UNIVERSITI TEKNOLOGI MARA
Cawangan Perak
Kampus Tapah

FACULTY OF APPLIED SCIENCES

SCIENTIFIC PROJECT COLLOQUIUM

2024

Final Year Project Colloquium 2024
Faculty of Applied Sciences,
Universiti Teknologi MARA,
Perak Branch Tapah Campus,
35400 Tapah Road, Perak, Malaysia.

Colloquium date 12 July 2024
Publication date 30 October 2024

Proceedings of Extended Abstracts

EDITORS
Pn. Rosliza Ali
Pn. Nunshaimah Salleh
Pn. Norsakina Zurina Zulkifli
Pn. Adibatul Husna Fadzil
Pn. Yanti Yaacob
Pn. Lili Widarti Zainuddin

e-I.S.B.N: 978-629-97630-4-8

Faculty of Applied Sciences,
Universiti Teknologi MARA,
Perak Branch Tapah Campus,
35400 Tapah Road,
Perak, Malaysia.

Preface

The Scientific Project Colloquium offers a platform for publishing Diploma Science final year projects (FYP). The objective is to effectively distribute research findings throughout all scientific disciplines. The primary objective of including final year projects into the course curriculum is to encourage students to put their theoretical knowledge into practical applications.

We would like to express our gratitude to our primary establishment, the Faculty of Applied Sciences and Universiti Teknologi MARA, Perak Branch, for their invaluable assistance.

Lastly, we would like to express our gratitude to all of the authors for the tremendous help in preparing the articles, without which this undertaking would not have been completed.

Editors

Rosliza Ali
Nunshaimah Salleh
Norsakina Zurina Zulkifli
Adibatul Husna Fadzil
Yanti Yaacob
Lili Widarti Zainuddin

Universiti Teknologi MARA
Perak Branch Tapah Campus
October 2024

THE EFFICACY OF LOCAL HOUSEHOLD DETERGENTS AGAINST *Escherichia coli*

Siti Hajar Noor Alshurdin*, Ali Imran Abdul Raman, Danial Azrayyhaqim Mohamed, Fatin Nursyahidah Zomorni, Noorakmal Bin Zaidi, Norhelena Aleesa Zulkepli, Nur Izzah Aishah Abd Malik, Wan Amir Abdullah
Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch Tapah Campus, 35400 Tapah Road, Perak, Malaysia.

*sitih203@uitm.edu.my

Abstract: With the increasing concern about bacteria spreading to the surroundings from clothes that were not washed properly, understanding the effectiveness of antibacterial properties in detergents becomes imperative. Thus, this study was conducted to assess the antibacterial efficacy of selected detergents against *Escherichia coli* (*E. coli*) through standard microbiological techniques. Two different commercial household detergents were prepared with different concentrations of 25%, 50%, and 100% to compare their effectiveness. *E. coli* was cultured and isolated for macroscopic and microscopic identification. The antibacterial activity of selected detergents against *E. coli* was assessed through disk diffusion method, conducted in triplicates for 24 hours. Other variables included 90% alcohol as the positive control and distilled water as the negative control. The findings indicate that all tested detergents with different concentration exhibited some degree of antibacterial activity, there were significant variations in their effectiveness against *E. coli*. Detergent A demonstrated strong bactericidal properties, significantly reducing bacterial growth compared to detergent B, and the most effective concentration of detergent is 100% for both. The results highlight the importance of evaluating the antibacterial effectiveness of household detergents to ensure optimal domestic hygiene and prevent the spread of potentially harmful bacteria like *E. coli*.

Keywords: *Antibacterial activity, household detergents, Escherichia coli, disk diffusion method, microbial efficacy.*

INTRODUCTION

Ensuring cleanliness is essential to prevent the transmission of infectious diseases, particularly in homes where harmful bacteria like *E. coli* can thrive easily. *E. coli* is a Gram-negative bacillus bacterium commonly found in the intestines of humans and animals. *E. coli* can quickly multiply under ideal growth conditions, with a replication time of approximately 20 minutes (Mueller & Tainter, 2023). Recent studies have shown that this bacterium can survive for long periods of time outside of the intestinal tract (Ishii and Sadowsky, 2008). *E. coli* can live in both air and non-air conditions, for example on clothes. Improperly washed clothing can retain harmful *E. coli* bacteria, increasing the risk of spreading the bacteria to others upon contact with the clothes. To prevent *E. coli* contamination, clothes need to be washed thoroughly with a detergent that can kill the bacteria (Reynolds *et al.*, 2021).

The emergence of resistant bacteria, including *E. coli*, highlights the importance of using antibacterial products in daily household cleaning routines. Laundry detergent by itself cannot eliminate *E. coli.* Household detergents with antibacterial agents have gained prominence and are widely marketed for their ability to reduce the spread of harmful bacteria within homes. Previous research has indicated that isothiazolinone is a crucial antibacterial agent in detergent necessary to eliminate *E. coli.* (Karsa, 2007). Apart from that, some studies have demonstrated the effectiveness of different antibacterial agents, such as alcohols and disinfectants, in combating bacterial pathogens (Aiello *et al*., 2007; Angkadjaja, 2007; Dancer, 2013; Hong *et al.*, 2014). However, there is limited literature specifically addressing the antibacterial properties of household detergents and their effectiveness against *E. coli*.

This study aims to assess the efficacy of various commercial household detergents against *E. coli*, focusing on their potential role in public health prevention. The effectiveness of the detergents was measured using the disk diffusion method, a well-established technique for antimicrobial susceptibility test (AST) (Matuschek *et al.*, 2014). The study findings show notable differences in the antibacterial effectiveness of two detergents tested. Detergent A exhibited potent bactericidal properties, effectively suppressing the growth of *E. coli*, whereas detergent B showed lower efficacy. These findings emphasize the importance of choosing appropriate household cleaning products to ensure optimal hygiene and reduce the risk of bacterial infections.

METHODOLOGY

Morphological Identification and Inoculation of *E. coli*

The *E. coli* was isolated from its stock culture by using the subculturing method. Bacteria colonies were cultured on Nutrient agar medium (Osuntokun *et al.*, 2022). Simultaneously, a portion of the *E. coli* culture was introduced into a nutrient broth tube by gently swirling the inoculating loop within the medium (Jain *et al*., 2020) to obtain homogenous suspension. Both agar plate and broth were incubated at the optimal growth temperature for *E. coli*, typically 37°C for 24 hours (Hamdi & Sami, 2020). After 24 hours, *E. coli* culture on the plates were studied and recorded based on their macroscopic and microscopic morphology. Fresh pure cultures, aged twenty-four hours, were prepared before use each time (Jouda *et al.*, 2016).

Source of Liquid Detergents and their Constituent

Two different brands of liquid detergent (Table 1) used for this research were purchased from a TF Value Market in Tapah, Perak Malaysia.

Preparation for Disinfectants

Disinfectants in the original packaging were considered to be at 100% concentration. To create 50% and 25% concentrations, the disinfectants were diluted with sterile distilled water through serial dilution (Jouda *et al.*, 2016). All different concentrations for both detergent A and detergent B were prepared in 250 mL of Schott bottle separately.

Assay of Antimicrobial Activity

Filter discs are about 5 mm in diameter from Whatman's No.3 filter paper and wrapped in aluminum foil and sterilized in an oven at 75°C for 30 minutes. Each sterile disc was individually impregnated with 100 µl of detergents at different concentrations (25%, 50%, and 100%) using different sterile pipettes and then air-dried (Okore *et al*., 2014; Jouda *et al.*, 2016). Nutrient agar plates were evenly spread with 200 µl of *E. coli* 10^6 suspension on the surface. The agar plate was divided into three zones designated for detergent, positive control, and negative control. Using sterile forceps, discs impregnated with different concentrations of detergent were carefully placed on the agar plates, along with a positive control disc containing 90% of ethanol and a negative control disc containing sterile distilled water (dH_2O). The forceps were used to gently press down each disc against the agar surface to ensure good contact. The plates were incubated in an inverted position at 37°C for 24 hours (Jouda *et al.*, 2016). The diameter of inhibition zones around each detergent-containing disc were observed and measured in millimetres using a ruler. A zone of inhibition shows antimicrobial activity against *E. coli*. Absence of zone of inhibition indicates that the disinfectant was ineffective while larger zones of inhibition indicate greater susceptibility of *E. coli* to the tested detergent. (Okore *et al*., 2014).

Table 1. The Main Chemical Constituent of Detergents

Liquid Detergents	Chemical constituent	pH
Detergent A (1 Liter)	Benzenesulfonic Acid (5%), Alkylbenzene Sulfonate, Ethoxylated Alcohol (4.85%), Isothiazolinone, ethanolamine (12.5%), N,N-dimethylformamide and water .	7.7 ± 0.03
Detergent B (1 Liter)	Sodium alkyl benzene sulphonate, Sodium carbonate (12%), Chloroxylenol (1.7%), Nonylphenol polyethoxylate (9.5%) and water.	8.5 ± 0.03

FINDINGS

Macroscopic and Microscopic Morphology of *E. coli*

The macroscopic and microscopic characteristics of *E. coli* colonies on nutrient agar were observed and recorded in Table 2. This finding was consistent with the study conducted by Ngamsurach and Praipipat (2022) where *E. coli* colonies on nutrient agar are easily distinguishable by their small to medium size (1-2 mm in diameter), punctiform appearance, circular shape, smooth and moist surface, and slightly raised elevation. The color of the colonies ranges from off-white to cream, depending on the strain and growth conditions (Basavaraju & Gunashree, 2022).

Antimicrobial Assay

After 24 hours of cultivation, the diameter of the zone of inhibition around each disc was measured. The result obtained in this study of the zone diameter of inhibition of both detergents with three concentrations 100%, 50% and 25% against *E. coli* is presented in Table 3. Both detergents displayed significant antimicrobial activity. The

findings indicate that the undiluted and diluted concentrations of the disinfectants exhibited different zones of inhibition against *E. coli.*

Detergent A was found to be highly effective against *E. coli* where the zones of inhibition ranged from 41 mm to 53 mm (Figure 1). On the other hand, detergent B was least effective against *E. coli* where the zone of inhibition ranged from 15 mm to 25 mm only (Figure 2). By comparing the undiluted with diluted detergent, the zones of inhibition of the undiluted (100%) showed higher zones of inhibition ranged from 53 mm (detergent A) to 30 mm (detergent B) on *E. Coli.* This is aligned with the idea that higher concentrations are better at eliminating pathogens Ngamsurach and Praipipat (2022). The antibacterial substances from the liquid detergents diffused into the agar to prevent germination and proliferation of the tested microorganism (Balouiri *et al*., 2015), which explains why detergents substances need more time to diffuse through the agar to be more effective. Ethanol had a quite presistent zone of inhibition with approximately 33 mm at 24 hours. It shows that liquid detergents A have better antimicrobial activity against *E. coli* compared to 90% ethanol. This may be due to the constituent of alcohol in the detergent have highly concentrated. Distilled water's lack of antibacterial qualities was confirmed by its absence of a zone of inhibition. However, from the triplicates of all antimicrobial activity tested, some 90% of ethanol disc used as a positive failed to show a significant zone of inhibition, due to its quick evaporation thus, it cannot destroy *E. coli* over a long time.

Table 2. Macroscopic and Microscopic Characteristics of *E. coili* on Nutrient Agar

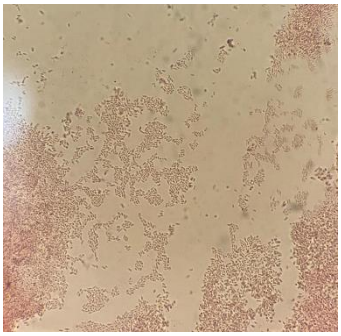
Macroscopic Observation	**Colony Morphology Characteristic**	**Microscopic Observation**	**Gram Staining and Shape**
 10^6 CFU mL^{-1} of *E. coli*	• Size: Punctiform and small • Colour: White • Opacity: Opaque • Shape: Circular • Texture: Smooth • Margin: Entire (non-undulated)	 Total magnification: 1000x	• Gram negative (pink) • Shape: Bacillus (rod-shape)

Table 3. Zone of Inhibition Produced by the used Two Liquid Detergents

Detergents	**Diameter zone of inhibition (mm)**				
	100% (undiluted)	**50% diluted**	**25% diluted**	**90% ethanol**	**Sterile dH_2O**
Detergent A	53	47	41	34	0
Detergent B	25	16	15	32	0

Findings from this study suggest that at all three concentrations of detergent A have a larger zone of inhibition compared to detergent B, which shows that detergent A has a much greater antibacterial activity against *E. coli* than detergent B. This is due to the antibacterial agents present in the content of detergent A, which is isothiazolinones and ethanolamine which are known to have good antibacterial properties (Karsa, 2007). The study confirmed that the effectiveness of antiseptics and disinfectants in killing bacteria is influenced by both the type and concentration of the product used (Jouda *et al.*, 2016) period of immersion and temperature (Lee *et al*., 2009). One possible reason to explain detergent B might be less effective against *E. coli* because it is a Gram-negative bacterium. Unlike Gram-positive bacteria, *E. coli* has an outer membrane made up of lipopolysaccharides. This membrane acts as an extra layer of protection, shielding the cell from harmful substances, such as certain antibacterial agents found in household detergents. The presence of this outer membrane can impede the entry of the active ingredients of detergent B, leading to a decrease in its ability to kill *E. coli* (Dai *et al*., 2019; Ngamsurach & Praipipat, 2022). Apart from that, detergent B is not environmentally friendly because it contains nonylphenol polyethoxylate as much as 9.5% per liter. Phenolic products, known for their high toxicity, are frequently utilized in healthcare facilities in various countries because of their low cost (Hamdi & Sami, 2020).

Figure 1. Zone of inhibition of Detergent A against *E. coli* after 24 hours

Figure 2. Zone of inhibition of Detergent B against *E. coli* after 24 hours

CONCLUSIONS

The effectiveness of detergents against pathogenic microorganisms is a crucial element in preventing and controlling the spread of microbial infections and the transmission of diseases. This discrepancy suggests potential variations in active ingredients or formulation between the two detergents. In summary, to achieve the best results in eliminating *E. coli*, it is recommended to use detergent A at a concentration of 100%. This study emphasizes the importance of using the right concentration of detergent to improve its effectiveness against *E. coli*. It is not recommended to use products that contain disinfectants that have higher potential of toxicity. To improve the study, including more bacterial strains such as Salmonella or Staphylococcus aureus could provide a more comprehensive understanding of the effectiveness of detergents against common household pathogens. Furthermore, conducting a comparison of various liquid detergent brands would offer insights into how different formulations impact antibacterial efficacy.

COMPLIANCE OF ETHICAL STANDARDS

Not applicable.

REFERENCES

Aiello, A. E., Larson, E. L., & Levy, S. B. (2007). Consumer antibacterial soaps: Effective or just risky? *Clinical Infectious Diseases*, *45*(2), 137–147. https://doi.org/10.1086/519255

Angkadjaja, S. (2007). *What makes antibacterial soap antibacterial? – USC Viterbi School of Engineering*. https://illumin.usc.edu/what-makes-antibacterial-soap-antibacterial/

Balouiri, M., Sadiki, M., & Ibnsouda, S. K. (2016). Methods for in vitro evaluating antimicrobial activity: A review. *Journal of Pharmaceutical Analysis*, *6*(2), 71–79. https://doi.org/10.1016/j.jpha.2015.11.005

Basavaraju, M., & Gunashree, B. S. (2022, November 11). Escherichia coli: An Overview of Main Characteristics. *Escherichia coli - Old and New Insights*. https://doi.org/10.5772/intechopen.105508

Dai, M., Guo, J., Xue, X., & Feng, Y. (2019). Preparation and investigation of High-Efficiency Antibacterial liquid dishwashing detergent. *Transactions of Tianjin University*, *25*(4), 322–329. https://doi.org/10.1007/s12209-019-00187-x

Dancer, S. J. (2013). Infection control in the post-antibiotic era. *Healthcare Infection*, *18*(2), 51–60. https://doi.org/10.1071/hi12042

Hamdi, M. A., & Sami, S. A. (2020). A comparison of antibacterial efficacy of some household detergents available in Makkah, Saudi Arabia, against 16 ATCC bacterial strains and clinical isolates. African Journal of Microbiology Research, 14(8), 388–394. https://doi.org/10.5897/ajmr2020.9281

Hong, S., Kwon, H., Choi, W., Lim, W. R., Kim, J., & Kim, K. (2014). Association between exposure to antimicrobial household products and allergic symptoms. *Environmental Health and Toxicology*, *29*, e2014017. https://doi.org/10.5620/eht.e2014017

Ishii, S., & Sadowsky, M. J. (2008). Escherichia coli in the Environment: Implications for Water Quality and Human Health. *Microbes and Environments*, *23*(2), 101–108. https://doi.org/10.1264/jsme2.23.101

Jain, A., Jain, R., & Jain, S. (2020). Sub-culturing of bacteria, fungi and actinomycetes. In *Springer protocols handbooks/Springer protocols* (pp. 101–103). https://doi.org/10.1007/978-1-4939-9861-6_29

Jouda, M. M., Dardona, Z., & Albayoumi, M. (2016). The Antibacterial Effect of some Household Detergents against Staphylococcus aureus. *International Journal of Current Microbiology and Applied Sciences*, *5*(2), 459–463. https://doi.org/10.20546/ijcmas.2016.502.051

Karsa, D. R. (2007). Biocides. In *Elsevier eBooks* (pp. 593–623). https://doi.org/10.1016/b978-044451664-0/50018-8

Lee, Y. (2009). Effects of chlorine concentrations and washing conditions on the reduction of microbiological contamination in lettuce. *Journal of the Korean Society for Applied Biological Chemistry*, *52*(3), 270–274. https://doi.org/10.3839/jksabc.2009.048

Matuschek, E., Brown, D.F.J. and Kahlmeter, G. (2014) Development of the EUCAST disk diffusion antimicrobial susceptibility testing method and its implementation in routine microbiology laboratories. Clin Microbiol Infect 20, O255–O266. https://doi.org/10.1111/1469-0691.12373.

Mueller, M., & Tainter, C. R. (2023, July 13). *Escherichia coli Infection*. StatPearls - NCBI Bookshelf. https://www.ncbi.nlm.nih.gov/books/NBK564298/

Ngamsurach, P., & Praipipat, P. (2022). Antibacterial activities against Staphylococcus aureus and Escherichia coli of extracted Piper betle leaf materials by disk diffusion assay and batch experiments. *RSC Advances*, *12*(40), 26435–26454. https://doi.org/10.1039/d2ra04611c

Okore, C. C., Mbanefo, O. N., Onyekwere, B. C., Onyewenjo, S. C., Ozurumba, A. U., & Abba-Father, C. A. (2014). Antimicrobial efficacy of selected disinfectants. *American Journal of Biology and Life Sciences*, *2*(2), 53. http://www.openscienceonline.com/author/download?paperId=387&stateId=8000&fileType=3

Osuntokun, O. T., Adu, B. O., Thonda, O. A., & Aladejana, O. M. (2022). Efficacy of Newly Emerging Detergents, Laundry Bleach, and Toilet Soap against Bacteria Isolated from Fairly used Clothes, Male/Female Underwear. *South Asian Journal of Research in Microbiology*, 13–43. https://doi.org/10.9734/sajrm/2022/v12i330273

Reynolds, K. A., Verhougstraete, M. P., Mena, K. D., Sattar, S. A., Scott, E. A., & Gerba, C. P. (2021). Quantifying pathogen infection risks from household laundry practices. *Journal of Applied Microbiology*, *132*(2), 1435–1448. https://doi.org/10.1111/jam.15273

Pejabat Perpustakaan
Library Office

Universiti Teknologi MARA
Cawangan Perak
Kampus Seri Iskandar
32610 Bandar Baru Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA
Tel: (+605) 374 2093/2453 Faks: (+605) 374 2299

UNIVERSITI TEKNOLOGI MARA

Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Setuju.

27.1.2023

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR

Saya yang menjalankan amanah,

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar