Ecoliminate: Assessing the Antimicrobial Effects of Malunggay (Moringa Oleifera) and Turmeric (Curcuma Longa) Against Escherichia Coli

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ABSTRACT

Escherichia coli contributes to global health challenges, causing various diseases in different places globally. Studies on plant extracts, like malunggay, turmeric, and garlic, show varying inhibitory effects on *E. coli*. Research highlights their potential as alternative antibiotics, with moderate success, though results vary. This underscores the need for enhanced public health strategies and research into natural antimicrobial agents to address *E. coli*-related infection. This study evaluated the antimicrobial efficacy of malunggay (*Moringa oleifera*) and turmeric (*Curcuma longa*) extracts using a true experimental quantitative posttest-only design to assess bacterial growth after exposure to different concentrations of malunggay and turmeric extracts with the agar well diffusion method. This design effectively tested the hypotheses and analyzed the relationship between variables. Three different extract concentrations were tested, including 25 mL malunggay and 75 mL turmeric, 50 mL malunggay and 50 mL turmeric, and 75 mL malunggay and 25 mL turmeric. Among these, the 50 mL malunggay and 50 mL turmeric extract exhibited the highest inhibition zone, indicating the strongest antimicrobial activity. Statistical analysis confirmed significant differences among the treatments, identifying this formulation as the most promising alternative. These findings suggest that optimizing malunggay-turmeric formulations could enhance their antimicrobial potential, providing a natural approach to combating antibiotic-resistant *E. coli.*

Keywords*:* malunggay, turmeric, Escherichia coli, antimicrobial, quantitative research

INTRODUCTION

In recent years, antibiotics resistance among bacteria has recently emerged a primary global concern, as many pathogens are now resistant to most available treatments. As a result, the fast-rising resistance threatens healthcare system and needs an urgent solution. In addition, one example is *Escherichia coli*, a common cause of diarrhea, which becomes harder to treat because of the decreasing antibiotic effectiveness leading to more complicated infections and longer recovery times. Additionally, as standard treatments become less effective, patients experience prolonged hospital stays, higher medical costs, and increased health risks. Therefore, exploring alternative therapies, such as antimicrobial agents, is crucial to help reduce antibiotic dependency and alleviate this growing health concern.

E. coli poses a significant global health burden, contributing to harmful diseases, and is still rampant and one of these diseases is diarrhea. In Africa, diarrhea causes an estimated 30 million severe cases and 330,000 deaths annually, primarily affecting children (Reiner et al., 2018). Similarly, Hartman et al. (2023) found that Sub-Saharan Africa continues to struggle with this issue, with an average of 1.7 million episodes annually. In addition, Urinary tract infections, commonly known as UTIs, constitute a significant portion of healthcare-associated infections, representing 19.6% in Europe and 12.9% in the U.S., underscoring the considerable challenge posed to infection control measures (Medina & Castillo-Pino, 2019). In particular, foodborne *E. coli* infections also show a significant public health concern, as demonstrated by over 8,500 reported cases within Europe in 2022 (ECDC, 2024). This issue is compounded by cross-contamination during food handling, the challenges of limited healthcare access, and rising antibiotic resistance (WHO, 2018; Poramathikul et al., 2021). Despite that, traditional medicine is still widely used in some communities (Njume & Goduka, 2024). Overall, *E. coli* continues to be a serious public health problem, highlighting the need for better treatment strategies and healthcare solutions worldwide.

In Asia, diarrhea is one of the major problems in most countries, such as in Cambodia. A study conducted in Cambodia between 2012 and 2018 examined the prevalence and etiology of diarrheal infections in the community, indicating an annual rate of 281.5 cases per 1,000 people (Kelly et al., 2023). Empirical antibiotics are frequently used to treat acute infectious diarrhea, but local antibiotic resistance patterns make this approach ineffective (Poramathikul et al., 2021). Meanwhile, UTI, also commonly caused by *E. coli*, is a common disease in many Southeast Asian countries. Myanmar and other Southeast Asian countries had a 94% prevalence rate of *E. coli* causing UTI. While Brunei, on the other hand, ranks the lowest with a prevalence rate of 1.18% (Rosero et al., 2021). Although diseases caused by *E. coli* remain a significant concern in Asian countries, its prevalence also offers an opportunity to enhance public health strategies and drive positive charges.

Several studies have evaluated the antimicrobial properties of plant extracts against *Escherichia coli,* demonstrating varying levels of inhibition. A local university in Cebu City, Southwestern University PHINMA (2018), conducted a study using malunggay (*Moringa oleifera)* seed extract in inhibiting the growth of *E. coli*, which shows inhibitory property of 16 mm within the two trials and 14 mm in the third, showing an 80% rate, with no significant difference observed between treatments. On the other hand, a study by Wada et al. (2021) reported that turmeric (*Curcuma longa*) and garlic (*Allium sativum*) extracts inhibited *E. coli*, with inhibition zones of 13 mm at 100 mg/mL and 11 mm, respectively. Similarly, Paramo et. Al (2020) examined the antimicrobial properties of combined malunggay and ampalaya leaf extracts, which exhibited moderate inhibitory activity (12-16 mm) with significant differences among treatments. A study by Wada et al. (2021) reported that turmeric and garlic extracts exhibited poor inhibition (≤14 mm), while Paramo et al. (2020) found that the combined malunggay and ampalaya extracts showed moderate inhibition (12–16 mm).

Further research has explored the antimicrobial potential of turmeric, particularly its effectiveness against *E. coli* and other pathogens. A study by Ilham et al. (2018) observed that the increase in the *E. coli* inhibition zone with higher concentrations of turmeric leaf extract was attributed to its bioactive compound. Similarly, Baitul et al. (2022) identified that turmeric extract from Madura exhibited the highest inhibition against *E. coli* at an 80% concentration, measuring 12.53 ± 0.46 mm. A study conducted by Ilham et al. (2018) and Baitul et al. (2022) suggest that turmeric extract demonstrated poor antimicrobial activity (≤14 mm) against *E. coli*, despite increased concentrations. In addition, research findings from Gurning (2020) reported that turmeric rhizome extract effectively inhibited the growth of *Candida albicans.* Furthermore, the study by Amadi et al. (2019) on the combination of turmeric rhizomes showed effectiveness against *S. aureus*, *P. fluorescens*, and *E. coli*, with the highest zone of inhibition observed at a 0.3g concentration. Results indicated a significant difference in the mean inhibition zones among the treatments.

The Philippines has an elevated rate of antibiotic resistance, particularly among common diseases. In contrast, *E. coli*-related diarrhea is rampant across the country. As evidence, a case in point is the situation in Vallehermoso town in Negros Oriental Philippines which in February 2023, nine water sources tested positive for *E. coli* leading to 203 cases of acute gastroenteritis caused by diarrhea and five fatalities (Partlow, 2023). The increase in cases is being managed as the residents receive distributions of jerry cans, water filtration tablets, and hydration solutions. The town's residents were advised to boil their water before consumption. Occasionally, a few medications are inappropriate before trying the drugs (Credo, 2024). Traditional medicine systems are being utilized simultaneously in rural and urban areas in the Philippines (Rondilla et al., 2021). With that, it is essential to recognize and provide appropriate alternative treatment to properly aid the said illness present in *E. coli*. On the other hand, malunggay (*Moringa oleifera*) has antimicrobial properties, which helps make it valuable in traditional medicine for treating wounds and preventing infections (Pimentel et al., 2020). This confirms the long-standing usage of malunggay as a natural cure for cuts and wounds in rural areas, particularly in Davao and Quezon. Additionally, the study by Sajid et al. (2021) highlights its effectiveness against pathogens such as *E. coli* and *S. aureus* and its antioxidant and anti-inflammatory benefits, notably recognized in Davao City.

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Moreover, its nutrient-rich leaves possess antidiabetic and antihypertensive properties, supporting its therapeutic use in skin wound healing and burn treatment in the Visayas (Martinez et al., 2020).

Turmeric and malunggay are widely used in the Philippines for their antimicrobial properties, particularly against *E. coli*. A study conducted by the University of the Philippines Los Baños found that turmeric essential oil demonstrated strong antibacterial activity against *E. coli*. In Davao, locals commonly apply turmeric paste to wounds and infections, while in the Visayas region, it is traditionally used as an herbal decoction to treat gastrointestinal illnesses (Santos et al., 2021). On the other hand, malunggay has also been shown to combat *E coli*, with studies in Cebu confirming its effectiveness against bacterial infections like diarrhea (Reyes et al., 2020). Many parts of the country use malunggay leaves in soup and as wound treatments to prevent infections (De Guzman et al., 2021). According to the study of Kasuma et al. (2020) further found the curcumin, turmeric's active compound, exhibited antimicrobial effects, though higher concentrations were needed for multidrug-resistance of *E. coli* strains. These findings emphasize the widespread use of turmeric and malunggay as accessible natural remedies for *E. coli* infections across the Philippines.

Despite the rapidly growing threat of antibiotic resistance, especially against *E. coli*, there is an urgent need to explore more natural alternatives. However, while malunggay (*Moringa oleifera)* and turmeric (*Curcuma longa*) have demonstrated individual antimicrobial properties, their combined effects have remained unexplored, constructing a significant research gap. To address this, the study aims to assess their potential synergistic effects against *E. coli*, also in regions like Mindanao, Philippines, where these plants are used commonly in traditional medicine. Guided by Pasteur's Germ Theory, which establishes microorganisms as the cause of disease, and Moerman's Non-Random Selection Theory, which highlights how plants are traditionally chosen for their medicinal properties, this research explores their potential as viable natural antibacterial agents. Given the increasing ineffectiveness of antibiotics and the prevalence of *E. coli*-related illnesses, especially in developing countries, this study is essential in identifying alternative treatments.

Statement of the Problem

This study aimed to assess the antimicrobial properties of malunggay *(Moringa oleifera*) and turmeric (*Curcuma longa*) against *Escherichia Coli* bacteria. Specifically, the study sought to answer the following questions:

1. What is the antimicrobial property of the different combined concentrations of malunggay and turmeric extract on *E. coli*?

    1.1 25 ml malunggay and 75 ml turmeric extracts;
    1.2 50 ml Malunggay and 50 ml turmeric extracts; and
    1.3 75 ml Malunggay and 25 ml turmeric extracts;

2. What is the antimicrobial property of commercial treatment against *E. coli* bacterial growth?

3. Is there a significant difference in the effectiveness of different combined concentrations of malunggay and turmeric extract on the inhibition of *E. coli*?

Hypothesis

The study's hypothesis was examined at the significance level of 0.05 alpha. The null hypothesis has been established by the researchers to respond to the issue mentioned in the previous section completely:

Ho: There is no significant difference in the effectiveness of different combined concentrations of malunggay and turmeric extract and the control group on inhibiting *E. coli.*

Significance of the Study

This study contributed to reputable and relevant academic resources and enhanced awareness of the antimicrobial effects of malunggay *(Moringa oleifera)* and turmeric *(Curcuma longa)* against *E. coli*. In addition, it can benefit the following figures:

Department of Health. Through this study, the Department of Health will obtain insights into the antimicrobial effects of malunggay *(Moringa oleifera)* and turmeric *(Curcuma longa*) by gaining and exploring alternative solutions to combat antimicrobial resistance (AMR).

Healthcare Practitioners. This will benefit those involved in alternative medicine, who could further utilize the research findings to validate these plants' use in treating infections. Healthcare professionals can also use findings to incorporate natural remedies into treatment plans for bacterial infections.

Pharmaceutical Companies. This study will help pharmaceutical companies obtain insights or use the findings to develop and enhance natural, plant-based antimicrobial products. This could also lead them to help create sustainable formulations to address *E. coli* infections and combat antimicrobial resistance.

Agricultural and Herbal Product Industries. In this study, the agricultural and herbal products industries may benefit by promoting and advancing the cultivation and commercialization of malunggay and turmeric, which leads to the development of accessible and affordable health solutions derived from these plants.

Patients infected with *E. coli*. This alternative treatment approach may provide valuable options for individuals seeking non-conventional remedies. This study suggests that *Moringa oleifera a*nd *Curcuma longa* compounds could offer an effective natural remedy for people suffering from *E. coli* infections, particularly those experiencing diarrhea.

Future Researchers. This study will be invaluable for future researchers, as it will assist them in uncovering and addressing additional issues related to the complexities associated with this study.

Scope and Limitations

This study assessed the antimicrobial effects of malunggay (*Moringa oleifera*) and turmeric (*Curcuma longa*) pure extracts on *Escherichia coli* using agar diffusion and minimum inhibitory concentration (MIC) tests.b The research was conducted in a controlled laboratory setting at a private school in Digos City from September 2024 to February 2025. The study focused on the antimicrobial activity of commercially available malunggay and turmeric extracts, with Povidone-iodine serving as the control. The variables investigated were the antimicrobial properties of the plant extracts and their efficacy in inhibiting the growth of *E. coli* under controlled conditions.

This study was limited to testing the effects of the extracts on only one bacterial strain, *E. coli*, and did not explore their potential antimicrobial activity against a broader spectrum of microorganisms. The extracts were prepared using specific methods and other extraction techniques were not considered. Environmental factors, different bacterial strains, and potential medical applications of the extracts were not part of this study.

Definition of Terms

The following terms were defined conceptually and operationally to learn and fully understand the study.

Antimicrobial Effects. It is the process of creating a substance that can exterminate microorganisms such as bacteria, stopping them from growing and causing a disease (Science Direct, 2024). The extract of the malunggay and turmeric was used in order to test out the efficacy of their antimicrobial properties against *Escherichia coli*. Their concentrations vary to examine which concentration is the most effective in preventing and restricting the growth of the bacteria.

Escherichia coli. It is a common type of bacteria that can cause severe food poisoning, diarrhea, and other bodily damage (World Health Organization, 2018). This bacterium was used to evaluate the antimicrobial qualities of the malunggay leaves combined with the turmeric extract.

Malunggay. It is a type of tropical tree which is common to many Asian countries, mainly used for food and medicinal treatments (Heuzé et al., 2019). It will be one of the components used to create an extract against the *E. coli*.

Turmeric. A type of herb coming from the ginger family which contains a large aromatic yellow rhizome

(Merriam-Webster, 2025). It possesses antimicrobial properties and was utilized against *E. coli*.

METHODS

This chapter covers the methodologies used to carry out the study. It addresses research design, subject of the study, sample approaches, data sources, data collection procedures, measurement techniques, analysis and interpretation methods, and ethical considerations.

Research Design

This study used a quantitative research design, in which the researchers collected and analyzed data to correlate the variables and test hypotheses. This type of research method can be used to evaluate causal links, make predictions, identify trends and averages, and determine findings for larger populations (Bhandari, 2023). As Sreekumar (2023) states, this method is utilized to monitor events that impact a specific sample population.

In this particular study, a true experimental design was used. Since it influences the confounding variables, it is competent to establish causal connections between the variables. Its ability to develop internal validity and control for the influence of extraneous variables through treatment manipulation is its distinctive strength (DeCarlo et al., 2022). According to Banzak and Williams (2023), it is the only design that can demonstrate a cause-and-effect link between the variables and is also the most accurate. Therefore, a true experimental investigation illustrates the approach that explains the correlation between the variables.

Moreover, the study aimed to discover if the malunggay (*Moringa oleifera*) and turmeric (*Curcuma longa*) could be utilized as antimicrobial agents against *E. coli*. Thus, the study applies the posttest-only design. The posttest-only research design aims to assess the measures given to the variables after they have received the intervention or the treatment (Budert-Waltz et al., 2023). This research design qualified the researchers to assess the bacterial growth sample exposed to different concentrations of the malunggay and turmeric extracts, which indicates that it is the most acceptable research design for the study.

Subject of the Study

This study investigated the antimicrobial effects of malunggay (*Moringa oleifera*) and turmeric (*Curcuma longa*) extracts against *E. coli*, a gram-negative bacterium commonly associated with foodborne illnesses and urinary tract infections. With the increasing problem of antibiotic-resistant *E. coli* strains, it was essential to explore alternative treatments, particularly those from natural sources, to help address this rising public health concern (Salam et al., 2023).

This study aimed to assess the effectiveness of malunggay leaf extracts and turmeric rhizome extracts in inhibiting the growth of *E. coli*. The experiment used Petri dish cultures of the bacteria as the main subjects. The bacteria were placed in a Petri dish with a 90-to-100-millimeter diameter. The research was carried out at Digos City Private Hospital, where all the necessary materials and equipment were provided. The study focused only on the bacterium itself and did not consider other factors, such as human variables or environmental conditions.

Sampling Technique

This investigation applied a completely random design for the subject in the experiment. Complete Random Design (CRD) implies selecting bacterial samples free of systematic bias. This way, researchers could ensure that the subset of bacteria utilized for study or analysis was neutral and representative. The CRDs are the most straightforward designs in which treatments are assigned to experimental units completely at random, according to Ruíz (2024). The variables in the series had equal distributions. Complete Random Design serves as a tool for drawing statistical conclusions about a population. It plays a crucial role in maintaining robust internal validity by applying randomization to minimize the influence of potential confounding variables. This strategy ensures that each strain has an equal chance of being part of the sample, lowering bias and increasing representativeness.

To address challenges with the complete random design method, researchers created a detailed list of all population members, ensured accessibility to each selected individual, and allocated sufficient time and resources to collect data from the required sample size (Stewart, 2024). This procedure ensured that it chose a representative subset of E. *coli*, contributing to the generalizability of findings to the broader population of this bacterium.

Data Gathering Procedure

Data-gathering procedures were vital to the research process as they significantly contributed to the reliability and validity of the findings. This research section outlined the methods used to collect the data, ensuring a clear comprehension of how the required information was obtained.

A. Collection and Extraction of Plant Materials

1. The researchers collected and washed specified quantities of selected fresh and healthy malunggay and turmeric.
2. Malunggay leaves were detached from stems and collected. Turmeric roots were peeled, and the flesh was gathered.
3. Malunggay leaves were crushed using a blender, and turmeric root flesh was processed through grating, followed by a strainer and cheesecloth extraction.
4. All materials underwent Ultraviolet-C (UVC) sterilization to prevent bacterial contamination and ensure aseptic conditions.

B. Preparations of Bacterial Strain and Culture Media

The following procedure was based on the article by Mettler-Toledo International Inc. (2023) and Tuttle et al. (2021) research.

1. *E. coli* bacteria were sourced from a specific hospital's laboratory. The said bacteria were obtained from the hospital patients and cultured for research purposes.
2. The bacteria were transferred to a petri dish, which serves as a culture medium for preserving bacteria, fungi, or other microorganisms.
3. The culture medium was secured and placed in a controlled environment to support the bacteria's growth and cultivation.

C. Formulation of Concentrations

The following procedure was adapted from the research by Obiajulu and Asogwa (2020), Ofoegbu et al. (2022) and John et al. (2018):

1. The turmeric and malunggay extract was then stirred thoroughly to ensure an even distribution of the beneficial compounds.
2. For Test 1, a combined extract solution of 25 mL malunggay extract and 75 mL turmeric extract was prepared. The two extracts were mixed thoroughly to ensure an even distribution of the beneficial compounds and their bioactive components. The concentration was then added, creating a total of 100 mL.
3. For Test 2, a combined solution of 50 mL malunggay extract and 50 mL turmeric extract was prepared. The extracts were blended thoroughly to ensure uniformity. The concentration was then added, creating a total of 100 mL.
4. Lastly, for Test 3, a combined solution of 75 mL malunggay extract and 25 mL turmeric extract was prepared. As with the previous tests, the two extracts were mixed well to ensure that their active components were evenly distributed. The concentration was then added, creating a total of 100 mL.

D. Determination of antimicrobial activity of *Escherichia coli*

The following determination procedure was adapted from the study by Hossain (2024):

1. To quantify the antimicrobial activity of *E. coli*, the extracts containing the bacteria were dropped or placed at the center of the slide.
2. The effects on the bacterial population and the reactions from the extracts were observed using a measuring instrument.
3. It was observed, and the measurements were employed to evaluate or trace the efficacy.

Measures

This quantitative study used the agar well diffusion technique described by Balouiri et al. (2016) to accurately assess the antimicrobial effects of turmeric and malunggay extract. The experimental plates were incubated at 37 °C for 24 hours, after which the zone of inhibition (ZOI) diameter was measured. To achieve trustworthy results, the assessments were completed by an experienced medical laboratory technologist with expertise in bacterial infection research, with a particular emphasis on *E. coli*.

Furthermore, according to Theuretzbacher et al. (2020), by evaluating the length and degree of bacterial suppression, the researchers investigated the possible therapeutic advantages of the turmeric and malunggay extract. The ZOI was interpreted using the guidelines provided by Hudzicki (2016), with diameters classified as resistant (<14 mm), moderate (15-17 mm), or sensitive (≥18 mm).

The primary goal of this assessment was to determine the possible efficacy of turmeric and malunggay extraction, specifically in terms of the influence of *E. coli*. The technologists evaluated important characteristics required to determine the extraction's potential as a therapeutic option for bacterial management. Following the assessment, the collected evaluations were carefully analyzed using an interpretation table. This thorough analytical method aims to identify and clarify the extract's influence on key bacterial management parameters, with a focus on its possible future use as an effective antimicrobial agent against *E. coli*.

Table 1. Escherichia coli Growth Inhibition Interpretation

Mean Score Interval	Descriptive Equivalent	Interpretation
≥18 mm	Susceptible	The antibacterial activity showed an excellent image of the zone of inhibition.
15.00 mm - 17.00 mm	Moderate	The antibacterial activity showed a fair image of the zone of inhibition.
≤14 mm	Resistant	The antibacterial activity showed a poor image of the zone of inhibition.

Analysis and Interpretation

In analyzing the data, both measures of central tendency and variability and comparative statistical analysis were utilized. Interpretations were based on a 0.05 level of significance. The statistical tools are enumerated below.

Mean. The mean inhibition zone diameter is calculated to assess the antimicrobial efficacy of each extract ratio, with higher means indicating more significant effects. Standard deviation measured consistency, where lower values signified stable antimicrobial action.

One-way ANOVA. A one-way ANOVA test was employed to determine whether significant differences existed between the inhibition zones of the three extracts ratios. A p-value less than 0.05 suggests that the results are statistically significant, indicating the need for further post-hoc analysis to determine which concentration is most effective.

Findings from this analysis highlight the optimal malunggay and turmeric extract ratio for inhibiting *E. coli* growth, providing insights for potential antimicrobial applications.

Ethical Considerations

This study provides significant importance on ethical considerations to ensure the rights of everyone involved are respected and protected throughout the research project.

Benefits of studying *E. coli* and its ways of treatment are useful in the field of medicine due to the rapid growth of the bacteria and its ability to affect people. This study would allow researchers to study the numerous effects of the bacteria and the ways to prevent them from spreading and affecting individuals. The study of *E. coli* and its prevention has contributed to the basic knowledge and fields such as microbiology and biochemistry (Keller & Dörr, 2023). In addition, conducting this study provides more profound knowledge about the bacteria, giving them a background on what more to expect and ways to restrain its negative effects.

Risks of this study must be carefully evaluated to maintain ethical integrity. Even in closely supervised laboratories, researchers dealing with pathogenic strains are more vulnerable to infection by means of exposure to bacterial cultures (World Health Organization, 2020). Moreover, it is essential to appropriately dispose of biological waste, adhere to containment procedures, and tightly regulate the excessive use of lab protective equipment, such as masks and gloves. Researchers' health and safety are safeguarded when ethical risk are conducted responsibly.

RESULTS AND DISCUSSION

This chapter presents the data gathered from the study, including the analysis and interpretation of results. The first section discusses the levels of antimicrobial activity observed in different concentrations of malunggay (Moringa oleifera) leaf ethanolic extract, turmeric (Curcuma longa) leaf ethanolic extract, and their combined extract, as well as the control treatment, povidone-iodine.

Antimicrobial Property of the Different Combined Concentrations of Malunggay and Turmeric Extract on *Escherichia coli*

The study determined the effectiveness of the malunggay and turmeric extracts on the growth inhibition of *E. coli* with three different treatments: Treatment 1 - 25 ml malunggay and 75 ml turmeric extracts; Treatment 2 - 50 ml malunggay and 50 ml turmeric extracts; and Treatment 3 - 75 ml malunggay and 25 ml turmeric extracts. The researcher assessed each concentration's antimicrobial activity by measuring the inhibition zone for each treatment across multiple replications. Hence, the researchers obtained the following results.

Table 2. Antimicrobial Property of the Different Combined Concentrations of Malunggay and Turmeric Extract on Escherichia coli

Treatments	**Zone of Inhibition (in mm)**			**Mean**	**SD**	**Description**
	R1	**R2**	**R3**			
T1	10	10	11	10.33	0.58	Resistant
T2	13	15	17	15.00	2.00	Moderate
T3	14	15	12	13.67	1.53	Resistant

These findings support the research conducted by Goli (2024), which underscores the synergistic potential of garlic and turmeric in combating microbial infections and promoting general health. A 50:50 combination of garlic and turmeric extract exhibited a 16 mm zone of inhibition against *E. coli*, indicating moderate antimicrobial activity, and greater efficacy than pure turmeric extract. Similarly, the study by Amadi et al. (2019) showed that 50:50 extract mixture of guava (*Psidium guajava*) leaf extract and alum, at 1.5 concentration, exhibited moderate antibacterial effects against *E. coli*, producing a 16 mm inhibition zone compared to 22 mm observed for chloramphenicol. In a related study, Merati and Boudra (2024) assessed the antibacterial activity of garlic and onion extracts, demonstrating moderate efficacy with an inhibition zone measuring 16.5 mm

Furthermore, Paramo et al. (2020) explored the antimicrobial properties of combined malunggay (*Moringa oleifera*) and ampalaya (*Momordica charantia*) leaf extracts. Their results revealed moderate antimicrobial activity, with inhibition zones ranging between 12 and 16 mm, and statistical analysis indicated a significant difference among the treatments tested.

Antimicrobial Property of Commercial Treatment using Povidone-Iodine on *Escherichia coli*

The study included the antimicrobial properties of the commercial treatment for *E. coli* using povidone-iodine and assessed the antimicrobial properties of povidone-iodine against *E. coli*. About 30μL of povidone-iodine was used in each trial, and the results showed an average zone of inhibition of 32.33 mm, with a standard deviation of 8.62 mm, indicating a susceptible response from the bacteria. **Table 3.** Antimicrobial Property of Commercial Treatment on Escherichia coli

Treatments	**Zone of Inhibition (in mm)**			**Mean**	**SD**	**Description**
	R1	**R2**	**R3**			
Povidone-Iodine	23	34	40	32.33	8.62	Susceptible

The findings support the research conducted by Pichon et al. (2022), which showed that povidone-iodine 5% alcoholic solution, 10% dermic solution, and PVP-I 4% scrub exhibited antimicrobial activities under experimental conditions. In vitro analyses indicate that PVP-I solutions significantly reduce *E. coli* bacterial counts, with effectiveness varying based on concentration and exposure duration. Additionally, the study by Seema et al. (2024) observed that PVP-I demonstrated antimicrobial activity against *E. coli*, producing an 18 mm inhibition zone at full concentration. Similarly, Rotter et al. (2022) investigated the antimicrobial potential of PVP-I and confirmed its effectiveness in reducing *E. coli* bacterial loads. Furthermore, PVP-I exhibited antimicrobial activity against *Staphylococcus aureus,* though variations in its efficacy were noted between the two (Rabenberg et al., 2020).

Significant Difference in the Antimicrobial Property of Different Combined Concentrations of Malunggay and Turmeric Extract and the Povidone-Iodine on the Inhibition of *Escherichia coli*

Table 4 shows the results of the one-way Analysis of Variance (ANOVA). It indicates a significant difference in the antimicrobial effectiveness of the different Malunggay-Turmeric concentration combinations against *E. coli*. The sum of squares between groups (875.667) represents the variation in bacterial inhibition due to differences in extract concentrations, while the sum of squares within groups (162.000) accounts for variations within each treatment group. The degree of freedom (df) between groups is 3, while within groups, it is 8, resulting in mean square values of 291.889 and 20.250, respectively. The computed F-value (14.414) is relatively high, indicating that the differences in antimicrobial activity among the tested combinations are unlikely due to random variation.

Table 4. Significant Difference in the Effectiveness of Different Combined Concentrations of Malunggay and Turmeric Extract on the Inhibition of Escherichia coli

	Sum of Squares	**df**	**Mean Square**	**F**	**p**	**Decision**
Between Groups	875.667	3	291.889	14.414	0.001	Reject H_0
Within Groups	162.000	8	20.250			(Significant)
Total	1037.667	11				

The p-value (0.001) is substantially lower than the conventional significance threshold of 0.05, providing strong statistical evidence to reject the null hypothesis. This confirms that the observed variations in bacterial inhibition among the different combined concentrations of malunggay *(Moringa oleifera)* and turmeric *(Curcuma longa)* extracts are not due to random chance but rather indicate a genuine difference in their antibacterial efficacy (Jain et al., 2022). The significant inhibitory effects observed suggest that these plant extracts possess bioactive compounds capable of effectively suppressing *E. coli* growth. These findings contribute to the growing body of research on natural antimicrobial agents and highlight potential applications of malunggay and turmeric extracts in developing alternative antibacterial treatments, particularly in response to rising concerns over antibiotic resistance.

Meanwhile, Table 5 presents the results of the post hoc comparisons conducted using the Tukey HSD test. This analysis was performed to identify which treatments exhibited significant differences in effectiveness. The results show significant differences between T1, T2, and T3 compared to the control treatment, as indicated by p-values less than 0.05. Additionally, the negative mean differences between these treatments suggest that the latter treatments are significantly more effective than the former. This implies that the control commercial treatment was statistically less effective in inhibiting the growth of *E. coli* compared to the experimental treatments.

Table 5. Post Hoc Comparisons using the Tukey HSD Test

	Mean Difference	**p**	**Decision**	**Interpretation**
Between T1 and T2	-4.667	0.604	Failed to Reject H_0	Not Significant
Between T1 and T3	-3.333	0.802	Fail to Reject H_0	Not Significant
Between T1 and Control	-22.000	0.001	Reject H_0	Significant
Between T2 and T3	1.333	0.982	Fail to Reject H_0	Not Significant
Between T2 and Control	-17.333	0.007	Reject H_0	Significant
Between T3 and Control	-18.667	0.004	Reject H_0	Significant

Overall, the zone of inhibition differs significantly between Treatment 1 and the Control, according to the results shown in Table 5. In comparison to the Control, which contains 30µL of povidone-iodine, Treatment 1, which includes 25 mL malunggay and 75 mL turmeric extract shows a mean difference of -22.000. Therefore, Treatment 1 shows lower efficacy compared to the control group. Furthermore, this indicates that Treatment 1 had the least efficacy among the four therapies studied. Treatment 2, which includes 50 ml malunggay and 50 ml turmeric extract shows a higher concentration with a mean difference of 15.00, has similar efficacy to the control group, which uses Povidone-Iodine, with a mean difference of 32.33. Treatment 2 and the control indicate that it could be a viable alternative to the marketed inhibitor. Additionally, this is especially important since it implies that treatment 2 may provide similar benefits in reducing bacterial growth. Given it efficacy and resemblance to the recognized, marketed inhibitor, treatment 2 presents a promising option for further exploration or potential implementation in relevant contexts.

These findings support the Germ Theory of Disease (Pasteur, 1861), which states that microorganisms are responsible for specific diseases and can be inhibited by antimicrobial agents. Additionally, the Non-Random Selection of Medicinal Plants Theory (Moermon, 1979) suggests that plants with proven medicinal benefits, such as malunggay and turmeric, offer viable alternatives to synthetic antimicrobial agents. Similar results were reported by Luu et al. (2021), who found that plant-based extracts possess vigorous antimicrobial activity against harmful bacteria. Moreover, Lopes et al. (2019) emphasized that medicinal plants are excellent sources of novel antimicrobial compounds.

The results are supported by the study of Patel (2023), stating that the combination of malunggay and turmeric enhances antimicrobial activity due to their synergistic properties. As to Povidone-iodine, as it is already known for its antimicrobial efficacy, according to Baitul et al. (2022), turmeric extract exhibited moderate inhibition against *E. coli*, producing inhibition zones of approximately 15 mm. Furthermore, Paramo et al. (2020) examined

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the antimicrobial potential of malunggay in combating other plant extracts, reporting moderate inhibitory activity ranging from 12 to 16 mm, which aligns with the inhibition zones observed in treatment 2. Therefore, the similarity in results between Povidone-iodine and the most effective herbal treatment (Treatment 2) underscores the antimicrobial potential of malunggay and turmeric extracts, suggesting that optimizing their concentrations could improve their efficacy as natural alternatives to commercial antimicrobial agents.

SUMMARY

This study addressed the growing issue of antibiotic resistance in *Escherichia coli*, which continues to pose a particular global health threat. Specifically, it aimed to evaluate the antimicrobial effectiveness of malunggay and turmeric extracts and determine whether their combination could serve as a viable alternative to commercial antimicrobial agents like povidone-iodine. To achieve this, a true experimental design was implemented using the agar well diffusion method at Digos City Private Hospital, where three different extract concentrations were tested.

The results revealed that Treatment 2, which contained 50 mL of malunggay and 50 mL of turmeric, exhibited the highest inhibition zone of 15.00 mm among the herbal treatments. However, it was still significantly less effective than povidone-iodine, which had an inhibition zone of 32.33 mm. Furthermore, statistical analysis confirmed a notable difference in antimicrobial efficacy, making Treatment 2 as the most promising natural alternative. While povidone-iodine remains the most effective treatment, optimizing malunggay-turmeric formulations could enhance their potential as alternative antimicrobial agents.

CONCLUSION

This study explores the antimicrobial efficacy of malunggay and turmeric, analyzing the importance of practical solutions for treating Escherichia coli infections. The aim is to assess the potential of these extracts as an efficient and sustainable alternative to traditional treatments. The results of this study lead to the following conclusions:

The antimicrobial efficacy of the combined treatments demonstrated different results. Small amounts of malunggay with significant amounts of turmeric and large amounts of malunggay with minimal amounts of turmeric showed a close relationship with smaller zones of inhibition, indicating similar resistance. However, the amount of concentration of these extracts showed a larger zone of inhibition, demonstrating as the stronger and more potent antimicrobial agent in the study, exceeding the other treatments in terms of effectiveness.

In conclusion, Povidone-iodine exhibited a moderate zone of inhibition against E. coli, showing its measurable antimicrobial effect and effectiveness as an antimicrobial agent.

Therefore, statistical data analysis revealed no significant differences in the antimicrobial effectiveness between the treatment pairs (T1 vs. T2, T1 vs. T3, and T2 vs. T3), as all p-values exceeded the 0.05 significance threshold. This suggests that, although some variation in the size of the inhibition zones was observed, the differences in antimicrobial activity between the treatments were not statistically significant, supporting the null hypothesis of no significant difference in effectiveness.

RECOMMENDATIONS

Based on the results and conclusion of the study, the following recommendations are as follows:

1. The researchers of this study suggest that Department of Health officials should look more into the potential of malunggay leaves and turmeric for medicinal treatments. This study encourages using natural and organic replacements like malunggay and turmeric as they are effective in eliminating bacteria such as *E. coli*.
2. The researchers encourage healthcare practitioners to further utilize the research findings to help validate the medicinal potential of these plants. Additionally, they should also explore malunggay and turmeric as complementary treatments for bacterial infection, particularly in integrative medicine.

3. Pharmaceutical companies should invest in research and development to formulate plant-based antimicrobial drugs using compounds derived from malunggay and turmeric. They should also develop cost-effective and sustainable products incorporating these antimicrobials to address *E. coli* infections.

4. The researchers suggest that the agricultural and herbal product industries should support and help the growth and cultivation of local plants and herbs that contain antimicrobial properties. With that, this could help local hospitals and medical laboratories and develop treatments for diseases involving contagious bacteria, reducing the need to rely on imported substances.

5. Patients infected with *E. coli* should be enlightened about the potential benefits of malunggay and turmeric as alternative or complementary remedies for managing *E. coli*. Additionally, individuals experiencing persistent or severe infections should still be advised to consult healthcare professionals before using alternative treatments to ensure safety and efficacy.

6. Future researchers should explore the synergistic effects of malunggay and turmeric with other known antimicrobial agents to determine potential combinations that enhance antimicrobial efficacy. Further studies could also focus on testing these plant extracts against more types of bacteria to understand their full range of effectiveness.

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In order to make our study successful, us researchers would like to acknowledge the people who assisted and contributed to the accomplishment of our research study. This study would not have been possible without their support and contributions. As a part of improvement to proceed with our research, we give appreciation and recognition for their assistance and willingness to help and that they will always be remembered.

First and foremost, we would like to give our utmost appreciation to our research teacher sir Cleford Jay D. Bacan, MA, for his unending support and assistance, helping us in completing this study. This study would not have been close to finishing without his aid.

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In addition, we would also like to give thanks to one of our members, miss Meirylle Mantalaba. She has been one of the most helpful members, driving us to the laboratory and lending us a place to work for our paper.

Above all, we give thanks to the Lord above for bestowing us the wisdom and motivation to work hard, helping us finish this study. Through his guidance, we are able to achieve the positive outcomes of the study.

Furthermore, each and one of us members offers dedication and hard work to these individuals who have contributed and continuously supported us since the beginning of our study. These people have always trusted us with our capabilities to construct and complete this study.

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APPENDIX A

COR JESU COLLEGE, INC.

Sacred Heart Avenue, Digos City,Province of Davao del Sur, Philippines
Tel No (082) 553-2433 local 101 • Fax No (082) 553-2333 • www.cjc.edu.ph

January 15, 2025

Mr. Jun Rey C. Dequiña, MATCC
School Principal
Cor Jesu College, Inc.
Sacred Heart Avenue, 8002 Digos City

Dear Mr. Dequiña:

We hope this letter finds you well. We respectfully request permission to borrow the school-owned UV Light for our research study, as it is essential for our experiments and achieving our study goals.

We assure you the equipment will be handled with care, safety protocols followed, and it will be returned on time in its original condition. If there are any terms for borrowing, we will fully comply.

Your approval would greatly help us complete our research. Thank you for your support and understanding.

Yours sincerely,

BASMAYOR, RHALF JAMES T.
LAMES, REGINA COELI P.
MALILAY, JENNIFER SHYNE A.
MANIB, MARIELLE JOY S.
MANTALABA, MEIRYLLE J.
NEROSA, REXANNE KELSHEIY B.
SANTOS, KRISTEN MARIANNE D.
SUCAYRE, AYESSA N.
VISAÑEZ, JOCEN G.

Noted by:
CLEFORD JAY D. BACAN, MA
Research Teacher

Approved by:
JUN REY C. DEQUIÑA, MATCC
School Principal

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November 20, 2024

ARA RAMEA D. AMAHAN, RMT
Chief Medical Technologist
Laboratory Department
Digos Doctors Hospital, Inc

Greetings, Sir:

We are Senior High School students from Cor Jesu College, Inc. and are presently conducting a research paper entitled **"ASSESSING THE ANTIMICROBIAL EFFECTS OF MALUNGGAY (*Moringa oleifera*) AND TURMERIC (*Curcuma longa*) AGAINST *Escherichia coli*"** which is a partial fulfillment for requirements in Practical Research 2. We are writing to inquire about the cost associated with obtaining Escherichia coli bacteria from your hospital's laboratory for our research subject.

We would appreciate it if you could provide the following details:

1. The price for the requested bacterial strain.
2. Any additional costs involved (e.g., shipping, handling, or laboratory fees).
3. The availability of the strain and the process for procurement.
4. Any specific documentation or permits required for the transaction.

If you require any additional information from our end to process this inquiry, please let us know. You can reach us at rhalfjames15@gmail.com or 0997-194-7762

Thank you very much and God bless.

Yours sincerely,

BASMAYOR, RHALF JAMES T.
LAMES, REGINA COELI P.

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FINANCIAL STATEMENT

COR JESU COLLEGE, INC.

Sacred Heart Avenue, Digos City, Province of Davao del Sur, Philippines
Tel No : (082) 553-2433 local 101 • Fax No : (082) 553-2333 • www.cjc.edu.ph

PRACTICAL RESEARCH 2
FINANCIAL STATEMENT

Research Title:	**EcoLIMINATE: ASSESSING THE ANTIMICROBIAL EFFECTS OF MALUNGGAY (*Moringa oleifera*) AND TURMERIC (*Curcuma longa*) AGAINST *Escherichia coli***
Grade and Section	12 STEM B
Submission Date:	April 8, 2025

Particulars	Price	Quantity	Amount
Laboratory	₱ 2000.00	1	₱ 2000.00
E.Coli	₱ 300.00	1	₱ 300.00
Turmeric	₱ 100.00	2	₱ 200.00
			₱ 100
		TOTAL	₱ 2500.00

Prepared by

RHALF JAMES T. BASMAYOR
Group Leader

Noted by

CLEFORD JAY D. BACAN, MAEd-MT
Research Teacher

Approved by

JUN REY D. DEQUIÑA, MATCC
School Principal

STATISTICAL RESULTS

Table 2. Antibacterial Property of the Different Combined Concentrations of Malunggay and Turmeric Extract on the Escherichia coli

Treatments	Zone of Inhibition (in mm)			Mean	SD	Description
	R1	R2	R3			
T1	10	10	11	10.33	0.58	Moderate
T2	13	15	17	15.00	2.00	Moderate
T3	14	15	12	13.67	1.53	Moderate

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Table 3. Antimicrobial Property of Commercial Treatment on Escherichia coli

Treatments	**Zone of Inhibition (in mm)**			**Mean**	**SD**	**Description**
	R1	**R2**	**R3**			
Povidone-Iodine	23	34	40	32.33	8.62	Susceptible

Table 4. Significant Difference in the Effectiveness of Different Combined Concentrations of Malunggay and Turmeric Extract on the Inhibition of Escherichia coli

	Sum of Squares	**df**	**Mean Square**	**F**	**p**	**Decision**
Between Groups	875.667	3	291.889	14.414	0.001	Reject H_0
Within Groups	162.000	8	20.250			*(Significant)*
Total	1037.667	11				

Table 5. Post Hoc Comparisons using the Tukey HSD Test

	Mean Difference	**p**	**Decision**	**Interpretation**
Between T1 and T2	-4.667	0.604	Failed to Reject H_0	Not Significant
Between T1 and T3	-3.333	0.802	Fail to Reject H_0	Not Significant
Between T1 and Control	-22.000	0.001	Reject H_0	Significant
Between T2 and T3	1.333	0.982	Fail to Reject H_0	Not Significant
Between T2 and Control	-17.333	0.007	Reject H_0	Significant
Between T3 and Control	-18.667	0.004	Reject H_0	Significant