significant zones of inhibition. But in the case of St iniae it showed complete resistance towards every sanitizer except lifebuoy, St iniae was found to be the most resistant bacteria.



## CONCLUSION

The antibacterial activity of five different Hand sanitizers [Yardley, Savlon , Meredith, Dettol, and Lifebuoy] were tested against different gram positive [Enterococcus, Staphylococcus aureus, Streptococcus iniae, Mycobacterium] and gram negative bacteria [Escherichia coli, Klebsiella, Vibrio parahaemolyticus]. Most Hand sanitizer exhibited considerable activity against the bacterial strains.

Most Hand sanitizers taken showed considerable activity against different bacterial strains, among which most effective sanitizer was Lifebuoy showing a good inhibitory effect against all bacteria taken except Klebsiella. E.coli was found to be the most sensitive bacteria while Streptococcus iniae was found to be the most resistant bacteria. Dettol was least effective hand sanitizer showing sensitivity towards E.coli, Vibrio and Enterococcus

## REFERENCES

1. Boyce, J. M., Pittet, D. [2002], Healthcare Infection Control Practices Advisory Committee; HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Society for Healthcare Epidemiology of America/Association for Professionals in Infection Control/Infectious Diseases Society of America. MMWR Recomm Rep. ;51:1–45.
2. Bloomfield, S. F. [2007] The effectiveness of hand hygiene procedures in reducing the risks of infections in home and community settings including handwashing and alcohol-based hand sanitizers. Am J Infect Control, [35] :27–64.
3. Centers for Disease Control and Prevention. [2002] Guideline for Hand hygiene in health-care settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA hand hygiene task force. MMWR. 2002;51:1–56
4. Erasmus, V. , Kuperus, M.N., Richardus, J.H., Vos, M. C., Oenema, A., van Beeck, E.F.,[2010], Improving hand hygiene behaviour of nurses using action planning: A pilot study in the intensive care unit and surgical ward. J Hosp Infect.,76:161–4.
5. Hassan, A. O., Hassan, R. O., Muhibi, M. A., Adebimpe, W. O. A ( 2012) survey of enterobacteriaceae in hospital and community acquired infections among adults in a tertiary health institution in southwestern Nigeria. AFR microbial res, 6 (1) : 5126 -5127
6. Hammond, B., Ali, Y., Fendler, E., Dolan ,M., Donovan, S. [2000], Effect of hand sanitizer use on elementary school absenteeism. Am J Infect Control. ;28(5):340–6.
7. Lauharanta J, Ojajärvi J, Sarna S, Mäkelä P[1991]. Prevention of dryness and eczema of the hands of hospital staff by emulsion cleansing instead of washing with soap. J Hosp Infect. ;17:207–15.

8. Larson, E.L., Hughes ,C.A., Pyrek, J.D., Sparks ,S.M., Cagatay, E.U., Bartkus J.M. ,[1998],Changes in bacterial flora associated with skin damage on hands of health care personnel. *Am J Infect Control.*;26:513–21.
9. Mondal S, Kolhapure SA.[2004] Evaluation of the antimicrobial efficacy and safety of pure hands herbal hand sanitizer in hand hygiene and on inanimate objects. *Antiseptic.* ;101:55–7.
10. Madan K, Prashar N, Thakral S.[2012] Comparative evaluation of efficacy of alcoholic vs. non-alcoholic hand sanitizers. *Int J Life Sci Biotechnol Pharma Res.* ;1:173–7.
11. Pittet D, Allegranzi B, Byce J. [2009] ,The World Health Organization guidelines on hand hygiene in health care and their consensus recommendations. *Infect Control Hosp Epidemiol.* ;30:611–22.
12. Pratt RJ, Pellowe C, et al. [2001] , The epic project: Developing national evidence-based guidelines for preventing healthcare associated infections. Phase 1: Guidelines for preventing hospital-acquired infections. Department of Health (England) *J Hosp Infect.* ;47(Suppl 1):S3–82.
13. Reynolds SA, Levy F, Walker ES.[2006] , Hand sanitizer alert. *Emerg Infect Dis.* 2006;12:527–9.
14. Son C, Chuck T, Childers T, Usiak S, Dowling M, Andiel C, et al. [2011] Practically speaking: Rethinking hand hygiene improvement programs in health care settings. *Am J Infect Control.* ;39:716–24.
15. Tambekar DH, Shirsat SD, Suradkar SB, Rajankar PN, Banginwar YS. [2007] Prevention of transmission of infectious disease: Studies on hand hygiene in health-care among students. *Cont J Biomed Sci.* ;1:6–10
16. Winnefeld M, Richard MA, Drancourt M, Grob JJ. [2000] Skin tolerance and effectiveness of two hand decontamination procedures in everyday hospital use. *Br J Dermatol.* ;143:546–50.
17. White C, Kolble R, Carlson R, Lipson N, Dolan M, Ali Y, et al. [2003], The effect of hand hygiene on illness rate among students in university residence halls. *Am J Infect Control.* ;31:364–70.



